**Understanding the requirements of a spatial data infrastructure for universities**

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# Abstract

The demand for geospatial data across different disciplines and organizations has led to the development and implementation of spatial data infrastructures (SDI) and the theory and concepts behind them. An SDI is an evolving concept about facilitating and coordinating the exchange and sharing of spatial data and services between stakeholders from different levels in the spatial data community. Universities typically have well-established libraries and digital catalogues for scientific literature, but catalogues for geospatial data are rare. Geospatial data is widely used in research, but geospatial data produced by researchers is seldom available, accessible and usable, e.g. for purposes of teaching or further research, after completion of the research. This article presents a model of an SDI for universities, the Academic SDI, based on the formal model of an SDI developed by the ICA Commission on SDIs and Standards (formerly the Commission on Geoinformation Infrastructures and Standards). The SDI implementations at a number of universities and research institutes are described and based on these a model of an Academic SDI is presented. The Academic SDI identifies important stakeholders and information requirements for an SDI in a university. The results contribute to understanding information requirements and important role players that need to be involved in a successful SDI implementation at universities.

# 1. Introduction

The demand for geospatial data across different disciplines and organizations has led to the development and implementation of spatial data infrastructures (SDI) and the theory and concepts behind them. An SDI is an evolving concept about facilitating and coordinating the exchange and sharing of spatial data and services between stakeholders from different levels in the spatial data community (Hjelmager et al. 2008). For example, a national SDI facilitates sharing and exchange of *public spatial data* in a country. Give a few examples of global, regional and local SDIs…

Universities typically have well-established libraries and digital catalogues for scientific literature. Give a few examples… Geospatial data is widely used in research, but geospatial data produced by researchers is seldom registered in catalogues. Therefore, after completion of the research, the data is not available, accessible and usable, e.g. for purposes of teaching or further research. There are many examples of digital catalogues for geospatial data in SDI implementations. Give a few examples…

Implementations of SDIs and catalogues of geospatial data at universities and research institutes would improve the availability, accessibility and usability of geospatial data, not only for use in research but also to communicate the results of the research. Such an SDI would facilitate sharing and exchange of *geospatial data produced for research and education and from research and education within universities and research institutes*.

This article presents a model of an SDI for universities and research institutes, the Academic SDI, based on the formal model of an SDI developed by the ICA Commission on SDIs and Standards (formerly the Commission on Geoinformation Infrastructures and Standards). SDI implementations at the universities of Stuttgart, Twente, Groningen, Ostrava, EDINA and the CSIR and based on these, the Academic SDI is described. The Academic SDI identifies important stakeholders and information requirements for an SDI at a university or research institute, specifically where these are different from SDIs in the public sector.

# 2. Related work

## 2.1 Demand for geospatial data at universities and research institutes

Any volunteers? This section should not be longer than half a page and describe the need for geospatial data in research and also why research results in the form of geospatial data should be made available, accessible and usable after completion of the research. The section should provide the motivation for this research, based on scientific literature.

## 2.2 Spatial data infrastructures

Any volunteers? This section should not be longer than half a page and provide background on the origin, purpose and current status of SDI implementation/practice and theory.

## 2.3 The ICA’s SDI model

The International Cartographic Association (ICA) Commission on SDI and Standards, formerly known as the Commission on Geoinformation Infrastructures and Standards, has developed a conceptual model of an SDI (Hjelmager et al. 2008, Cooper et al. 2011, Cooper et al. 2012). The model describes an SDI from different viewpoints specified in the Reference Model for Open Distributed Processing (RM-ODP) (ISO 1998). Each viewpoint provides a different abstraction of the SDI. See Table 1. To date, the Commission has described an SDI from the enterprise, information and computational viewpoint.

**Table 1.** RM-ODP view points (Source: ISO 1998).

|  |  |
| --- | --- |
| **Viewpoint** | **Description** |
| Enterprise viewpoint | Concerned with the purpose, scope and policies governing the activities of the specified system within the organization of which it is a part |
| Information viewpoint | Concerned with the kinds of information handled by the system and constraints on the use and interpretation of that information |
| Computational viewpoint | Concerned with the functional decomposition of the system into a set of objects that interact at interfaces – enabling system distribution |
| Engineering viewpoint | Concerned with the infrastructure required to support system distribution |
| Technology viewpoint | Concerned with the choice of technology to support system distribution |

From the enterprise viewpoint, an SDI is concerned with the purpose, scope and policies governing its activities. Policies should be understood broadly to include legislation, standards, agreements, best practices and business models. An SDI stakeholder is an individual, group or organization with an interest in the SDI achieving its purpose. SDI stakeholders either impact the SDI or are affected by the SDI. See Table 2. Stakeholders define the scope and policies to meet the purpose of the SDI; they implement the SDI based on the scope and policies; and they make use of products and/or services as intended in the purpose of the SDI (Hjelmager et al. 2008). The model of the Academic SDI describes specializations of stakeholders in an academic environment.

**Table 2.** SDI stakeholders (Source: Hjelmager et al. 2008)

|  |  |
| --- | --- |
| **Stakeholder** | **Description** |
| Policy maker | Sets the policy pursued by an SDI and all its stakeholders |
| Producer | Produces SDI data or services |
| Provider | Provides data or services to users throughout SDI |
| Broker | Brings users and providers together and assists in the negotiation of contracts between them |
| Value-added reseller | Adds some new feature to an existing product or group of products, and then makes it available as a new product |
| User | Uses the SDI for its intended purpose |

From the information viewpoint, an SDI is concerned with geographic information and the semantics of that information. The ICA’s SDI model defines a number of information viewpoint classes: policy, product specification, product, metadata, catalogue, information and knowledge. See Figure 1. Policies determine the specifications for geographic information products, which could be data or service products. Products are prepared and provided according to the specifications. Metadata describes the products. Products and metadata are registered in catalogues to facilitate discoverability of the products. New information and knowledge may be derived from the products (Hjelmager et al. 2008). In this article specializations of the information viewpoint classes for the Academic SDI are presented.

|  |
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| **Figure 1.** Information viewpoint classes in the ICA’s SDI model (Source: Hjelmager et al. 2008) |

# 3. Implementations of SDIs at universities and research institutes

For each implementation:

* Describe the purpose/intent of the SDI, current state of the SDI
* Identify and describe the SDI stakeholders (Policy Maker, Producer, Provider, Broker, VAR, End User) that are/were involved and what their roles/mandates are/were.
* Lessons learnt about the stakeholders – who was important, who not? If the SDI was a success, how did the stakeholders contribute to this? If the SDI failed, how did the stakeholders contribute to this, e.g. were important stakeholders not involved? Or did they not have an appropriate mandate? Or did they not understand the concept of an SDI….?

More details about the ICA’s SDI model are available in these two papers:

* Cooper, A.K. et al., 2011. Extending the formal model of a spatial data infrastructure to include volunteered geographical information. In *25th International Cartographic Conference (ICC)*. Paris, France, 10 pages. <http://researchspace.csir.co.za/dspace/handle/10204/5212>.
* Hjelmager, J. et al., 2008. An initial formal model for spatial data infrastructures. *International Journal of Geographical Information Science*, 22(11–12), pp.1295–1309. [http://csdila.unimelb.edu.au/publication/journals/AN INITIAL FORMAL MODEL FOR SDI.pdf](http://csdila.unimelb.edu.au/publication/journals/AN%20INITIAL%20FORMAL%20MODEL%20FOR%20SDI.pdf).

## 3.1 Stuttgart University of Applied Sciences, Germany

Franz-Josef, are you still OK to do this?

## 3.2 University of Twente, Netherlands

Barend, are you still OK to do this?

## 3.3 University of Groningen, Netherland

Barend, where you planning to do this one as well?

## 3.4 Technical University of Ostrava, Czech Republic

Petr, are you still OK to do this?

## 3.5 EDINA, UK

Conor, are you still OK to do this? Or can you recommend one of your former colleagues at EDINA?

## 3.6 CSIR, South Africa

Antony, are you still OK to do this?

## 3.x

Anybody else? I think there was an SDI at a university in Brazil/Latin America?

# 4. The Academic SDI

## 4.1 Enterprise viewpoint of the Academic SDI

The purpose of the Academic SDI is to make geospatial data produced for research and education and from research and education discoverable, accessible and usable within universities and research institutes. Where possible, the Academic SDI should draw on other SDIs, e.g. by harvesting metadata from a national SDI.

Figure 2 shows the specializations of the SDI stakeholders, based on the descriptions of SDI implementations in the previous section (the current figure shows results from the Helsinki Commission Meeting… we may have to adjust/refine/expand the diagram based on the descriptions in section 3… ). The stakeholders and their roles are described in Table 3.

|  |
| --- |
| **Figure 2.** Stakeholders in the Academic SDI  |

**Table 3.** Academic SDI stakeholders

|  |  |
| --- | --- |
| **Stakeholder** | **Description** |
| **Policy Maker** |
| Funder  |  |
| Organization |  |
| ExternalLegislator |  |
| **Producers** |
| Educator.ClassLecturer |  |
| Educator.ResearchSupervisor |  |
| Student.ClassParticipant |  |
| Student.ResearchStudent |  |
| Researcher |  |
| ExternalProducer |  |
| **Provider**  |
| Data Provider |  |
| Service Provider |  |
| **Broker** |
| Broker |  |
| **VAR** |
| VAR |  |
| **End User** |
| EducatorUser |  |
| StudentUser |  |
| ResearcherUser |  |
| ExternalUser |  |

# 5. Discussion

This section will be written based on what we see in section 4.

# 6. Conclusion

This article presented a first description of an SDI for universities and research institutes, the Academic SDI, based on the formal model of an SDI developed by the ICA Commission on SDIs and Standards. The Academic SDI is based on SDI implementations at a number of universities and research institutes. It identifies important stakeholders and information requirements for an SDI at a university or research institute, specifically where these are different from SDIs in the public sector.

Explain how an academic SDI is different from other (national) SDIs…

The results contribute to understanding information requirements and important role players that need to be involved for a successful SDI implementation at universities and research institutes.

# Acknowledgements

To be done…

# References

Cooper, A.K. et al., 2012. A spatial data infrastructure model from the computational viewpoint. *International Journal of Geographical Information Science*, 27(6), pp.1133–1151.

Cooper, A.K. et al., 2011. Extending the formal model of a spatial data infrastructure to include volunteered geographical information. In *25th International Cartograhic Conference (ICC)*. Paris, France, p. 10 pages.

Hjelmager, J. et al., 2008. An initial formal model for spatial data infrastructures. *International Journal of Geographical Information Science*, 22(11–12), pp.1295–1309.

ISO/IEC 10746-1:1998, *Information technology — Open Distributed Processing — Reference model: Overview*, Geneva, Switzerland: International Organization for Standardization.