

Atlas of INSPIRE – evaluating SDI development through an inventory of INSPIRE experiences of European national mapping agencies*

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Abstract

The paper describes how practice of INSPIRE implementation are affecting Spatial Data Infrastructure (SDI) development. It contains the results of a EuroSDR (European Spatial Data Research) project 'Atlas of INSPIRE implementation methods'. Aim of the project was to make an inventory of experiences when implementing INSPIRE, in order to share exemplary practices and solutions among national mapping agencies and national INSPIRE contact points. This inventory formed the basis for the generation of the prototype Atlas for all national mapping agencies, policy makers and other stakeholders who have to implement INSPIRE. For SDI research the Atlas provides empirical base material for the conceptualization of SDI implementation approaches. The analytical framework to look at INSPIRE implementation drew on two theoretical notions of how implementation actions can lead to information infrastructure development: a cultivation approach and a design approach. A qualitative data collection process, through a survey and two workshops, tested the extent to which either of the two approaches were prevalent for the INSPIRE implementation. The survey and the workshops provided primary data on INSPIRE implementation experiences of representatives from twelve European countries (Belgium, Bulgaria, Croatia, Cyprus, France, Germany, Netherlands, Poland Slovakia, Sweden, Switzerland, United Kingdom). Comparing the national

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experiences showed that both types of approaches of INSPIRE implementation are present in the EU countries. The cultivation approach is more prevalent in countries which established SDI organizational structures outside the NMAs, and the design approach is more prevalent in countries relying solely on NMAs for INSPIRE implementation. Embedding INSPIRE implementation in national SDI activities seems furthermore to relate to cultivation approaches, consisting of a gradually flatter inter-organizational working relations, and a scaling up strategy which iteratively links the (supra)national implementation plans of INSPIRE to the local implementation plans in national and sub national organizations, and vice versa. The variety in approaches imply that a uniform, best practice, INSPIRE implementation approach for all countries does exist, but that the choices for certain practices strongly relate to the local contextual conditions and windows of opportunities. The implication of these findings for research in SDI development is that more emphasis should be placed on the mechanism of interaction between the slowly changing socio-organizational context and rapidly changing technologies.

Keywords: INSPIRE, SDI, information infrastructure theory, cultivation, design

1. INTRODUCTION

The EU Directive 2007/2/EC to establish an Infrastructure for Spatial Information in the European Community (INSPIRE) applies for all member states of the European Community (European Parliament and the Council of the European Union, 2007). As there is, however, no uniform road to Spatial Data Infrastructure (SDI) establishment and development, the ways that individual countries implement INSPIRE differ. In addition, the extent to which individual practitioners and organizations perceive successes and bottlenecks in the implementation trajectory also differs. Motivated by this observation, the aim of the EuroSDR (European Spatial Data Research) Project's 'Atlas of INSPIRE implementation methods' was to make an inventory of experiences when implementing INSPIRE under the assumption that these experiences implicitly develop the SDI. The inventory shows the variety of implementation strategies of INSPIRE by national mapping agencies (NMAs) and national INSPIRE contact points, and forms the basis for the generation of the prototype Atlas of INSPIRE implementation strategies. Despite the different jurisdictions under which these NMAs operate, common for all NMAs is that their national interest, with often a clear function in the national public administration, provides them influence in national policy making and other public administrative organizations. Their practices therefore clearly affect the dominating public views and activities for SDI development, and provide a good representative sample of national public sector practices relevant for SDI development. Masser (2010) also notes that two thirds of the SDI initiatives in Europe were led by NMAs in 2007. This was particularly the case in the central and eastern European countries that became members of the

European Union in 2004 and the Nordic countries. The Atlas of implementation practices could therefore serve as a first step towards evaluating and conceptualizing SDI development, because it involves a selection of the main contributors to SDI development. Moreover, national mapping agencies are still exemplary for other stakeholders who have to implement INSPIRE and who operate in the SDI development (particularly those involved in producing spatial data).

The analytical method for making the inventory of experiences in the implementation of INSPIRE relied on two ideal type approaches on how to manage the development of information infrastructures, a cultivation approach and a design-oriented approach. The basic assumption when making this inventory is that INSPIRE aims to foster an information infrastructure, and that developing information infrastructures relies on the interaction between social and technical phenomena. This means that the technology used in the infrastructure only has value if the technology is adopted, used and scaled up to a broader group of users. This human context is essential, because the acceptance of rules inherent of the technology depends on the view that people have on the technology. The specific organizational context under consideration in this paper concerns the National Mapping Agencies (NMAs) in Europe. We argue that the historical development paths and established working relations of staff members within NMAs influence their perceptions and views towards new technological rules, such as those formulated by INSPIRE (Kok and Crompvoets, 2010). This argument relies on a theoretical expectation, grounded in information infrastructure literature. The implication of the argument is that current INSPIRE implementation methods need to build-in more appropriate ways to appraise the dynamic and volatile nature of the context in which INSPIRE is having an impact, and needs to be more open to the dynamic influence that the context is exercising.

This paper contains the following sections. The first section discusses the analytical method with the two ideal type approaches to carry out the inventory. From the factors which differentiate the two approaches follows a section on the data requirements, and a data collection strategy. The subsequent section provides the results of the data collection, followed by an interpretation section on the results. In the concluding section we review which approach corresponds to empirical results and what this implies for the development of the Atlas, and for the implementation for INSPIRE as a whole.

2. CULTIVATION VERSUS DESIGN APPROACHES

As INSPIRE is a policy instrument to steer the development of an information infrastructure in a particular direction, it is useful to consider how theorists are conceptualizing information infrastructure developments. The publications of

Hanseth and Monteiro (1998) and Hanseth and Lyytinen (2004) contributed extensively to the conceptualization of information infrastructures. They argued that the information infrastructures rely on socio-technical phenomena, because people act and react, utilize and ignore, benefit and suffer when interacting with the problems and opportunities of the technical infrastructure. The interaction with the technological infrastructure generates personal experiences, and these experiences influence personal perceptions of infrastructure successes and failures. The reverse is, however, equally valid. The experiences that people bring along (including interactions with other types of infrastructures) when interacting with the technological possibilities, also influence which technological possibilities people adopt and which ones not. Various authors have examined this socio-technical interaction process. Broadly speaking, there are two ideal types to manage and influence this process, which we will refer to as a 'cultivation' approach and a 'design' approach.

With regard to the cultivation approach, Hanseth and Monteiro (1998) define information infrastructures as enabling, shared, open, relying on socio-technical networks, connected to other infrastructures. Bowker et al. (2007) add that information infrastructures are *pervasive enabling resources*, containing the technologies, organizations, and individuals (designers, developers, users, mediators, managers and administrators) which enable the generation of organizational and societal outcomes and instruments. Both documents point to the open and continuous nature of information infrastructures, and to the different people which act with and within these infrastructures. All these people operate within their own networks with other people, and all these networks contain their own values, beliefs and views to what is considered successful and what is a failure. The implication of this variety is that there is not a universal view on a best practice and a success story, because the success heavily depends on the views of success in that specific (socio-organizational) context. The development of the infrastructure relies on an installed base of professional and scientific values and paradigms, and lock-in effects of past choices on technologies. Both constrain future opportunities and decisions. Standardization in the cultivation approach is the result of a long term process of institutionalization of certain practices. The information infrastructure growth and development is visible when additional socio-technical activities take off (bootstrap) and scale up.

With regard to the design oriented approach, the basic assumption is that all information infrastructure development starts with the initiation of a new policy and a new design, which is unrelated or independent of previous policies and designs. There is a firm belief in the appropriateness of certain technologies for implementation of the policies. The implementation of the policy follows a sequential, planned path, determined by the choice of the technology and the space that the technological design provides during implementation. Information infrastructure development in this view is linear, and moving to increased 'levels

of maturity' in technology specification and architecture enforcement (Bosch, 2002; Layne and Lee, 2001). Given linear maturity development, the assumption is that managers and coordinators can actively steer the development paths through guidelines, milestones and rules. The implication of this assumption is that the technological development path can occur in isolation of the context in which the development is taking place, and that choices made in the design process are independent of the socio-organizational context in which the technological actors operate. Standardization in this view consists of the set of technical solutions. As the technology and the context follow different development paths in this view, the only way to connect them is through coercive formalization (of standards, for example).

A comparison of the two approaches (cultivation and design), drawing from the comparative information infrastructure studies of Hanseth and Lyytinen (2004) and Ribes and Finholt (2007), shows 5 prominent differences. Firstly, the cultivation approach assumes that existing elements of an infrastructure inscribe the behaviour of actors. The infrastructure thus develops from an installed base of ideas, actors and solutions. The installed base of values is derived from the historically constructed solutions of the most dominant professional field. Contrastingly, design approaches assume a degree of freedom for actors in any of their technological choices. Hence, they develop the infrastructure from a clear base.

A second difference is in sequential trajectory of activities and decisions. The cultivation approach assumes that certain choices in technologies lead to so-called 'lock-in' effects, because once 'stuck' with a particular technology, one becomes dependent on the technology and the limitations in functionality of the technology. Organizations are thus locked in these limitations. As a result, current choices in activities are dependent on past choices of activities. Hence, they are contingent and path dependent. The design approach assumes that at any given time it is possible to choose alternative technologies, and assumes that professional and organizational actors can act independently of previous technological constraints or socio-organizational changes. Hence, the choices are independent of the previous path of development.

Thirdly, the two approaches are different in how they approach standards and standardization. The cultivation approach regards standardization as a process of institutionalization. Certain processes and technological choices evolve into 'standard' processes and choices if they become enshrined regular socio-organizational behaviour and values. This does not only relate to 'de facto' (data, process) standards, but also to 'de facto' values and practices. Essentially, standardization in this view is a gradual development towards broadly accepted and adopted values, practices and standards regarding a particular technology. Contrastingly, the design approach views standards as discretely designed

technological solutions to interoperability problems. Interoperability is achieved by 'standardizing' data, data models and processes. Different from the cultivation approach, the view in the design approach is that standards should not be gradually adopted, but should at some point be decided upon and enforced if necessary. Institutional arrangements for standards do not gradually develop, but follow from standardization laws and enforcement.

Fourthly, the process of growth follows different trajectories in either approach. In the cultivation approach growth of the information infrastructure follows from coincidental co-occurring events or conditions, which at some given moment open windows of opportunity for growth. In the design approach, growth is seen as the result of a rationally planned development process.

Finally, the relation of information infrastructures with the organizations operating on those infrastructures differs in the two approaches. Where the cultivation approach assumes a crucial and indispensable interaction and co-construction of the goals of organizations with the goals of the technology underlying the infrastructure, the design approach assumes the technical information infrastructure design and implementation as following a process which is independent of the socio-organizational goals and strategies. The differences between the two approaches can be summarized in the Table 1, which provides the criteria with which current INSPIRE implementation strategies could be compared.

Table 1: Differences between cultivation and design approaches

Criteria	Cultivation approach	Design approach
(Professional) origin from where infrastructure develops	Installed base of accepted professional and scientific values and paradigms	Clear base – no particular values or paradigms assumed
Effects of origin on development path	Path dependency given the lock-in effects	Path independency, given the view that technology is value-neutral
View on standards	Standardization as processes of institutionalization	Standards as technological solutions
Development / growth process of infrastructure	Coincidental bootstrapping and scaling up	Planned, sequential development processes
Relation of actors with goals of socio-organizational environment	Co-evolution of socio-organizational and technical developments; goals are co-constructed	Technology and socio-organizational follow separated paths, and aim for separate goals.

3. METHOD OF DATA COLLECTION

The data collection aimed at examining to which extent NMAs were following which ideal type information infrastructure development approach. Two methods were chosen to conduct the data collection:

1. A survey among all NMAs. We validated the results of the survey by comparing it with the responses provided by Crompvoets and Vandenbroucke (2010). Although this survey had another research context, it relied on the same target group, and similar issues.
2. Two instances of a focus group with INSPIRE managers in NMAs.

Both the survey and the focus groups workshop included questions which were constructed on the basis of the five criteria of Table 1. The difference between the cultivation and design approaches is visible by looking at the choices, activities and interactions of individual practitioners, and by investigating the perceptions that INSPIRE managers in NMAs when they make their choices in implementation, and when they qualify progress, success and failure. So, the focus of the data collection was not on investigating how the annual reports of NMAs reflect progress – this would provide a formal and often more political image -, but on investigating and appraising what INSPIRE implementers in each country actually do, and how they perceive the effects of the INSPIRE related activities. Investigating actual choices, activities and interactions of individual practitioners requires a qualitative approach relying on how practitioners phrase their views (Berntsen, Sampson, and Østerlie, 2000; Lee, 1999). Such views may not be formulated in direct and formal statements in written documents (formal and informal), but are more likely be emerging in informal discussions and interviews (Gummesson, 2000; Putnam, 2005). The survey and the focus groups aimed therefore at triggering the NMA managers to reveal their actual activities and views on their activities. This was achieved by translating the items of each of the criteria (origin, path (in)dependency, standardization process, growth process, relation to environment) of Table 1 into operational questions in the survey and in the workshops. Both the survey and the workshops targeted the NMAs and national INSPIRE contact points, assuming they were most aware of the national INSPIRE implementation activities.

To examine the professional and organizational origin from which INSPIRE activities developed, both the survey questions and the workshop discussion items aimed for finding factual information on the organizations and persons active and responsible for the INSPIRE implementation. Finding out in which organizational and cultural history INSPIRE is 'landing' is relevant for the assessment of which organizational culture and which historical practices are likely to dominate the INSPIRE implementation trajectory (Ciborra and Hanseth, 1998).

The second issue, the path (in)dependency, required an investigation into subsequent activities and executed strategies. The starting point of implementers and the choices that they make when having to implement INSPIRE reveals their priorities, and their 'easy' targets. The latter are activities with which they are more acquainted, and typically result from the historical paths. To evaluate the priorities and 'easy' targets the survey questions aimed to concretize which subsequent initiatives INSPIRE implementers were undertaking, and the workshop expanded on these subsequent initiatives by specifically referring to the type and sequence of particular strategies they were using for this (technological, economic, organizational and institutional). The emphasis in the data collection on this point was to confine to actual experienced activities and effects as a result of INSPIRE, hence to exclude activities and which were only reported in formal documents. The reason to express this specific confinement was to collect more personal details of actual activities, rather than to collect 'diplomatic answers' and 'hear-say' effects.

The issue of standards and standardization was approached from two sides. The survey focused on finding out which national standardization activities derived from INSPIRE. The workshop provided the opportunity to approach the process of standardization in a wider scope, in order to derive whether the INSPIRE related activities were part of a broader institutionalization process of standardization, or whether these were conducted in isolation of other standardization processes. This broader perspective was addressed through a session with sets of propositions. All participants discussed four dichotomous pairs of propositions relating to respectively organizational processes, cooperation, complexity of data exchange, efficiency. The perception of actors was evaluated through a work group session, whereby participants had to indicate how they perceived the influence of certain developments through the opposing propositions (proposition pairs). A proposition sheet acted as a tool for discussion. For each pair the participants were requested to indicate the extent to which their experiences matched either of the two propositions. In this way the workgroup results did not only provide an inventory of different experiences, but also provided a set of explanations why certain actors were more inclined to agree with certain propositions than other actors or other propositions. This provided data on both the processes and the rationale for the processes.

Fourthly, the data collection on the issue of infrastructure growth and development concentrated on actual changes, and on whether changes occur coincidentally or as a result of a planned, step-by-step management process. The views on actual changes were collected through the survey question on changes occurring in organizations and in financial management. The step-by-step process relied in the workshop discussion items on additional fund generation, and plans for future developments. The assumption hereby was that if

organizations seek additional funds and plan actively for new INSIRE or SDI related projects, then the SDI is growing and developing.

Finally, the relation of INSPIRE and INSPIRE actors with other actors in the immediate socio-organizational and societal environment focused on the issue of effectiveness and uncertainty. The reasons for this focus was the assumption that if environmental factors determine the course of infrastructure development (such as in the cultivation approach), then INSPIRE implementation actors are likely to report ineffectiveness of their actions and are likely to face uncertainties. Reversely, if the design approach would be implemented, then the presence of perceptions of ineffectiveness and uncertainty would be unlikely, because actors would then just follow the design imperatives. Table 2 shows the survey questions and focus group workshop discussion items for each of the criteria which differentiate the two ideal type approaches of information infrastructure development.

Table 2: Translation of information infrastructure implementation criteria to survey questions

Implementation criteria	Survey questions	Workshops discussion items
Origin from where infrastructure develops	Which organizations and which sectors are the most active in the INSPIRE implementation?	Who in your country is currently undertaking what in relation to INSPIRE?
Contingent effects of the origin on development path	Which INSPIRE implementation initiatives are prioritized, completed, and/or on hold?	What are the current priorities in technological, economic and organizational strategies?
View on standards and standardisation	Which (data) standards and standard practices are adapted as a direct result of INSPIRE implementation?	How did the organizational (data) processes, the inter-organizational cooperation (with data), the complexity of data exchange and the efficiency (of data processes) change?
Development / growth process of infrastructure	Which changes are occurring in the organizational and financial management of SDI related activities?	How would you use additional funds for further development of the SDI?
Relation of actors with goals of external environment	Which structures and practices initiated for INSPIRE implementation do your stakeholders still consider ineffective and which cause you uncertainty?	Which INSPIRE achievements are you proud of towards your stakeholders, and which ones do you and they consider disappointing?

4. RESULTS

NMA representatives from twelve European countries (Belgium, Bulgaria, Croatia, Cyprus, France, Germany, Netherlands, Poland Slovakia, Sweden, Switzerland, United Kingdom) completed the survey, and participated in the workshops conducted in April 2009 and in January 2010. The reasons for the survey questions and the survey results were presented during the workshops. Both the survey and the workshop results formed the basis for the prototype Atlas of INSPIRE Implementation methods.

Professional origin of infrastructure development

The survey responses revealed that the organizations which are the most active in INSPIRE implementation are similar throughout Europe. The respondents primarily referred to Departments of Lands, Surveys, Mapping and Topography, the Cadastres, the Ministries and Administrations of Environment as primary organizations involved in INSPIRE activities. This is also confirmed in the report of Cromptvoets and Vandenbroucke (2010). Although the institutional embedding of these organizations differs per country, their functions are largely similar. They constitute national agencies, which are functionally responsible for the collection and distribution of foundation spatial data sets. Most of these agencies have been operating directly in the public sector, and/or rely primarily on public sector funding. The domain that the actors in these agencies represent constitutes primarily the geo-information domain, although in some instances respondents referred to the domain of informatics and/or environment. The geo-information domain draws however on a long history of professional development and generation of professional values. Koerten (2007) argues that the professional traditions and values (of national mapping and mapping accuracy) are dominant narratives among the staff members within most NMAs. This historical professional narrative can negatively affect the new INSPIRE narratives, which are national and international cooperation and data sharing. Similarly, certain cultures and traditions of the national public administrative system are influencing the choice of national INSPIRE contact points. In some countries the national contact points are also contact points for other EU coordinated programs, whereas in other countries INSPIRE is completely isolated from any other EU project coordination mechanism.

Contingent effects of origin on development path

The responses differed considerably regarding the sequence and priority setting of INSPIRE related activities. The Belgium respondent indicated, for example, that INSPIRE led to the establishment of a SDI organizational structure and the technical activity of building up the spatial metadata. Contrastingly, in Bulgaria, for example, the technical activity of the metadata completion was still on hold, but most of the efforts focused on the establishment and the approval of a spatial

data access law. In Croatia such a legal framework still had to be worked out, but an NSDI body had received a legal mandate, and had started a series of public awareness campaigns. Similarly, the Swedish respondent referred to the establishment of a national coordination structure, yet also noted that the adaptation of the environmental law to comply with INSPIRE was still on hold.

Given the variation in priority setting and sequence of activities, it is likely that both the professional and the national public administrative setting are strongly influencing the choices that actors make in INSPIRE implementation activities.

Standards/standardization

Regarding the changes in standards, the survey results showed that in most EU member states certain changes in data access and data production rules have taken place. Examples of such changes include the Flemish formulation of a Geospatial data infrastructure (GDI) decree (Belgium), a law on state survey and estate cadastres (Croatia), Geodata access law (Germany), Spatial data infrastructure law (Poland) and a change in the law on geodesy and cartography (Slovakia). Furthermore, in the Netherlands, Sweden and the UK the INSPIRE Directive was anchored in existing laws through amendments of those laws, whereas in France the national coordinators were transposing the law through local authorities.

The priorities and sequence in how to implement INSPIRE articles differed per country. Respondents referred to certain articles as 'headache' articles because of the difficulties they faced when implementing these. The Bulgarian respondent referred to INSPIRE articles 10, 11 and 18 for example (articles dealing with Compliance to interoperability; network establishment; constituting coordination structures); Cyprus to Article 9 (article dealing with the deadlines for having established implementing rules); Sweden to article 17 (article dealing with Security and secrecy) and Poland to article 7, 11, 12 (Implementing management rules; network establishment; technical networks in public authorities). Overall, common 'headaches' in the eyes of the respondents were issue of data sharing and interoperability, coordination and (re-)allocation of data authority. INSPIRE implementers typically postpone activities to address these headaches.

The responses on standards during the workshops were diverse. On the first proposition pair related to organizational processes, participants indicated that having to comply to INSPIRE rules changed some of the internal rules of national organizations in a more drastic way than any other similar rules from national and supranational agencies. Most respondents, however, did not see any change in organizations other than the national coordinating organizations. For the propositions which related to cooperation, participants found that the cooperation and exchange of data according to INSPIRE rules was felt as a long, difficult and

uncertain process of institutional negotiations, and complex legal structures. It was definitely not felt to be a matter of just practical organization through individual layers of (sub)contracts.

In response to the propositions related to the complexity of data exchange, most felt that the increasing possibilities of web technology made the technical sharing of data increasingly easier, but at the same time made the overall dissemination of geodata and geoservices more complex.

On the fourth and final proposition pair related to efficiency, most of the participants could not indicate whether having to comply to INSPIRE had made any effect on their work efficiency. No one could provide any evidence of where, and to which extent efficiency had changed since the adoption of INSPIRE.

Growth process

In terms of SDI growth, the survey respondents indicated that very few operational and organizational management changes have taken place since the inception of INSPIRE. Some respondents indicate having established working groups, and having arranged cooperation contracts. However, INSPIRE did not induce innovative operational procedures or new management strategies. Very few participants of the workshops indicated having made large internal organizational changes or major changes in internal resource allocations. Still, INSPIRE has generated national discussions on data responsibilities, and on the need for intra-organizational attitude changes. In a few countries, organizations have started to innovate ways of working and associated management methods.

On the topic of financial sustainability of the INSPIRE initiated activities, both the survey responses and the workshop contributions showed that few organizations are able to execute new investments, few foresee any budget re-allocations, and very few have any additional funds to execute the additional activities needed to comply with INSPIRE. Only the Swedish representative reported an additional government investment of 50Mkr (≈ 4.65 M€) /year for 3 years, of which 30 Mkr was reserved for coordination activities. Other countries reported having to work with 'standard policies of public investments', 'state budget funds', 'no overall INSPIRE budget', etc. As a result, all workshop participants applauded the exercise of what to do when having additional funds. The ideas deriving from this hypothetical question ranged from developing more technical products, such as developing 3D models, to more socioeconomic issue, such as setting up appropriate progress evaluation mechanisms. Overall, all respondents and workshop participants agreed that they require more structural funds to execute INSPIRE requirements. Moreover, the responses point to a growth process of SDIs which is very ad hoc and coincidental. The INSPIRE implementation

activities do not generate a lot of growth or development in the eyes of the respondents.

Relation with environment

Finally, the survey respondents had different perceptions on current inefficiencies and uncertainties. Some respondents blamed inefficient and inert public sector structures for inefficiencies in INSPIRE transposition and implementation. Others referred to general difficulties when coordinating and cooperating (with both public and private sector agencies). Again others had difficulties with starting up the technical programs, such as implementing metadata requirements and/or interoperability. The two workshops revealed in addition that the INSPIRE implementers do not perceive INSPIRE as an end goal (yet), but as a vehicle to promote public sector back office integration and cooperation. Furthermore, the effect of the formalizing processes through INSPIRE is that it has raised high awareness about spatial issues among many other public agencies, and that it is pushing innovation in older inert institutions. Common problems include the difficulty in promoting data sharing and interoperability, and difficulties in coordinating activities across different administrative levels and across themes.

A general observation from both the survey and the workshops results was that there still exists a clear difference in perceived implementation difficulties between older and newer member states. Both the transposition of INSPIRE into national legislation, and the adaptation to national coordination structures strongly rely on the national public administrative context. Whereas most western European countries have gradually adapted and shaped INSPIRE related activities and organizations, most eastern European countries are in a more abrupt process of re-inventing their organizations and institutions. In the latter case, more drastic legislative and institutional reform is already anticipated. This may also explain their inclination toward more design oriented approaches, even though most representatives admitted the need for awareness raising.

5. INTERPRETATION OF RESULTS IN TERMS OF THE TWO APPROACHES

This section reflects on the findings in the previous section from the perspective of the two ideal types of implementation strategies, being 'cultivation' and 'design'.

Professional origin of infrastructure development

Both the agencies and the domains which are most active in the INSPIRE implementation represent historically rooted communities of mapping, cadastre and environmental protection actors. As a result, it is only logical that they would approach INSPIRE from their own gradually established professional values. The technological choices to prioritize metadata creation are typically rooted in the

catalogue practices of mapping agencies, and the registration practices of cadastres. This prioritization reflects a design approach. Similarly, the organizational structures which were set up to handle INSPIRE reflect the organizational structures of the NMAs and/or cadastres. In other words, INSPIRE implementation follows an operational path for which organizational blueprints exists.

Contingent effects of origin on development path

The result of the mapping and cadastre professional origin is organizational and institutional isomorphism (DiMaggio and Powell, 1983). INSPIRE implementation resembles NMA and cadastre implementation practices, and a professional tradition is continued. Such a continuation may however derive from principle survival strategies of the professional community. The professional community has been under severe constraints due to budget cuts, and adopting the responsibility of new endeavours may prolong their existence. The effect is however that these causes may strongly complicate effective INSPIRE implementation. Priorities are not fully rationally determined, but depend on possible strategic survival chances (Pfeffer and Salancik, 1978). The variety in responses with regard to current effects of INSPIRE reflect these differences in priorities per country. Moreover, they reflect a difference in what actors operating at the national level perceive as relevant, successful and/or problematic, and what they choose to be a priority. When survey respondents emphasize achievements in organizing structures, they implicitly describe a culture of starting by constructing structures and distributing responsibilities, rather than by starting pragmatically with activities and then investigating which organizing structures are most appropriate to fit those activities.

The survey responses show a geographical distinction between approaches in this sense. The Netherlands respondents mentioned for example the establishment of operational cooperation agreements between several national and local organizations as an achievement resulting from INSPIRE, whereas the Belgium respondents emphasized the construction of a completed metadata set. This clear difference in prioritizing the sequence of activities reflects a difference in approach. The Netherlands case is leaning towards cultivation, whereas the Belgium case leans more toward design. Essentially, this implies that although INSPIRE explicitly prescribes certain deadlines and targets, favouring the implementation of a design approach, NMAs may still seek the freedom to choose and justify a cultivation approach.

Standards /standardization

The initiatives dealing with introducing and embedding geospatial data and process standards differ per country. This difference implies that the type and sequence of activity choices are essentially contingent, i.e. dependent on national

and local assessments of what requires which priority. Certain choices for standards may in fact not result from having to comply with INSPIRE, but result from local assessments that these choices fit the organizations. In such cases the emergence of standards is simply co-occurring with other organizational development activities. The changes in standards which the respondents and participants contributed to the INSPIRE implementation initiatives tend to point only to changes in organizational structures and responsibilities, rather than to changes in behaviour and attitudes. The implication of this finding is that although INSPIRE implementation results in changes in work processes, and in allocation of organizational resources, it remains difficult for Directives such as INSPIRE to influence, or even to standardize, the general data sharing and exchange attitude and behaviour.

Exemplary of this difficulty is the issue of inter-organizational cooperation. Inter-organizational cooperation is still felt as uncertain and problematic in almost all countries. As a result, there has not been any standardization of inter-organizational coordination practices at either national, supra-national or sub-national level. This seems to reflect that cooperation still remains highly contextual, and that cultivation approaches, which favour a gradual adaptation of organizational processes to techno-organizational requirements, are more conducive than design-oriented approaches which deny such a gradual adaptation need. The INSPIRE Directive, which contains several 'hard' deadlines may thus work counter-effective in standardizing cooperation practices. Cooperation cannot be directed and transposed by legal deadlines, but requires a process of gradual adaptation. Still most NMAs have started the implementation with the implicit assumptions of a design approach of implementation, with a smooth transposition of its content, following a clear path with deadlines. In reality, however, the examples of NMA implementation show that the staff members face many operational and contextual 'headaches'. These can only be addressed through gradual adaptation of operational processes, and societal needs.

Growth process

The results on limited change in operational and organizational management practices reveal that the information infrastructure development path is slow, despite the stimulus of INSPIRE. In all cases the working relations with other agencies remained largely hierarchical (only few cases of more horizontal or matrix working relations), the management methods remained largely conventional (no cases were reported where actors adhered to alternative forms of chain management or cross-organizational management) and the responsibility structures remained unchanged (i.e. no cases of shared responsibility). Even though these changes are limited, this practice corresponds mostly to the cultivation approach. Scaling up of INSPIRE compliance and the

anticipated innovation in spatial data sharing practices is more likely to depend on a (coincidental) bootstrapping mechanism, than on the execution of planned, standardized coordination efforts. The fact that most respondents point to an ad hoc and coincidental growth process of SDIs indicates that a bootstrapping mechanism, where a specific event, accidental funds, or a specific product of one organization triggers a sudden change, is more likely to stimulate growth than planned development steps. A change in budgeting structure could potentially stimulate the emergence of such bootstraps. Currently, most organizations are 'stuck' in traditional funding and budgeting mechanisms, and do not have sufficient capacity to acquire additional funds or develop alternative funding mechanisms. As a result, the scaling up will remain dependent on coincidental changes.

Relation with environment

Finally, the effect of INSPIRE on the socio-organizational environment in which it needs to be implemented is still limited. The fact that INSPIRE is still largely seen as a vehicle to raise awareness of public sector reform rather than as an instrument to realize public sector reform is an indication that the influence of INSPIRE on the environment is limited. The resulting change in information infrastructure is thus also limited, although gradual changes are taking place. The gradual nature of change is reflecting the cultivation approach more closely than the discrete and planned type of changes of the design approach.

Summary

Comparing the findings to the criteria in Table 1 shows that NMAs are implementing INSPIRE from a well-established professional origin. Although a design approach is initially propagated in many of the NMA implementation trajectories, both financial and resource constraints force many NMAs to increasingly adopt a cultivation approach. Goals of INSPIRE are increasingly connected to other NMA and societal goals. This makes complying to INSPIRE not just a planned and sequential implementation process, but a process of seeking complementarities between INSPIRE and national or organizational objectives.

6. CONCLUSION

The inventory of experiences and perceptions of European national mapping implementers of INSPIRE shows a large variety in national endeavours. An analytical framework relying on two ideal type approaches helped to qualify the activities of INSPIRE implementation. The results show that most countries initially tend to favour a design oriented approach of implementation, characterized by prioritizing implementation plans, establishing (transposing) legislation, and aiming to achieve technical project plans (such as the

establishment of metadata systems). This is not surprising, because the INSPIRE itself has many explicit characteristics of such a design approach. However, in some countries (notably Netherlands, Sweden, Germany, and to some extent Belgium) the NMAs are increasingly leaning to a cultivation approach of INSPIRE implementation. Instead of constructing rules and technologies to reach the strict INSPIRE deadlines, they tend to evaluate how the current context (consisting of currently applying rules/law, operational arrangements and existing organizations) already meet the INSPIRE requirements. In addition, they emphasize investing in activities which could complement the INSPIRE objectives in the long run.

The variety in implementation strategies in Europe proves that reaching a uniform and standard recipe for INSPIRE implementation model for all European countries is impossible. This has two implications. On the one hand, those countries favouring the design approach are likely to face the contradictions of schedules, legislations and uniformity, as the context of technologies and organizations are rapidly changing. As a result, the designs will require constant updating. On the other hand, for those countries favouring the cultivation approach, the emphasis on the local context may in fact rapidly diminish the relevance of INSPIRE as a guideline for SDI related activities. This in itself may not necessarily be harmful for SDI development, but it may complicate international agreements on constructing follow up policies for INSPIRE.

The focus in this research on NMAs, and their practices of INSPIRE implementation activities is indeed a limited view on SDI development at large. This is a direct result of the limitation of the Atlas project. The results are therefore in particular valuable for the NMAs themselves. However, the practices of NMAs are not isolated in the SDI development. Their national function provides them influence in national policy making and other public administrative organizations. Their practices therefore clearly affect the dominating public views and activities towards SDI development. Therefore, the practices of NMAs through INSPIRE provide a good representative sample of national public sector practices relevant for SDI development. Furthermore, activities of INSPIRE are not the only activities contributing to SDI development. However, most participants noted that INSPIRE was the key activity which they associated with SDI. Still, extending this research to other sectors and other type of organizations could enhance the understanding of SDI development at large. This could involve the role of commercial agencies, involved in many of projects dealing with the construction of IT architectures, and the role of thematic lobby groups and citizens, who increasingly apply geospatial technologies. Additionally, further research could look into similar directives as INSPIRE which aim to contribute to SDI development.

This research project emphasized looking at the practice of actual implementation activities. This is a first step towards understanding how certain practices in a smaller sense relate to a bigger picture of SDI development. The variety of choices that national agencies make for the purpose of SDI development shows that despite common goals (formulated by INSPIRE) implementation strongly depends on national structures, behaviour and priorities. SDI development is thus likely to follow a different path than what is planned and controlled by policy makers and SDI practitioners. This conclusion implies that SDI development research needs to be better embedded in a collection of practice-based research, which could better explain why and socio-organizational changes co-occur with technological developments. The experiences and perceptions of success and failure of practitioners strongly relate to their socio-organizational conditions, societal windows of opportunities, and to their historical contingencies. Research on SDI development must thus be stronger based on practice-based research, which is stronger connected to socio-organizational theories and methodologies.

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