

The Internet of Decisions

Abstract

There is a need to change from systems thinking to infrastructural thinking about decision support systems (DSSs). Decision makers (citizens, policy makers, business managers) do not benefit nor add value to the data and data infrastructures on Inter/intranet because of lack of *DSS Infrastructure* (DSSI). Reasons are heterogeneity and non-interoperability, lack of standards and easily reconfigurable and adaptable DSSs as well as scattered scientific and industrial communities.

Main objectives are

- to support development of new distributed inter-operable DSSI (e.g. standards, policies, ontologies, opensource software, discovery and work flow tools), and
- to develop decision fusion and aiding methodologies especially for spatial data handling, and easily scalable and interoperable DSSs,
- and to link dispersed research and practice communities.

Benefits are an integrated European development of DSSI, and fair conditions for industry to add value to data for decision makers.

Keywords

Decision Support Systems Infrastructure, Spatial Data infrastructure, Data Infrastructure, Internet, Decision Fusion, Decision Making and Aiding Practice, Multiple Criteria Decision Aid, Decision Support Systems, Web Services, Web Applications, Interoperability, Scalability, Open Standards, Policies, Ontologies, Open Source Software, Internet of Decisions

Background, problems

More and more data is available on Internet and intranet. Huge efforts have been and are being made on development of 'data-rich' governments, companies, and society by means of data infrastructures. Example of such efforts in the public sector is given by the EU INSPIRE directive which requires member states to harmonize spatial environmental data for developing an European wide spatial data infrastructure. Countless databases and data infrastructures are maintained on intranets of government agencies, provincial and local governments. Likewise in the private sector utility companies, civil engineering firms, spatial planning consultants and the like, maintain countless intranet databases and infrastructures. And since a few years, citizens produce and use spatial information in Web2.0 initiatives such as *Openstreet* maps or ad hoc initiatives such as the Haiti disaster mapping. Another sector is the medical sector that produces loads of data accessible with web technology (national electronic health records).

Management information systems and later *Decision Support Systems* (DSS) were developed to make use of the increase of electronic information availability since the 60s. But, we hardly see such systems developed for Internet or intranet, the most data rich environments ever. Many of the old ideas about systems to support decision making and decision aiding will indeed not do in this new environment of information infrastructure. There is a need to change from systems thinking to infrastructural thinking about decision support technology.

We observe scattered European initiatives of such infrastructural thinking and aim to collect these under the concept of *Decision Support Systems Infrastructure* (DSSI). In the narrow sense DSSIs are web-based interoperable and scalable decision science technologies. But like other infrastructures, DSSI develop and operate in a complicated technical and social environment.

Therefore DSSIs not only need embedding and adaptation to existing infrastructures of Internet and data, but similarly require appropriate ontologies, protocols of communication, policies for distribution and acceptance, legal frames (e.g. privacy and security), and most differentiating from other infrastructures, they adapt to and shape decision making and aiding practice, and conventions about that practice.

Following Star et al. (1996) and Edwards et al. (2007) we may recognize that DSSI emerges as:

- an embodiment of standards, global and technical in nature
- links with conventions of practice, global and social in nature
- the actual practice learned as part of membership of a community, local and social in nature
- installed base of technology that it is built on, local and technical in nature.

We will explore, negotiate and develop together these aspects of DSSI with the different academic and practitioner communities.

And there are signs of DSSIs in the making:

1. The *Decision Deck Project* (<http://www.decision-deck.org/>), supported by Cost Action ALGODEC (<http://cost-ic0602.org/>) aims at collaboratively developing Open Source software tools for Multiple Criteria Decision Aid (MCDA).
2. The *Agreement Systems* Cost Action (<http://www.agreement-technologies.eu/>) aims at developing next generation distributed systems based on agreements between computational agents.
3. The *Open Geospatial Consortium* (OGC) is an international industry consortium of 416 companies, government agencies and universities participating in a consensus process to develop publicly available interface standards (*OGC® Standards*)
4. The *Spatial Decision Support* (SDS) Knowledge Portal (<http://www.institute.redlands.edu/sds/four.htm>) aims at developing an ontology of spatial decision support tools and becoming a repository portal of interoperable tools.

A number of **problems and opportunities** are to be addressed by shifting to infrastructural thinking:

1. Because of the heterogeneity and non-interoperability of decision science technologies, opportunities are missed for sharing information between public and/or private sector organizations, within countries but also across national borders.
2. Lack of standards and certified specifications are a concern both for industry and governments. Proprietary standards restrict available resources and potential

solutions. Open standards enhance development and prevent monopolistic power closing down development.

3. DSS design, development and deployment currently require expert software engineering skills as well as excessive development delays. Instead end-users could directly configure and adapt the openly available DSSI to their specific needs.
4. DSS redundantly use many similar methods, which could be shared and distributed between international, national and local governments, provided that they were sufficiently standardized.
5. The scientific and industrial communities concerned with DSSI development are at present largely scattered and specialized, hardly exchanging their ideas, even when tackling similar theoretical and practical problems.

This Action addresses fundamental (infrastructural) issues that are as such not well suited for being funded by a technology focused research programme addressing specific needs of a selected industrial research consortia like it is the case in the FP7. General DSSI problems are by essence transnational, public-private and interdisciplinary. They may only be efficiently tackled by an open network of European experts as promoted by the very Cost Actions programme.

Benefits

Concerning the previous list of problems and opportunities, this Action will provide:

1. An integrated European development of DSSI and of the installed base of data infrastructure and practice.
2. Conditions for an industry to add value to data on Internet and intranet for public policy and security, and private sector development with open standards.
3. Increase fair competition amongst private and/or public actors when offering web-based decision support services.
4. Make comprehensive decision fusion and aiding methodologies involving especially spatial data handling available for end-users via an easily scalable and interoperable DSSI, particularly valuable and crucially needed in case of disaster recovery management problems for instance.
5. Foster a European community of researchers and practitioners, especially early stage ones, representing a new generation of DSS designers, developers and/or expert users providing better decision aid theory and faster best practice examples of Internet based decision aiding processes.

Objectives, deliverables and expected scientific impact

The **objectives** are:

1. Support new distributed interoperable DSSI (e.g. DSS standards, policies, ontologies, open source software, discovery and work flow tools) that complement the rapidly growing spatial data infrastructures.

2. Encourage, make aware of their responsibility and bring major cloud actors like Amazon, Google, IBM, Microsoft with innovative scientific methodology to adopt open interoperable standards in their DSSs developments.
3. Develop on the one hand comprehensive decision fusion and aiding methodologies involving especially spatial data handling and, on the other hand, easily scalable and interoperable DSSs.
4. Permanently equip the different scientific communities with a hitherto absent communication about DSSI by means of a journal to be established with this Cost Action and first issues to be published with collaborative papers from Cost Action members.
5. Directly expand and integrate in Europe the activities of a number of networks with proven scientific and organisational capacity like the Open Geospatial Consortium, the Decision Deck Consortium, the EURO working groups on MCDA, DSS and Group Decision and Negotiation systems, and JRC-IES.

The expected **deliverables** are:

1. Federate several well established and renowned scientific communities like the OGC, the D2C, the EURO MCDA, DSS and GDN working groups, to work on a common scientific topic which are DSS infrastructures.
2. Each working group of this Action will prepare a book to be delivered as series. These books will consolidate existing knowledge, identify bottlenecks and raise key research questions in their WGs as learned from interaction with the other WGs.
3. STSMs will result in scientific publications on dedicated topics within or between working groups. We expect particularly to foster a community of early stage researchers and practitioners.
4. Regular Training Missions will develop operational capabilities of OR practitioners and scientists, especially early stage ones, for using profitably the emerging DSSI and provide further training opportunities for decision makers in public administrations and business.
5. Putting up a specific web site with an e-Learning Programme for both early stage academics and practitioners.

The expected **impacts** are:

- new knowledge about innovative DSSI features, future research directions and guidelines,
- awareness of DSSI in academia and practice, especially early stage professionals,
- an industry of both large companies and SMEs providing day to day DSS for citizens, policy makers, B2B, etc.

Scientific programme and innovation

The scientific work on DSSI is distributed along the following themes:

- as embodiment of standards,
- as links with conventions of practice,

- learned as part of membership,
- built on an installed base.

The innovative feature is the paradigm shift from scientific methods and systems thinking to infrastructural thinking with the active involvement of local decision making practice.

Organisation

Open and flexible working groups (WGs) will be created around the four themes of the scientific programme:

1. Standards, specifications, interoperability of DSSI evolution (tech. & global),
2. Global conventions about decision processes (global & social),
3. Local practices of decision making (local & social),
4. Local technical environments in which decisions are made (local & tech.).

WGs will work on their own field and collaborate with the others.

Participants

The proposal is currently supported by a group of 23 scientists and professionals from European countries (BE, CH, DE, FI, FR, IT, LU, NL, PL, PT, UK) and three from overseas (CA, US).