Sensemaking of complex sociotechnical systems: the case of governance dashboards

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Sensemaking of Complex Sociotechnical Systems

- the case of governance dashboards -

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ABSTRACT

This research project is concerned with developing a suitable visualization model to depict a complex socio-technical system such as a city. It focuses on governance dashboards as the main starting point as these aim to depict many aspects of a city and, it is argued, already reflect and shape a city in its totality. Governance dashboards however pose a number of challenges and may not be the most suitable visualisation for representing a city. It is proposed to create a visualisation model that would fully capture a city in its complexity whilst being cognisant of allowing users to engage with detail.

CCS CONCEPTS

• **Human-centered computing → Visualization theory, concepts and paradigms**; • **Applied computing → E-government; Multi-criterion optimization and decision-making**;

KEYWORDS

Systems Thinking, Visualization

1 INTRODUCTION

Complex socio-technical systems are defined by an expansive and interdependent web of technology and social interaction and give rise to a number of complex challenges such as policy resistance, unclear / loose disciplinary boundaries and the difficulty to envisage the long-term effects of what seems to be simple decisions. Humans' difficulty in comprehending complex systems has lead to unanticipated consequences such as road building programs that have increased rather than decreased traffic, flood prevention projects that have made flooding worse and negative effects of pesticides on bird populations [10]. Data Visualisation, with its aim to facilitate understanding [2], may be a useful tool to make

complexity easier to understand. However, attempts to visualise complexity paradoxically do so by restraining the same complexity often within too narrow borders (see for example the London Situation Room, https://www.youtube.com/watch?v=6UPITLg9uzw, focusing on data from three providers). Cities are good examples of complex systems as the different spheres of city life (political, economic, social and technological as well as the wider environment) have complex relationships with each other which are constantly changing, with feedback loops both within and across spheres, and with actions having unknown longterm effects. Equally, within cities, challenges tend to be complex and not easily solved (traffic congestion not solved by building more roads). The focus of this research is to develop a visualisation model that would capture this interrelated complexity while being cognisant of specific detail of each domain.

2 DASHBOARDS IN THE CONTEXT OF SMART CITIES

Most city visualisations focus on a specific area only. Governance dashboards however tend to amalgamate data from many different departments and different sources and are lauded as providing a "One-Stop Digital Shop for Digestible Data on Your City"[1] by giving people access to information about a locality, thereby increasing their understanding of it. However, governance dashboards are problematic on three distinct levels.

(1) Governance agendas define which data is worth gathering, what cleaning and filtering should be undertaken to transform it into usable data fit for its stated purpose. Data in this context is never neutral but informed by the political framework [3].

(2) The heterogeneous nature of the data sources themselves bring challenges as they may be sourced from different city departments or external entities (such as social media, semi-state bodies etc.).

(3) Lastly, the audience of governance dashboards is extremely varied. Not only do dashboards users have different capabilities in relation to the technology employed, they also pursue different agendas and their sense-making will be as much informed by their individual background as it is by the type of visualisation employed.

With regard to the final point, [3] argues that there is a broader concern regarding the use of city data. The author argues not every aspect of a city can be measured (and maybe should not be measured) and an over-reliance on data could lead to serious problems if

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[1]"The One-Stop Digital Shop for Digestible Data on Your City". 4th April 2016. CityLab, The Atlantic. https://www.citylab.com/life/2016/04/this-new-data-tool-brings-city-data-to-the-surface/476661/ accessed May 22nd 2017.

the data infrastructure breaks down or is hacked. Many of these initiatives "are contingent, relational and contextual" and their output creates an 'image' of a city that is not based on reality but instead asserts "a particular expression of power/knowledge" [4]. There is also a concern that city dashboards facilitate an inward-looking culture driven by control, ignoring the connections a city has to its surroundings and the wider world [6].

These challenges are reflected in the visualisation process itself. According to [8] less research has been carried out into the underlying epistemology of creating data visualisations, i.e. what are the reference points for the data analysis, the algorithms and the visualisations itself? They stress that visual literacy will be an essential skill and that the provision of source code and specifications needs to be included but also expanded to allow users to fully understand visual representations of data. They are concerned that visualisation as a tool carries its own reductive meaning which in turn influences our agenda as researchers [8]. Data Visualisation is seen as creating knowledge about "collective life" in a myriad of societal spheres including culture and politics [1].

Making sense of complex sociotechnical systems is even more difficult. While people are good at making sense of straightforward cause and effect systems, complex systems (such as a city) include numerous different feedback loops, an interplay of cause and effect that is far from straightforward, and hidden relationships between the components [10]. DesignX [7] - coined by a number of designers in response to defining design dealing with, as of yet, unknown approaches - focuses on the broader contextual complexities of sociotechnical systems. According to [7] DesignX encompasses dealing with three challenges that could be described as human-centered (psychology of human behaviours and cognition), society (social, political and economic framework of complex sociotechnical systems) and engineering (technical issues that contribute to the complexity of DesignX problems). [7] maintain that each of these areas poses considerable challenges but that these challenges need to be tackled in order for people to understand complex systems. The challenges include the need to focus more on human behaviour and emotions (and how these may influence a person'ĂŹs understanding), the realisation that by breaking down a complex system into its component parts, the overall picture may be lost and the interrelatedness of the parts is missed, and the fact that multiple areas have different perspectives and needs (thereby focusing on different aspects of the overall issue) [7].

3 METHODOLOGY

As governance dashboards have so far not been evaluated in relation to users' sense-making processes, this project firstly attempts to establish if users can extract complex information from such initiatives. This led to the design and implementation of a scoping study[5] to define basic assumptions and gather a pool of interested volunteers for future more in-depth research [2].

4 INITIAL RESULTS

We carried out the scoping study in early 2018 in which 36 people participated. Initial feedback indicate that while some people found it possible to find information on an existing governance dashboard

(in this instance the Dublin Dashboard, www.dublindashboard.ie) the majority of respondents were unable to find more complex information. Survey participants were given a specific question (What is the impact of traffic congestion on health?) and asked a series of sense-making questions. While most were able to find information about traffic in Dublin (travel times, parking etc.), 63% did not find any information about the causes of traffic congestion and 72% were unable to find health related data.

Learn about	Nothing	A little	Quite a bit	A lot
Causes of congestion?	20	8	3	1
Effects on health?	23	6	0	3

While it is anticipated that a current usability study of the Dublin Dashboard will improve user experience and interaction, this study indicates that governance dashboards do not allow users to explore the complexity of cities and interconnectedness between its components.

5 NEXT STEPS

It is envisaged that an analysis of the textual content of this study as well as further in-depth research into sense making of governance dashboards will be carried out within the next months. Concurrently, Systems Oriented Design [9] methods will be employed to develop possible alternative visualisations of city complexities. Initially matched to survey feedback, pilot visualisations will be tested iteratively before a final prototype is created. The process will be fully captured with a view to initiate a model which will be adaptable to other complex socio-technical systems.

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[2]https://kwiksurveys.com/s/jfD30NNn