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Spatial data infrastructures: what are the benefits of SDI usages on the long term and how to evaluate them?

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Nowadays the continuous development of Spatial Data Infrastructures (SDIs) provides a favourable context for environmental and urban management. A SDI can be briefly defined as a set of technological and non-technological components constituting an intra and inter-organizational network that facilitates access, exchange and sharing of geographical information (GI) held by different producers in order to maximize their use, management and production (Rajabifard *et al.*, 2002; Vandenbroucke *et al.*, 2009). It is now largely expected that SDIs should contribute to broader goals such as economic development, social stability, good governance and sustainable management of the environment (Williamson *et al.*, 2003; Masser, 2010).

However, the real contribution of SDIs is still difficult to evaluate apart from some general positive statements which are not demonstrated or even supported by objective findings. The problem is large as SDIs are complex distributed frameworks that involve a large number of users and organisations that are likely to produce, manage, analyse and exchange geographical information at different levels of abstraction and scale. So far, if SDIs have been studied by a number of scholars over the past few years in relation to normalisation initiatives, conceptual modelling approaches and a few more technical issues, the question of the usage of such infrastructures and their related value are still to be explored and studied (Crompvoets *et al.*, 2008)

In a recent work we introduced a methodological approach for identifying SDIs' users and usages (Georis-Creuseveau, 2014). This framework develops a quantitative and qualitative data collection based on an extensive survey and interviews applied to several coastal SDIs in France. We applied a series of statistical, social network-based and data flow analysis that favour a modelling of SDI usages. The results highlight the structural and quantitative properties of a series of SDIs, by differentiating between predominant and outlier SDIs at different organizational levels.

A number of additional and specific research questions arise throughout this research. The challenging ones cover not only theoretical and methodological issues, some of them oriented to the main semantics behind the notion of SDI usage and the difficulty of evaluating them, but also the need for a close evaluation over time of users' expectations as well as a better study of the SDIs' contribution to societal and environmental goals. In particular, it appears that SDIs generate large, complex and dynamic information networks whose specific properties as well as the many data flow exchanges are still to be analysed over time in order to derive and evaluate SDI usages. These are the directions this position paper proposes to share and discuss within the scope of the workshop. The ones, but not limited to, we would like to address are listed below:

Research issues	Directions to discuss and explore
Evolution of SDIs' user categories and profiles	User categorisation and multivariate statistical. Regular data collection and surveys.
Evolution of SDIs' usage and users' satisfaction on the long term, identifying the main changes or/and significant patterns and drivers of changes	Qualitative studies (surveys, interviews), indicators, statistics, metrics, web-based analysis, Internet traffic statistics according to different levels of functionalities, governance and communities of practice. Regular data collection and surveys. Gartner's hype cycle (to apprehend appropriations, visibility etc.) (Fenn and Raskino, 2008), novel forms of Gartner's hype cycle (e.g., multi-dimensional), dynamic SNAs, local & global analysis.
Evaluation of a SDI at the design and life-cycle levels. Post-analysis of SDIs according to initial expectations	Application of Gartner's hype cycle at the design level. Exploration of novel methods to compare initial expectations to concrete implementation.
Analysis of the evolution of networks of SDIs	Dynamic social network analysis, dynamic analysis of conceptual data flows, network and temporal data mining. Categorisation and analysis of these SDIs at multiple organisational levels.

The aim of this research is to make some progress towards the analysis of SDIs usages as well as their evolution over time. We believe that, by improving geographical information access at large, favouring collaborative data production and information exchanges, SDIs appear as a particularly relevant research topic to study social and spatial dynamics related to GI produced by a large spectrum of users from experts to citizens. The usage itself is a marker of the SDIs' contribution to societal and environmental goals. The large information flows passing through SDIs thanks to user interactions are of wide interest and should be studied. But still, following the evolution of the SDIS usage is a necessary step to improve our understanding of the properties of the "geographic information universe" (Janowicz et al., 2014) and its social and technical characteristics. As such, monitoring the main properties and evolutions of SDIs usage and GI usage should provide some relevant qualitative and quantitative indicators, which, when combined with other dimensions of GI (semantics, data quality, legal issues...) should feed on-going discussions related to Geographic Information Observatories.

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