Developing geographic information infrastructures

The role of information policies

Bastiaan van Loenen

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Contents

Acknowledgements

There you are, December 1999, with your suitcase on Amsterdam International Airport after 16 months Maine. Now what? In a year and a half I learned that open access to government information is essential for a democracy. Nevertheless the Europeans obstinately continued to keep their cost-recovery policies. Against their own interests, I thought then, and "I will educate and persuade them". However, after a 5-year period for this PhD research, it appears that the differences between the United States and Europe are not as large as I had suspected and that the Europeans have valid reasons for their policy.

Without the help of the forty interviewees I would not have been able to come to such a conclusion. Their input is greatly appreciated. I also would like to thank Harlan Onsrud for his inspiring manner of instructing and discussing the accessibility subject. His inspiration was one of the causes of absorbing this subject. I also highly appreciated the opportunity Jitske de Jong provided me to start a PhD project at her research group. Her encouraging comments have been very helpful and motivating especially in the final stages of the project. Further, thanks must go to Jaap Zevenbergen. Like a true advisor, he provided me with the usual feedback, but was able to keep the spirit for my research high. Also Bas Kok has played an important role in the last 5 years. His sharp view on the development of GIIs and particularly the Dutch and European GII has helped me significantly in improving my understanding of the complex matter of GIIs. The outcomes of our discussions have contributed and will contribute to the increased understanding of how to promote GII development. I also thank Augustine Mulolwa. As a Zambian, he made me realise that GIIs are a relative luxuriously phenomenon compared with issues and situations in other parts of the world where people struggle to feed themselves and where people have to cope an inferior quality of infrastructures such as roads, electricity and water. Further, Augustine's GII expertise was very welcome together with his warm personality. Of course, the other colleagues in Delft should be mentioned here. They made my PhD journey very enjoyable and they are cordially thanked for providing me with needed information, joy and for listening to my frustrations in whatever field :-).

Finally, I thank my family, which makes me realise every day that one works to live. A wonderful thought for someone who can lose himself in small attempts to improve the world.

1 Introduction

The availability of information in information societies is a key issue that affects the entire society's well-being. In the information age access to information has become of vital importance to the economic and social development of the nation. "The foundation of the information society is informationalism, which means that the defining activities in all realms of human practice are based on information technology, organized (globally) in information networks, and centred around information (symbol) processing" (Castells and Himanen, 2002, p. 1). Information technology has increased the availability and access to information. It allows us to access and share information in a relatively unfettered fashion across digital networks, ignoring jurisdictional borders.

The infrastructure underlying the foundation of an information society can be referred to as the information infrastructure, which is defined as the combination of computer and communication systems that serve as the underlying infrastructure for organizations, industries, and the economy (NRC, 1999a). Since the information infrastructure provides the foundation of an information society, the development of this infrastructure and the way it functions are critical for society. An adequate information infrastructure allows for information to be collected efficiently (collect it once, use it many times) and provides reliable information for effective use in decision-making processes at all levels.

A geographic information infrastructure (GII) represents a special type of information infrastructure. They are special because they contain information about particular locations on the Earth; for example, they may show the location of schools in a town. Geographic information is special in that it refers to a location on the earth. This reference gives information extra value. However, adding a geographic component to information requires qualified human expertise and equipment, which makes the collection and processing of geographic information more expensive than other types of information. A GII facilitates availability and access to geographic information for all levels of government, the commercial sector, the non-profit sector, academia, and ordinary citizens (see Onsrud, 1998b). It includes the policies, organizational remits, information, technologies, standards, delivery mechanisms, and financial and human resources necessary to ensure that those working at the local, national, regional, or global levels are not impeded in meeting their objectives (GSDI, 1997).

Like differences in socio-economic development, countries may also have differing levels of GII development. To promote GII development, it is possible to follow various strategies, focusing on one, all, or an appropriate combination of GII components. But policy makers need to understand that the best policies for developing GII should be oriented towards satisfying the requirements of users rather than stressing introduction of the latest technologies or collection of high-quality information (see also Borgman, 2000, p. xi; McLaughlin and Nichols, 1994, p. 72; Masser, 1999, p. 81; and STIA, 2001, pp. 8-3/8/9). With respect to meeting user requirements, questions of access to (public) information are likely to be critical factors (see, for example, Borgman, 2000, p. x; Masser, 1999, p. 81; Tosta, 1999, p. 23). Therefore, it should be understood that in the context of a GII, access to government information policies are important for the availability and successful use of the information as well as for the success of the GII itself. However, we can only discuss the mechanisms that enable access to public information if public sector information exists: it must have been collected, processed, and maintained.

Government has an important role in GII development: it is both provider and user of geographic information, and in many instances government agencies lead GII development. This is especially true for the government's role as provider of geographic information. It can decide what information is collected, and through its access policies, it can also determine the extent to which a dataset can be used.

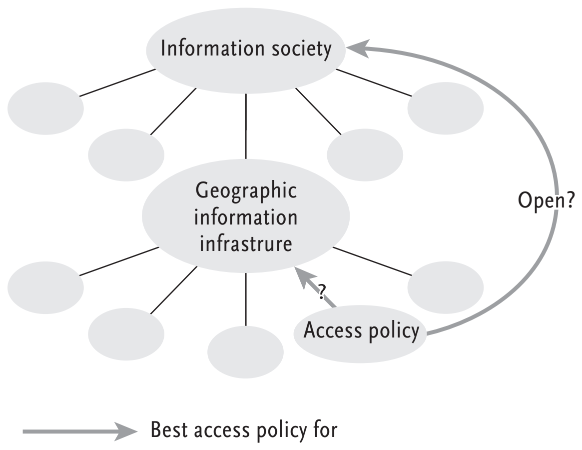
Two access doctrines are dominant in the literature: open access policies and cost recovery policies. The open access approach assumes that government information is available for a price that does not exceed the cost of reproduction and distribution, with as few restrictions on use as possible. In the cost recovery approach, the price of government information covers the cost of development and dissemination at least, and may also include a return on investment. Use of the information is restricted, and government may even choose exclusive arrangements.

1.1 Which access policy most closely meets user requirements?

Many researchers have compared open access policies to the cost recovery model (Van Loenen and Onsrud, 2004; Weiss and Pluijmers, 2002; KPMG, 2001; K+V, 2001; Berenschot and NEI, 2001; Rhind, 1992; Rhind, 2001; Pira et al., 2000; Hernandez et al., 1999; Ravi bedrijvenplatform, 2000; Ravi, 1999; Lopez, 1998; Coopers Lybrand, 1996; Onsrud et al., 1996; Johnson and Onsrud, 1995; and others). Most studies compare the open information policies of the US federal government to the restrictive policies of European countries and conclude that the open access policies of the US federal government should be implemented in other countries because they may lead to significant macroeconomic benefits (see Pluijmers and Weiss, 2002; KPMG, 2001; Pira et al., 2000; Lopez, 1998).

The researchers do not, however, provide any guidelines about how countries which currently recover costs through selling information can adopt open access policies. This may explain why so few countries have changed their cost recovery policies for public sector information to open access policies, despite the recommendations. For example, although general government information policy in the European Union and the Netherlands encourages government organisations to adopt open access policies, certain public

Figure 1.1 The most appropriate access policy for GII development has not been determined



sector bodies are exempt because: (a) they partly depend on the income from selling information resources to finance their operations (Van Boxtel, 2002), or (b) are given the means to continue their cost recovery policies (EU, 2003). The reluctance to convert to open public information policies may be owing to the absence of guarantees that the public sector information supplier will be compensated for the expected loss of income when cost recovery policies are converted to open ones. The potential loss of income for public sector organisations responsible for providing geographic information needs to be addressed by other means of support. If such means are uncertain or not available, the public sector entity may be forced to collect less comprehensive datasets with lower frequencies; the existence of datasets currently available can no longer be guaranteed (see Van Loenen et al., 2005). Provided that a GII builds on certain datasets with sustainable qualities, open access policies may be counter-productive for the development of a GII and information society (Van Loenen, 2005b), (see also Figure 1.1).

Further, research on government access policy has not (or has only briefly) addressed the impact the transformation of cost recovery policies to (open) information policies may have on the quality of a dataset. Research on access policy has rarely taken into account the GII development perspective itself, and most researchers ignore differences in scale both among the datasets and the economies, nor do they indicate differences between specific user groups, making the research less useful than currently believed.

Although the importance of access policies in the development of a GII is commonly understood, few research exists that links the success of access policies to this development. Consequently, the question of "which funding model allows ready access to high-quality data[1], low-cost geographic infor-

1 High-quality data may be referred to as sufficient for intended purposes.

mation that is necessary to advance GII development" (Lopez, 1998, p. 97) remains unanswered in current research results. The debate about which is the best access policy to advance a national GII remains unresolved. Thus, policy-makers who struggle over which strategy to use for GII development have no definitive answer about the appropriate access policy for promoting use of geographic information. They remain equally without advice about how to develop the GII so that it can fulfil the infrastructural function it is expected to in the information society.

Crucial to developing a GII is an understanding of the role information policies may have on information quality in general and on the GII itself. This study will add those perspectives to the current research results and, if necessary, provide guidelines for changing current policies to more beneficial access policies.

1.2 Research question

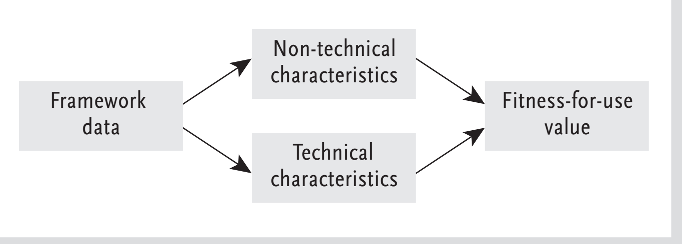
This research is centred on the following question: *What role do access policies play in the development of a geographic information infrastructure (GII)?*

The three objectives of the research are:
1. to develop a model that describes the different stages of development in geographic information infrastructures;
2. to provide a framework for researching access to geographic framework information policies in the context of the development of geographic information infrastructures, accounting for the level of development of such infrastructure; and
3. to assess the impact of access policies on the characteristics and use of large-scale geographic framework datasets.

First we develop a model that describes the different stages of development for geographic information infrastructures. In the development of this model we focus on three perspectives: (1) institutional, (2) technical data characteristics (data quality), and (3) non-technical data characteristics (price, use restrictions, delivery mechanism, and others).

Second we outline a framework for researching access to large-scale geographic framework information policies in the context of the development of geographic information infrastructures. This framework accounts for the level of development of such an infrastructure. Together, the GII development model and the access policy research framework will help us assess the impact of access policies on the characteristics and use of large-scale geographic framework information, as well as their impact on GII development. This may allow for judging the effectiveness of access to information policies.

Figure 1.2 Use of framework data is determined by both technical and non-technical data characteristics



1.3 Hypotheses

The study examines four hypotheses concerning the role of access policies in the development of a GII.

Hypothesis 1: *The extent to which a dataset is used is determined by both the technical and non-technical characteristics of the dataset.*

The extent to which a GII's framework datasets are used is one way to assess its development. This study hypotheses that both the technical characteristics of a dataset and the non-technical data characteristics decide the extent to which a framework dataset may be used; its fitness-for-use value (see Figure 1.2). This hypothesis is the basis for the research framework developed for assessing access policies from the perspective of a GII.

Hypothesis 2: *The technical characteristics of a dataset and its access policies are balanced: excellent technical characteristics are accompanied by datasets with restrictive access policies, while poor technical data characteristics are accompanied by datasets with open access policies.*

The second hypothesis addresses the potential relation between dataset policy and its technical characteristics. It assumes that the information policy is decisive for the technical characteristics of the dataset. Figure 1.3 shows the hypothesized relation between access policy and data characteristics.

The open access policies of the US federal government are often pointed to as the reason why open access policies should apply to government information. Figure 1.4, which shows the most current Digital Orthophoto Quadrangles (DOQ) for the location of the Twin Towers, suggests that the open access policies of the US federal mapping agency (USGS) is known to contain poor information (see also NRC, 2003, p. 1; cf. Figure 1.5). In addition, the experiences of academics in the US suggest that access policies become more restrictive as the level of detail of the information increases (see Van Loenen, 2002b). Moreover, the results of a GITA survey acknowledge that the cost recovery policies of the UK Ordnance Survey are justified by the quality of its products, which "far exceed the quality, in terms of accuracy and timeliness, of most products given away in the United States" (GITA, 2005; see also Lopez, 1998, p. 79).

Figure 1.3 The relation between data characteristics and access policy

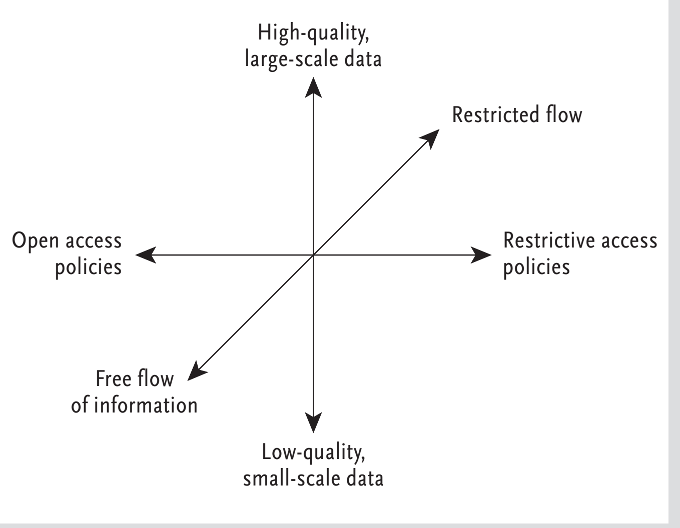
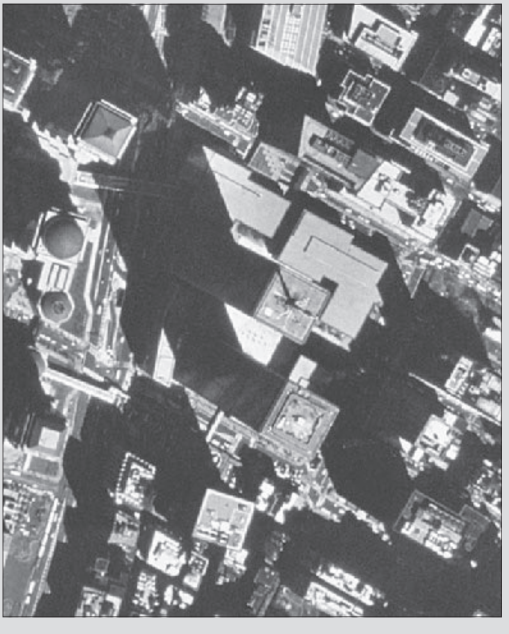


Figure 1.4 Manhattan, NY (Twin Towers)



Source: USGS, 4/8/1994

Figure 1.5 Manhattan, NY (no Twin Towers)

Source: USGS, March 2002

The hypothesis seeks conformation with economic theory stating that quality of information is related to the price and use restrictions of information. Therefore, it is assumed that the differences in technical data characteristics may account for the existence of different access policies among the jurisdictions of Europe and those in the US. Hypotheses three and four are closely related and are discussed together.

Hypothesis 3: *The stage of development for the components of the 'GII framework dataset maturity matrix' is decisive for the most appropriate access policy for framework datasets.*

This hypothesis links the most beneficial access policy to the development of a GII. It is assumed that in its initial stages the most appropriate access policy for GII development may be different from the most beneficial access policy for GIIs in more advanced stages of development.

Hypothesis 4: *At an advanced level of GII development only a policy of open access to public information enhances further GII development.*

This is more specific than the third hypothesis, as it assumes that for large-scale geographic framework information with advanced technical characteristics, *only* open access policies can enhance the further development of the GII, because cost recovery policies would be counter-productive. Thus, from the perspective of a GII, we hypothesize that in an advanced stage of GII development access to high quality large-scale framework information should be provided through open policies.

1.4 Research design

The research design addresses the three research objectives. Here we explain how the research is accomplished for each objective.

1.4.1 Developing a model that describes the different stages of development for geographic information infrastructures

The GII as such is a relatively new concept whose definition, objectives, and strategies have been extensively discussed at all levels. Significant focus and progress have been achieved especially in the technological GII. However, few (scientific) researchers have attempted to investigate the success of a GII or to model GII development from, for example, an institutional perspective. Moreover, the technological advances have not been assessed from the perspective of GII development, which is also true for the non-technical aspects such as access policies.

The development of a GII is extremely complex, and research on this has only recently begun to emerge (see Delgado et al., 2005; Kok and Van Loenen, 2005; Crompvoets et al., 2004; Steudler, 2003). A general model explaining the development of a GII is, however, unavailable. Although access policies are assumed to be critical for the development of a GII, it has neither been ascertained nor confirmed by research. It may well be that aspects other than access policies are equally important (or more so) for the development of a GII. While these other factors are unknown, they may be related to both the GII and the access policy.

Since the research aimed at linking the most appropriate access policy to a certain stage of GII development, we started to develop a draft model for such development. The GII maturity matrix is comprised of an institutional component, as well as technical and non-technical components. First, we examined it from the institutional perspective, developing a model from studying the available literature and the practical experiences of GII developers in the Netherlands and the US. The available literature was also used to extend the model from the technical and non-technical perspectives. Together, the institutional, technical, and non-technical GII models comprise the GII maturity matrix..

1.4.2 Creating a research framework for assessing access policies for GIIs

In the field of geographic information infrastructures, many researchers have focused on the most beneficial access policies for a specific jurisdiction. These studies focus on access policy and its relation to the use of the information. The present research, however, assumes that the technical characteristics of a dataset as well as the non-technical characteristics may be essential for a proper understanding of appropriate access policy.

Up to now there has been no comprehensive research framework for assessing the success of access policies when developing a GII. This study outlines a research model to account for all aspects of the dataset important for an understanding of the logic behind a dataset's access policy and its relation to information quality, use, and the satisfaction of the user. A draft of the framework was presented at the GI days in Münster (Van Loenen, 2003b), and we included feedback from this event in the final research model. The model is based on the hypothesis that both the technical characteristics of a dataset and the non-technical characteristics influence the extent to which a dataset is used.

1.4.2 Assessing the impact of access policies for the technical characteristics and use of geographic framework datasets

To assess the impact of access policies on the technical characteristics and use of a (framework) dataset, the research uses a multiple case study design. The case studies also allowed for acquisition of additional information to develop the GII maturity matrix.

By definition, a multiple case study design must include more than one case. By selecting five jurisdictions with a similar level of socio-economic development but with varying access policies for similar information, the research aimed to employ 'replication' logic. Each case was carefully selected so that it would either: (a) predict similar results (a literal replication) or (b) produce contrasting results but for predictable reasons (a theoretical replication) (Yin, 1994, p. 46).

Initially, the case studies were selected for the extent to which they were similar to the Netherlands with respect to: (a) level of socio-economic development, (b) size of the jurisdiction, (c) population density, and (d) government type. By selecting maximum variance in the unit of analysis for access policies for large-scale geographic framework information, the study aimed to show both literal and theoretical replication. Five jurisdictions were included in the research: (1) the Netherlands, (2) Denmark, (3) the German state of Northrhine Westphalia, (4) the US state of Massachusetts, and (5) the US Metropolitan region of Minneapolis-St. Paul.

1.5 Scope of the research

This research focuses on geographic information infrastructures (GIIs), which may also be called spatial data infrastructure, geospatial data infrastructure, geographic data infrastructure, or spatial information infrastructure (see, for example, Masser, 1999). Various terminology has been used to identify the same phenomenon. Although these names may seem interchangeable, a geographic information infrastructure suggests that it has a different scope than, for example a spatial data infrastructure.

First, spatial information may include any space, not only space on the Earth's surface (Longley, 2001, p. 5). It can include 3D images of the human body for medical purposes, information on the design of a car, and information about the position of the moon and the stars.

Geographic information can be a subset of spatial information for the Earth's surface and near surface (Longley, 2001, p. 5). Longley provides an identical description for geospatial information (Longley, 2001, p. 5), arguing that there is no real distinction between geographic and geospatial. Since the word 'geospatial' can be confusing, 'geographic' is the preferred term. In most GII initiatives information that is linked to the Earth's near surface is central. It applies to topographic information (both 2D and 3D), ortho-imagery, administrative boundaries, parcel information, administrative information, and most other datasets.

Second, the terminology for GII may include either data or information. The International Standards Organization (ISO) defines data as: "A representation of facts, concepts or instructions in a formalized manner suitable for communication, interpretation or processing by human beings or by automatic means" (ISO 2382/1 01.01.01). Information is defined as: "the meaning that a human being assigns to data by means of the convention applied to that data" (ISO 2382/1 01.01.02). In a geographic context, it can be argued that data are the bits and bytes without meaning or context. These bits or bytes are transformed to information through the data processing system using a data model. When the data model is applied to the data results in a specific context (map of Amsterdam), they become meaningful (e.g., green areas correspond with a forest). The data model enables interpretation of the facts as well as providing meaning, which is then considered real information. Data can be considered information when *someone* recognises it as such (Couclelis, 1998, p. 211). Thus, the value of the information can vary among people. The location of a river (data) to a tourist may represent a place to swim (information 1) or to an energy company, a source of hydro energy (information 2). Anyone unfamiliar with the concept of 'the location of a river' (not knowing what a river is, for example) cannot interpret this information: for them it remains data (meaningless information).

This research uses the terminology geographic information infrastructure because it is considered the most appropriate term for the phenomenon researched.

The focus of this research is on large-scale geographic framework datasets (to a scale of approximately 1:1,000) in densely populated areas. The scale of a dataset, its technical characteristics, and type are among the factors that determine the cost of data collection, which can vary significantly. A 1:1,000 dataset with comprehensive content for a complete jurisdiction is expensive compared to a 1:1,000,000 dataset that covers only one type of data for a sub-jurisdiction. This applies specifically to framework datasets, which are the core of the GII. They may be defined as datasets commonly used as a base dataset upon which other datasets can be placed (Phillips et al. 1999), datasets that are commonly referred to, or datasets that provide sufficient reference for most geo-located information (Luzet et al., 2000). Although framework datasets are costly to collect and maintain, their existence benefits many organisations. Thematic datasets build on the framework dataset. They are not as expensive to create, but benefit relatively few organisations.

Scale, technical data characteristics, and type of dataset are rarely addressed in either research or discussions of access to government geographic information. Conclusions from past research have been used as general statements about the success of a policy. Policies that may have been successful for one range of scales, however, do not necessarily apply to other ranges of scale.

This research focuses on the cadastral dataset and large-scale topographic datasets for four reasons:

1. Parcel and large-scale topographic information are considered important for local levels of GII (see, for example, Rajabifard et al., 2000);
2. As a framework layer for the local levels of GII, the high level of detail in the information can be used as the basis for other hierarchal levels of GIIs;
3. These datasets are relatively expensive to collect, process, and maintain; but
4. They have barely been addressed in research assessing the success of access policies.

Moreover, the research focuses exclusively on digital geographic information in vector format. Although geo-referenced imagery may be sufficient to locate particular objects and for other uses, more advanced applications such as geographic analyses require digital geographic information in vector format. More specifically, for raster data, Micus recommends transitioning to vector data to achieve a factual data reference (Micus, 2001, pp. 22-25).

Our analysis also assumes that jurisdictions of comparable geographic size and population density have similar needs for geographic framework datasets. Therefore, the focus of the research in the case studies is on jurisdictions comparable to the Netherlands in geography. It is assumed that for large-scale geographic information a value-added market potentially exists. It is further assumed that an information product is only viable if a certain critical mass can be reached. This mass is assumed to be at the level of the complete jurisdiction rather than at sub-jurisdictional levels such as a single town.

In assessing access policies and technical data characteristics, the research has not reviewed the budgets available for data acquisition and provision.

1.6 Research outcomes

Our research outcomes confirm the general belief that access policies are critical for GII development. Further, the research provides detailed information on GII development in five areas. Moreover, the research also includes new knowledge about the success and stages of development for each GII, which may be relevant for those involved in developing GIIs.

Since the starting point of the research is the Netherlands, we have prioritised it to provide GII developers in the Netherlands with guidelines for further developing the Netherlands' Geographic Information Infrastructure (NGII). In addition, the research provides policy makers in the jurisdictions investigated with guidelines to further develop their own GIIs. Finally, the research has much broader significance than only the five researched jurisdictions; it provides other jurisdictions the means to adopt an appropriate policy for GII development.

1.7 Reading guide

This dissertation is comprised of four major parts (see also Figure 1.6). The first part, chapter 2, provides background information on GIIs. In chapter 2 we introduce concepts relating to a geographic information infrastructure. A wide variety of definitions, objectives, and strategies are described and analysed.

Chapter 3, 4, 5, and 6, which comprise the second part, address the first objective: building the GII maturity matrix. Chapter 3, the institutional context of a GII, discusses the institutional elements of the GII and provides the institutional building blocks for the GII maturity matrix. Chapter 4 provides a first draft of GII development focusing on technical dataset characteristics. The inclusion of the non-technical GII characteristics in the matrix (chapter 5) completes the GII maturity matrix. The maturity matrix, its components, and the interactions among the various components, are explained in chapter 6.

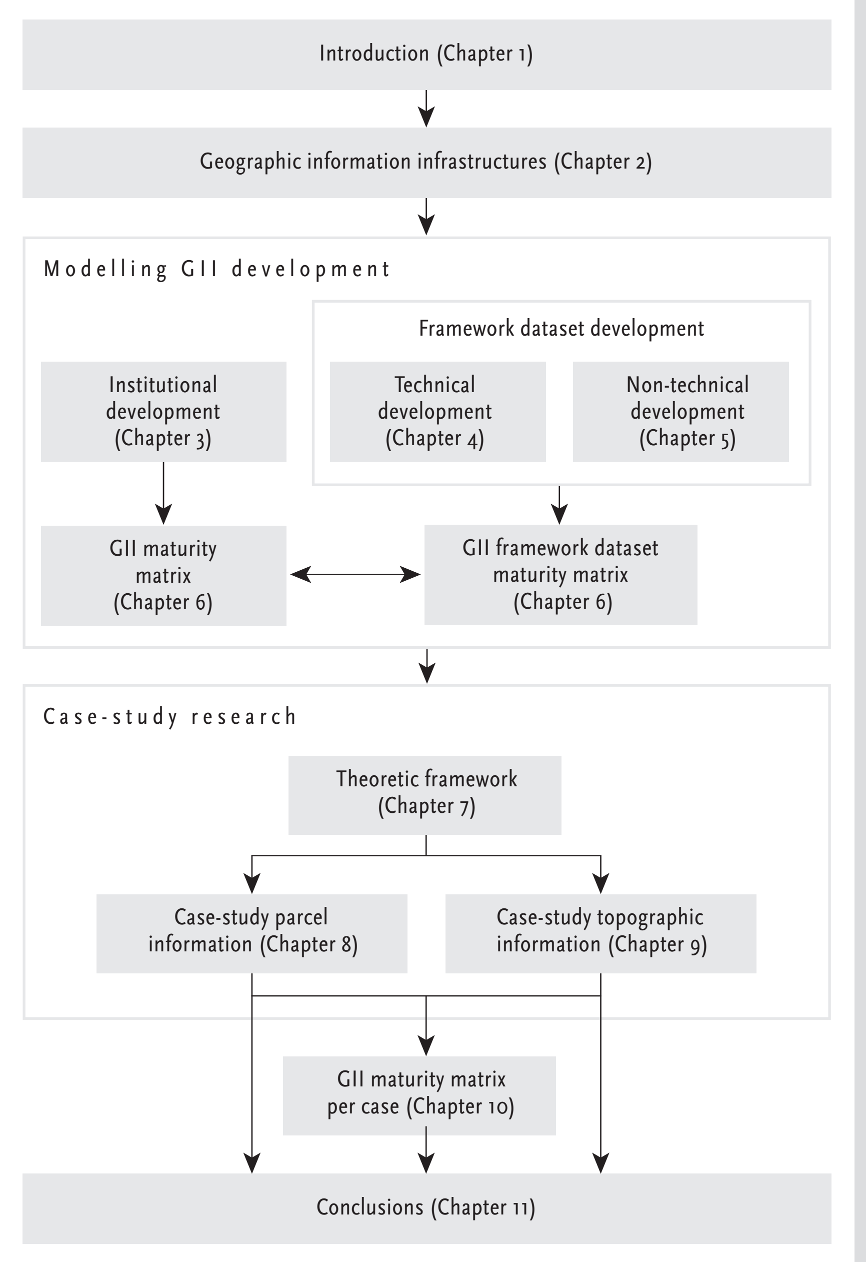
The third part, chapter 7, 8, 9, and 10 contains the case study research. Chapter 7 provides the justification for the research choices and explains the framework used for researching information policies. This framework guided the case studies. Chapters 8 and 9 present case study findings for parcel information and large-scale topographic information, respectively. Chapter 10 synthesizes the findings of the case studies with the draft maturity matrix of chapter 6. The GIIs in the case studies are analysed and GII maturity is assessed for each case.

Chapter 11, comprising the fourth part, presents the most significant findings and proposes ways to address information policy issues to promote GII development, and ultimately, society. Finally, a glossary is provided to explain the acronyms used in this research.

Chapter 2 is especially useful for obtaining general information about GIIs.

Chapter 3 is valuable for learning about institutional aspects in the development of a GII. Chapter 4 elaborates on development from a technical, information quality perspective, and Chapter 5 focuses on the non-technical, information policy aspects of GII development. Chapter 6 provides a quick overview of the GII maturity matrix, as it summarizes chapters 3 through 5. Those interested or involved in researching access policies will probably be interested in chapter 7. Finally, chapters 8, 9, and 10 may be of special interest to anyone involved in or occupied with parcel information, topographical information, or GII development in Denmark, the Netherlands, Northrhine Westphalia, the Metropolitan region of Minneapolis-St. Paul, or Massachusetts.

Figure 1.6 Reading guide



2 Geographic information infrastructures

2.1 Introduction

This chapter focuses on the geographic information infrastructure. It will first address the general concepts of infrastructure and information infrastructures to provide the context in which GIIs operate. Further, it provides, analyses and categorises the variety of definitions and objectives of GIIs. The analysis and categorisation follows and builds on available analyses and categorisations of the GII theory primarily developed at Melbourne University. Further, the core components of GIIs are provided and discussed. This chapter provides in-depth information on GII initiatives, the differences and commonalities, and current level of development of GII theory. People familiar with GII concepts and theory are recommended to start reading chapter 3.

2.2 What is an (information) infrastructure?

The term information infrastructure or global information infrastructure are commonly used without explanation what exactly is meant by the term. Many think of an infrastructure in terms of its physical features, like the definition in the Webster dictionary: “Infrastructures are the basic facilities, services, and installations needed for the functioning of a community or society, such as transportation and communications systems, water and power lines, and public institutions including schools, post offices, and prisons” (website Webster). Robert Pepper of the US Federal Communications Commission, however, explains that infrastructure contents more than just the physical features such as roads (in Coleman and McLaughlin, 1997): “When we talk about infrastructure, we tend to think about wires - hardware. Infrastructure is far more than that. It is people, it is laws, it is the education to be able to use systems. If you think about the highway system, we tend to think about bridges and interstates, but the infrastructure also includes the highway laws, drivers’ licenses, McDonalds along the roadside, gas stations, the people who cut the grass along the highways, and all of those support systems. You cannot talk about infrastructure in the telecom-information sector without also talking about the human support systems.” For a qualification of infrastructure as both a social and technical construct, Star and Ruhleder (1996, p. 113) found eight dimensions that form an infrastructure (cited in Borgman, 2000, p. 19):

> “An infrastructure is embedded in other structures, social arrangements, and technologies. It is transparent, in that it invisibly supports tasks. Its reach or scope may be spatial or temporal, in that it reaches beyond a single event or one-site practice. Infrastructure is learned as part of membership of an organisation or group. It is linked with conventions of practice of day-to-day work. Infrastructure is the embodiment of stand-

> ards, so that other tools and infrastructures can interconnect in a standardized way. It builds upon an installed base, inheriting both strengths and limitations of that base. And infrastructure becomes visible upon break-down, in that we are most aware of it when it fails to work- when the server is down. The electrical power grid fails, or the highway bridge collapse."

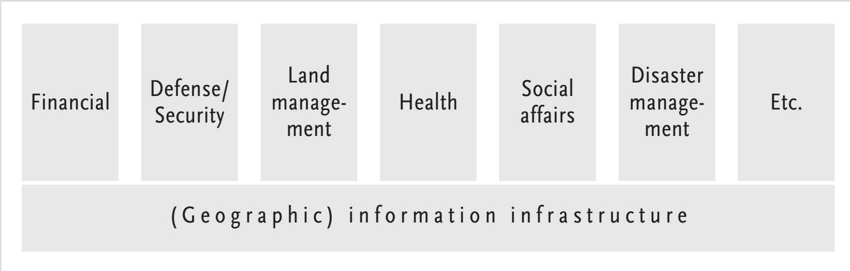
Beyond these components, Kelley (1993) believes 'infrastructure' shares the following characteristics with information: (a) it exists to support other economic or social activities, not as an end in itself; (b) it incurs a relatively high initial capital cost; and (c) it has a relatively long life. Therefore it requires long-term management and commitment of funds. A wide variety of infrastructures exist: telecommunications, energy, banking and finances, national security, health, transportation, water management, among others. Borgman (2000) argues that in the past these were operating in a relatively independent manner. Information technologies have allowed the linkages of these infrastructures making them interdependent, and "thus all information technologies could be considered parts of an information infrastructure" (Borgman, 2000, p. 21). In addition, the information infrastructure is the core infrastructure for sectoral information infrastructures such as a national health information infrastructure (see, for example, National Committee on Vital and Health Statistics, 2000), environment information infrastructure (see Saarenma et al., 2002), and the transportation information infrastructure (see TRB, 2004). Figure 2.1 shows this relationship graphically.

The term 'national information infrastructure (NII)' was popularised in the mid-1990s by US Vice-President Al Gore. Many people, in and beyond the US, prefer the term 'global information infrastructure' (GII), in order to emphasise the interconnectedness of the network, of countries and of people (website Roger Clarke).

In the literature the definition of an NII has developed from a technical focus, similar to: "The various media, carriers and even physical infrastructure used for information delivery" (Branscomb, 1982). Another technical definition is "A multidimensional phenomenon, a turbulent and controversial mix of public policy, corporate strategies, hardware and software that shapes the way consumers and citizens use information and communications" (Wilson III, 1997, p. 4). A comprehensive definition including information content and people is: "a technical framework of computing and communications technologies, information content, services, people, all of which interact in complex and often unpredictable ways" (Borgman, 2000, p. 30).

The information infrastructure will at least bring us what we already have, but in ways that are better, faster and cheaper (King and Kraemer, 1995, p. 14). It will promote economic development and make countries highly competitive. One of the most significant benefits of an Information Infrastructure is

Figure 2.1 An (geographic) information infrastructure as foundation for other infrastructures



that it promotes the minimisation of duplicate information collection. "By facilitating information sharing and to allow for information integration, the value of existing information resources is maximised. The time, effort and resources previously spent on the collection of the same or similar information may now be used to collect new information or to create new innovative products. By reducing duplication and facilitating integration and development of new and innovative applications, [information infrastructures] can produce significant human and resource savings and returns" (after Chan et al., 2001, p. 65). In addition, information infrastructures may allow users of (geographic) information to respond more effective to demands from society, for example, through 24/7 available services (see King and Kraemer, 1995, p. 14).

Within the information infrastructure, geographic information may be considered a special type of information. This speciality has resulted in the emerging of geographic information infrastructures as part of or independent of information infrastructures.

2.3 Geographic information is special

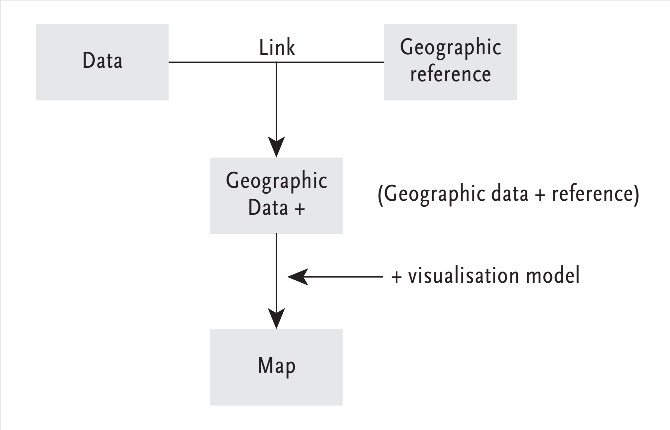
Geographic information is special in that it refers to a location on the earth, in one way or another. "Geographic data link place, time, and attributes. Some attributes are physical or environmental in nature, while others are social or economic" (Longley, 2001, pp. 64-65). Other (physical) infrastructures may benefit from linkage to the GII, for example the health care infrastructure, the broadcasting infrastructure, the administrative financial infrastructure, the military infrastructure, the traffic infrastructure, and many other infrastructures. The linkage of information to the earth gives information extra value, but adding a geographical component to information is also a costly process.

2.3.1 Value of geographic information

The value of information increases when it is linked to the Earth. It makes the object or subject easy to identify, and as a result easy to reach. The need for geographic information is evident since long. Maps, for example, have throughout the centuries been strategically important especially for navigation purposes. Also in the American revolution, it was Thomas Jefferson who wanted to know everything by location to find the best strategy to cope with the native Americans (Wood, 1997). For political purposes, we need to know where what is. In the past a simple map was sufficient. With the increasing complexity in today's world the complexity of mapping also increases. Not only do we want to know more, we also want to know it more precise, more up-to-date and presented in a user-friendly way so that also laymen may understand it and use it. There is always a need to have access to answers to questions like where am I, where are you, and what is where? These questions can be linked to property issues, situations of war, criminality, economic development, health, geographic planning, disaster management, and many more. Moreover, modern technology allows for information searches and analyses by geographic unit, making it extremely useful for geographic management and planning, for example disaster management purposes. In addition, both public (execution of policies) and private sector (profiling) linking a geographic element to the attribute may address the specific needs of the people in a geographic area more properly (see Rogers, 1993, p. 12). Longley (2001, p. 6) argues that "Almost all human activities and decisions involve a geographic component, and the geographic component is important". An example shows what value geographic information adds to normal information. Imagine a situation of Mr X. His income is €100,000, end of the story: we cannot approach him physically and exploit the information. The linkage of an address to Mr. X allows the public tax office to send a tax form to his address, and the salesman of Mercedes-Benz a folder of its latest models. He has now become more than his name; an asset that is easy to reach. When we include his attributes in a database with all inhabitants of area Y, we can map the income distribution, the distribution of sexes, or the distribution of people with a Mercedes-Benz. Another example is in health care: the knowledge that there is a relation between the characteristics of people and the likelihood for a disease is extremely valuable (see, for example, Snow, 1855). The location of these specific people helps to find them and cure or prevent the disease. These examples can be applied to many more human activities and decisions. It is not surprising that a Dutch study found that of all government information, geographic information is commercially the most interesting (BDO, 1998, p. x). Thus, geographic information may be considered more valuable than just information.

However, geographic information is "highly disparate and often inextricably linked to the provision of other public goods" (Coopers Lybrand, 1996). The real value of geographic information for society is difficult to assess, and therefore the economic value is often underestimated (OXERA, 1999, p. 3).

Figure 2.2 From data to a map



2.3.2 Cost involved in building geographic datasets

Geographic information is also special because of the high cost involved in building geographic datasets (Van Loenen, 2003a; see also Longley, 2001, p. 6). Unlike many other types of information, the collection, maintenance, and publication of geographic information requires qualified human expertise and equipment to process, manage and use it. Moreover, to create geographic products or services out of geographic information typically requires advanced human and computer skills. The information itself needs to be collected to become part of the infrastructure, it needs technology for its transfer, and it needs technology for its presentation and interpretation. We have to decide which visualisation model to use for the visual representation of the information: which scale, which colours for what attribute, and which features to show (see Figure 2.2).

Especially the technical aspects involved in the creation of a map require advanced expertise. For instance, geographic information is multidimensional (x,y), voluminous (large databases), and represent a 3D world on a flat (2D) surface (Longley, 2001, p. 6). Further, to integrate and analyse the many varied types may be time-consuming, and the process of updating is complex (Longley, 2001, p. 6). Moreover, services are needed to make geographic information accessible and useful for end-users such as citizens. In addition, unlike other types of information (taxpayers information, birth of a child, property ownership transfer), geographic information does not come to the information collector. The surveyor has to go out for his survey, the aerial photo's must be flown and processed, and the GIS expert performs the digital mapping and processing for further uses. The visual representation of the real world may vary significantly due to choices in scale and quality. A neighbourhood may be mapped on any scale between, for example, 1:500 and 1:25,000. Further, we can choose to collect only information about a single street, or information about the entire city. Scale and quality of a dataset are important for the cost of creating a dataset, and its usability. In general terms, the following applies: the larger the scale (the higher the level of detail), the higher the cost, and the

Figure 2.3 Relation between scale and cost per geographic unit

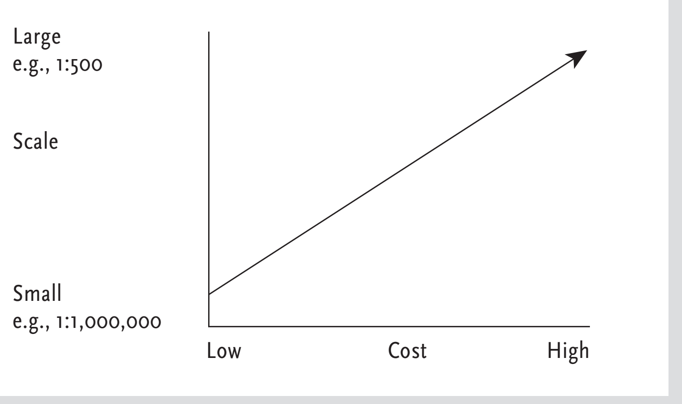
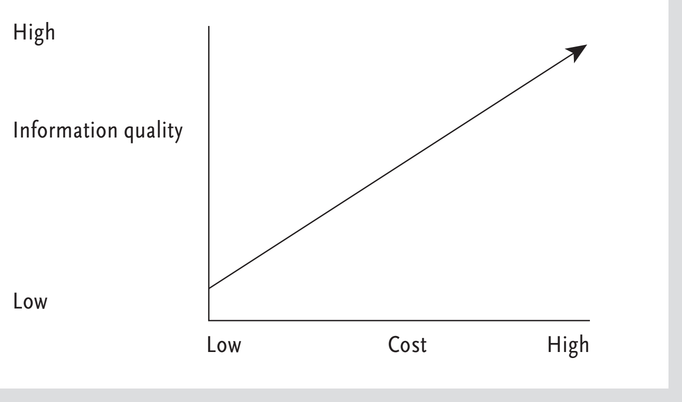


Figure 2.4 Relation between information quality and cost



higher the quality the higher the cost (see Figure 2.3 and Figure 2.4).

Creating a geographic dataset out of series remote sensing images may be illustrative for the cost involved. Remote sensing is the technique of obtaining information about the environment and the surface of the earth from a distance, for example, from aircraft or satellite (website Terralink). These images are only usable if one could interpret them. For a sufficient accurate interpretation, the remote sensing specialist selects several suitable areas with known vegetation. The reflection patterns of the remote sensing images of these specific areas are used for interpretation of the other images. The costs of the remote sensing camera, satellite or aircraft are relatively high. Also the required expertise for interpreting the images, and necessary use of heavy computer power for automated processing make the collection and processing for these images relatively costly.

Moore' s Law rules that computer processing power may double every 18 months, which may lead to less costs. However, faster technology also allows for new applications and generates new user expectations requiring more computer power. Similarly new technology, such as laser altimetry that were initially considered too expensive and technologically too demanding are now increasingly used.

The question that rises in such a context of valuable, but costly to obtain, geographic information is how to fund its collection, processing, and dissemination. How may one use scarce (public) resources for the provision of needed geographic information. These questions are addressed in developing GIIs.

2.4 What is a GII? Perspectives and objectives

2.4.1 Introduction

The Executive Order 12906 of the Clinton administration in the US, launched the concept of National Geographic information infrastructures in the political arena. It defines a National Geographic information infrastructure as "the technology, policies, standards, and human resources necessary to acquire, process, store, distribute, and improve utilisation of geospatial data" (Executive Order, 1994, amended by Executive Order, 2003).

The European Union (Bangemann, 1994) and many other regions and countries followed the US in developing GIIs (Masser, 2005). The definition of what a GII is and what its objectives are, however, are not without discussion. In geographic information infrastructure literature and initiatives, a wide variety of terminology, interpretations, and accordingly, definitions of a GII exist.

2.4.2 Classification of definitions of GII

Chan (et al., 2001) explored many of these definitions used in GII initiatives. He identified four different perspectives of GIIs: (1) the identificational, (2) technological, (3) organisational, and (4) productional perspective (see also McLaughlin and Nichols, 1994, p. 70). The difference between the four perspectives may especially be highlighted by the envisioned role users may play in GII development.

The identificational definition specifically justifies the investment that is needed to set up a GII. It explains the uniqueness of geographic information, rather than the GII itself. An example is found in "The European Geographic Information Infrastructure is the European policy framework creating the necessary conditions for achieving the objectives. It thus encompasses all policies, regulations, incentives, and structures set out by the EU institutions and the Member States in this pursuit" (EC, 1995). Users are not considered in this perspective.

The technological perspective describes the form and the function of a GII. An example definition may be: "The technology, standards, access systems and protocols necessary to harmonise all of Canada's geo-spatial databases, and make them available on the Internet" (CGDI, 2000). This can be regarded as a producer oriented perspective aiming at promoting access to the available sources, implicitly assuming that this is what the users need.

An organisational perspective describes the GII in terms of its building blocks. Its view is more comprehensive than the identificational and technological perspective in the sense that it includes the organisational or institutional context. The definition that fits in this organisational perspective is the definition of the US NSDI: "the technology, policies, standards, and human resources necessary to acquire, process, store, distribute, and improve utilization of geospatial data" (Executive Order, 1994). This perspective is regarding the GII as a rather static concept, addressing the user as human resource without explicitly addressing its needs.

Some initiatives have taken a hybrid perspective. For example the GSDI definition takes a technological and organisational perspective: "A geographic information infrastructure is one that encompasses the policies, organizational remits, data, technologies, standards, delivery mechanisms and financial and human resources necessary to ensure that those working at the appropriate (global, regional, national, local) scale are not impeded in meeting their objectives" (GSDI, 1997).

Finally, Chan (et al., 2001) identifies the productional perspective. This perspective describes a GII as a dynamic concept, which develops through interaction between suppliers and users of geographic information. In this respective, the suppliers and the users of geographic information in an organisation are interdependent. In this model the building blocks are individual "corporate" GIIs, which use and/or supply geographic information and technology, and interact with each other as members of the geographic information sector, in order to fulfil society's social, economic and environmental needs. He continues that:

> "The interaction involves spatial data and technology users adding value to the original spatial data provided by spatial data suppliers, and then on-selling the value added data to other users. This continual value-adding process ends at an ultimate user, often a member of the public, who uses a spatial data product to make decisions. As a result, the interacting stakeholders groups can be visualised as a network of value adding chains of suppliers and users of spatial data/technology, or alternatively, the different dimensions of the spatial data industry. This industry, in turn, represents the environment in which the SDI functions and evolves."

Chan (et al., 2001) argues that since the diffusion of GII takes place in a dispersed scenario in which the final purposes, functionality and composition of the GII are only vaguely defined, the productional perspective has the most potential in facilitating GII development.

The four perspectives of Chan may be important in understanding the stage of development of a single GII initiative. The examples show that different environments, or cultures use a definition that is likely to suit the needs at a particular moment of that environment best. It may well be that at the start of a GII initiative a different definition is used then later on. Evolving needs, or a better understanding of the concept may explain this.

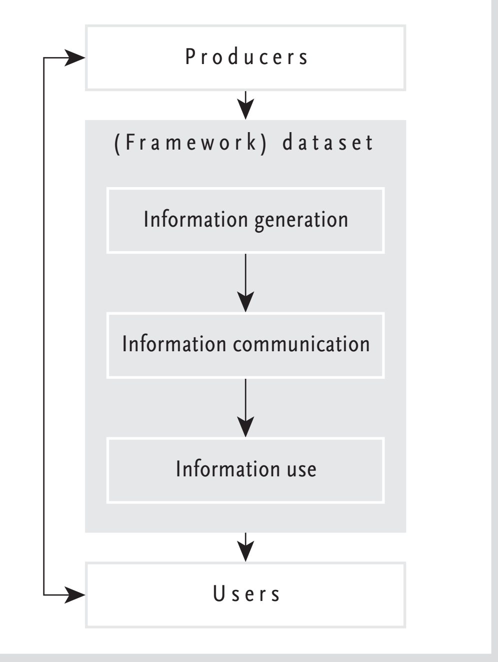
As Chan already identified, the first three perspectives regard the GII as a rather static concept. Chan's productional perspective addresses the dynamic nature of a GII by focusing on the interaction between suppliers and users in a "network of value adding chains of geographic information". Technology, connecting the information resources to each other and other users, changes at a high pace, together with the increasing expectations and demands of users (see e.g., Rezgui et al., 2005, p. 187). However, the productional perspective suggests that the dynamic nature of the GII also applies to the foundation of the GII: the framework datasets. Although the interaction between users and suppliers may be highly dynamic, a framework datasets' technical and non-technical characteristics develop gradually towards their ideal. The ideal framework dataset, or ideal combination of framework datasets may change slightly due to technological advances, but the core will remain the same. For example in the Netherlands, the geographic information sector is still working towards the ideal envisioned in the early 1990s. Similar developments for framework datasets exist, for example, in the US. A composite perspective of the technological, organisational and productional views is the geographic information process perspective.

2.4.3 The geographic information process perspective

Similar to the productional perspective, also in the geographic information process perspective the interaction between suppliers and users is central. The process perspective further believes that the ideal of the foundation of the GII is rather stable than dynamic. Ideal framework dataset characteristics are relatively constant: framework datasets need to exist, be complete, current, accurate, and interoperable with other datasets.

Further, the geographic information process assumes that the value of information comes from its use (see Onsrud and Rushton, 1995, p. ix). When it has been collected, its use should be optimised. Use optimisation implies interaction between suppliers and users. The interaction may be technical of nature in information exchange of interoperable datasets, but may also concern discussions about access policies. Further, use implies knowledge that the information has been collected and can be found easily. Moreover, the dataset also has to be accessible and available for further use. Use optimi-

Figure 2.5 The geographic information process



sation also means that information has to be shared and integrated in order to efficiently cope with available resources. Thus, the focus on the use of the information results in a relatively stable ideal of the GII framework datasets. More generally, a GII facilitates the process of information acquisition, information delivery and information usage: the geographic information process (see Figure 2.5). From this perspective, an appropriate definition of a GII is: a framework continuously facilitating the efficient and effective generation, dissemination, and use of needed geographic information within a community or between communities (after Kelley, 1993).
The definition describes the facilitating function of the GII, provides its components (the framework), and the focus on needed geographic information presupposes interaction between users and suppliers, addressing the dynamic nature of the GII. The framework consist of seven interdepending components: (framework) datasets, institutional framework, technology, standards, financial resources, and human resources. Section 2.6 elaborates further on these components (see Figure 2.11). These components interact, which is a condition for the further development of the infrastructure.

2.4.4 Objectives of GII

"The principal objective for developing GII for any political/administrative level is to achieve better outcomes for the level through improved economic, social and environmental decision–making. The role of GII is to provide an environment in which all stakeholders, both users and producers, of spatial information can cooperate with each other in a cost-efficient and cost-effective way to better achieve organisational goals" (Rajabifard et al., 2002b). Therefore, it should be noted that a "GII is not an end in itself but a means to support policy making as well as economic and social development, hence they should be seen in the context of the evolving focus and nature of environmental, regional, and economic policies across jurisdictions" (Craglia, 2005).

Although all GII initiatives strive to contribute significantly to local, and national, but also regional or global economic growth and the establishment of preferred social and environmental objectives, the objectives of GII initiatives differ. Some initiatives have almost identical objectives emphasising the same issues others diverge significantly.

The differences may be explained by the stage of development of a GII. Several GII scholars have recognised two generations of GIIs: the first generation and second generation GIIs (see Masser, 2000; Rajabifard et al., 2003, p. 95).

First generation GIIs

Several GIIs were initiated in the late 1980s and beginning 1990s. In his review of eleven of these early GIIs, Masser launched in 1999 the term first generation GIIs (Masser, 1999). Masser found several commonalities among them:

1. They are explicitly national in nature;
2. They refer either to geographical information, spatial information, geospatial information, or in one case, to land information;
3. They also refer to terms such as infrastructure, system or framework, which imply the existence of some form of coordinating mechanism for policy formulation and implementation purposes (Masser, 1999, p. 68).

The objectives of the first generation have been summarised by Masser (1999) as "to promote economic development, to stimulate better government and to foster environmental sustainability". Typical stakeholders in the first generation GIIs were primarily government-based with the public information producers well represented. The initial motivations were "information focused", concentrating on information integration, reducing duplication, using resources more effectively, and creating a base from which to expand industry productivity and the geographic information market (Rajabifard et al., 2003, pp. 101, 107; Rajabifard et al., 2002b, p. 14). Thus, information was the key driver for GII development (Rajabifard et al., 2003, p. 104). Consequently, the value of GIIs was measured in terms of their productive output, the savings for producers of geographic information, and from sharing (Rajabifard et al., 2003, p. 104). The information centric strategy of the first generation has also been referred to as a product-based approach of GII development (see also section 2.5.3).

Objectives of the first generation were typically objectives meeting supplier needs such as promoting access to (public) geographic information, and objectives in terms of expected efficiency accomplishments. One example of such objectives may be to "Enable the unlocking and improvement of geospatial information for the benefit of the citizen, business growth and good government" (see NGDF, 2000; Hadley and Elliott, 2001). Another example is "To harmonise all geographic information and make them available on the net" (CGDI, 2000). Finally, one GII scholar has argued "A (global) GII should lead to the minimization of duplicating national efforts, minimization of the cost of Research and Development and to the identification of the critical opportunities and threats inherent in creating a (global) geographic information infrastructure" (Rhind, 1997).

However, the providers' perspective of maximising access to and availability of currently existing geographic information, and efficiency maximisation assume that the collected information is needed, and therefore its use should be maximised. The user is neglected and it is likely that the needs of the user are not sufficiently addressed. The second generation GIIs addresses the users of geographic information.

The second generation GIIs
The experiences and outreach of the first generation GIIs has resulted in second generation GIIs. Rajabifard et al. (2003, pp. 104-105) argues:

> "In the second generation, people recognize that societal issues can be critical factors in determining the success of GIIs, which has meant that the GII coordinating agencies have had to develop a much richer and broader conception of who their communities are, how they behave, and particularly how they are likely to respond to the introduction of a new GII initiative. The second generation has a more holistic understanding of the financial and socio-cultural benefits of GII development, which is now measured in many respects, including in terms of its support for spatial decision-making, its criticality to national security and emergency management, and in terms of its intrinsic value-who can afford not to have it?"

In the second generation, people recognize that GII is all about facilitation and coordination (Rajabifard et al., 2003, p. 104). From this perspective, a GII is the framework to facilitate the management of information assets focusing on communicating the GII concept, instead of aiming toward the linkage of available datasets (Rajabifard et al., 2002b, p. 15). In addition to address the GII from a broader society perspective, capacity building, and coordination, meeting user needs is central to the second generation GIIs. The use of information is central and especially the existence of web services and other information applications are regarded as one of the main technological drivers of second generation GII because "such services are partly able to fulfil the needs of users and improve the use of data" (Crompvoets et al., 2004, p. 668; see also Rajabifard et al., 2003, p. 104). Consequently, the second generation GIIs have formulated their objectives in terms of fulfilling the needs of users.

Several GIIs have addressed the GII from a user-oriented perspective. The state of Queensland (Australia) is one example that regards GII as a way to help society to advance instead of a means to an end. Their GII objective is "To meet the needs of government, industry and the community" (Chan et al., 2001). The province of New Brunswick (Canada) focuses on "Providing easy, public access to integrated land-related information in support of informed decision making". The Australian objective is "To ensure that spatial data users will be able to acquire consistent datasets to meet their requirements, even though the data is collected and maintained by different agencies, and to maximise the government investment in collecting and maintaining data" (Holland, 1998, p. 8). Another example is available from the Netherlands (Ravi, 1995): "To provide the user with the geographic information needed to carry out his tasks" and the GSDI objective "To ensure that those working (with geographic information) on the [appropriate scale] are not impeded in meeting their objectives" (GSDI, 1997). Further, also several GII scholars have put the user central in the objectives of a GII. Onsrud (1998b), for example, defines the objective as "To facilitate the availability of and access to geographic information for all." Also Coleman and McLaughlin address the user: "To deliver spatially related information from many different sources to the widest possible groups of potential users" (Coleman and McLaughlin, 1998, p. 129). Finally, Van Oosterom does this from an European point of view: "The National Geographic Information Infrastructure allows for better access to geographic information and improves the ease of use of geographic information in organizations and for individuals that are occupied in one way or another with a spatial problem" (Van Oosterom, 2001, translation BvL).

However, the user community is large and divers and the perspectives of the different groups may be at odds with one another (Coleman and McLaughlin, 1998, p. 139). Moreover, "[end users] desire reliable, up-to-date data as quickly as possible and as inexpensively as possible but their underlying requirements and traditions with respect to practical data usage may vary widely" (Coleman and McLaughlin, 1998, p. 139). What are the needs of the divers user community? There is, however, a difference between the needs and the desires of users (see, for example, Bemelmans, 1994, p. 186). Desires are subjective views of human beings on the situation they prefer. Needs are a more objective assessment of what is necessary. In general, human beings have trouble in assessing their needs: their view is troubled by personal experiences, unwillingness to share their needs, and above all the human mind is limited in processing much information at the same time. Desires therefore do only reflect the needs to a small extent (see Bemelmans, 1994, pp. 186, 187, 291; Graafland, 1998, p. 13 and further). Aside from the difficulty to find out about the needs of a community, Bemelmans notices that there should be a balance between the benefits of a decision and the costs that come with it (Bemelmans, 1994, p. 291).

Although in most situations an assessment of the needs delivers a more effective 'product' than fulfilling the desires, sometimes also an assessment of the needs alone is not sufficient. Firefighters in New York at 9/11, for example, were equipped with palm pilots to locate hot spots and other dangerous areas. In theory this would have been the most effective way to master an incident. However, the firefighters were not used to work with this modern equipment, and continued to make their notes on paper.

The second generation of GII users expect user orientation represented by clear terminology, information, and easy access to and use of information services. The group of first generation GIIs now developing towards a second generation GII, finds difficulties in meeting the requirements of the users. For example, Crompvoets (et al., 2004, p. 685) has found for clearinghouses that GII people are dissatisfied with their clearinghouse likely because the clearinghouse cannot live up to the expectations of the second generation GII people. Clearinghouses are currently information driven mechanisms, passively presenting metadata in a user-unfriendly way (see also Crompvoets et al., 2004, p. 686).

Despite the difficulties in addressing user needs, the user should be central in the long-term objective of a GII. A dataset that is not used is useless.

It is the user perspective that should primarily be considered in developing a GII: once the needs of the user are fulfilled, the information will be used and the more it is used the greater its value for society (see also Onsrud and Rushton, 1995, p. ix). The needs of the users of geographic information may represent the geographic needs of society. Meeting the needs of users will be of increasing importance for the successful development of a GII. Therefore the objective of a GII should be:

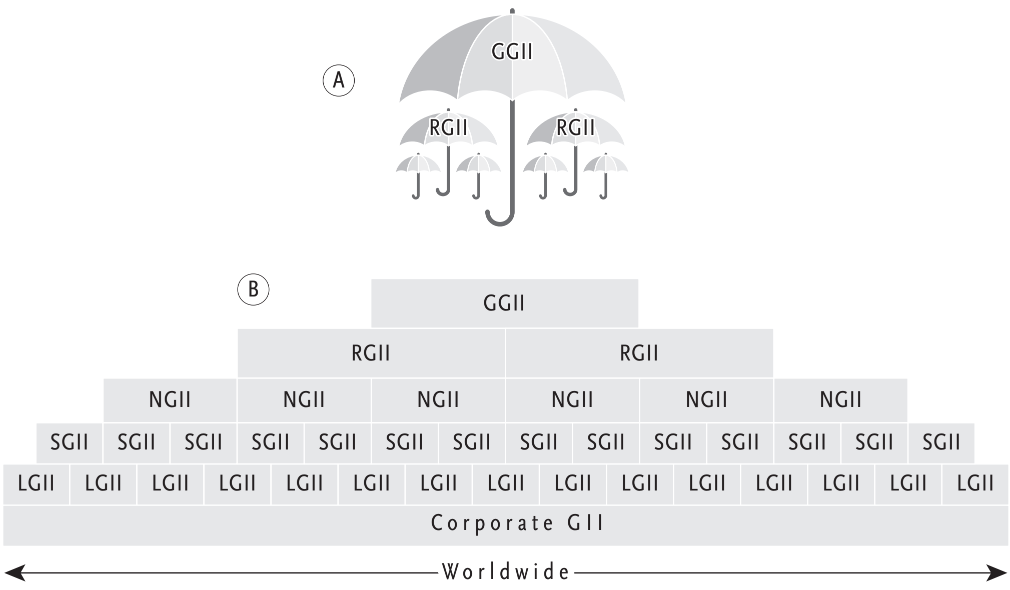
1. to provide users the geographic information they need (quality, type, scale, among other aspects);
2. in a way needed by these users (price, user interface, among others);
3. in an efficient way.

For technical and non-technical data characteristics, chapter 4 and 5 elaborate on the needs of the user communities.

2.5 Levels of GII

Infrastructures operate in hierarchical layers (see Bemelmans, 1994, p. 143). The highest layer applies to the global community, the lower only to local communities. GIIs also exist on different jurisdictional levels: there are local GIIs, national GIIs, regional GIIs and a global GII. Each level has its own characteristics in the core elements of the infrastructure. Rajabifard et al. (1999, p. 3) recognise two views explaining the relation between the different levels: the 'Umbrella view' and the 'Building block view' (see Figure 2.6). In the umbrella view, the GII in the high level encompasses all the core components of the GIIs in the levels below. In the building block view, the high GII levels build on the lower levels of GII. The lower levels provide the information needed by the higher GII levels. Each GII level is primarily formed by integrating geographic databases originally developed for use in corporations operating at that level and below (Rajabifard et al., 2000). A further development of the building block view is the pyramid model in which interconnected GIIs at corporate, local, state or provincial, national, regional and global levels make up a GII hierarchy (see Figure 2.7). The role of a National GII in the GII hierar-

Figure 2.6 The umbrella and the building block view



(A) The umbrella view of GII (B) The building block view of GII

GGII = global geographic information infrastructure
RGII = regional geographic information infrastructure
NGII = national geographic information infrastructure
SGII = state geographic information infrastructure
LGII = local geographic information infrastructure

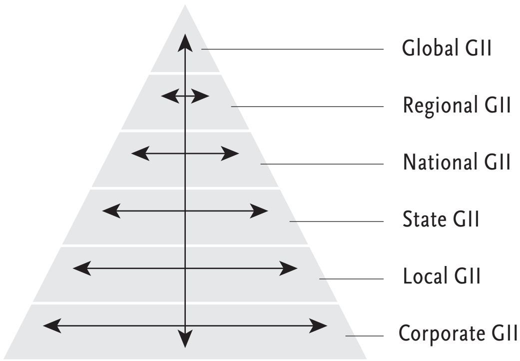
* The original figure uses SDI instead of GII.

Source: Rajabifard et al., 1999

chy is special since it is the only hierarchal level with strong links to both the upper and lower levels of the GII (Rajabifard et al., 2000).

From a policy or institutional perspective, the layers on top may be determinative for the lower layers. If a national government decides that the access to government information policy applies to all government information, then the lower levels do have to adhere to this policy. On the other hand, the hierarchy statement may not always apply. Jurisdictions have often a high level of autonomy: they do not necessarily adhere to regional or global policy lines. For example, the members of the EU are independent of EU standpoints. Sometimes this is even true for local policies in relation to national policies. In Zambia, for example, the Western province has a special status and does not always obey national rules. The other way around is unlikely to appear: one cannot rule over something one does not control. Therefore, it would be exceptional that local government authorities force national government to apply local policies to national datasets.

Figure 2.7 Relationships between and within hierarchical levels of GII



Sources: Rajabifard et al. 2002a; Rajabifard. et al., 1999

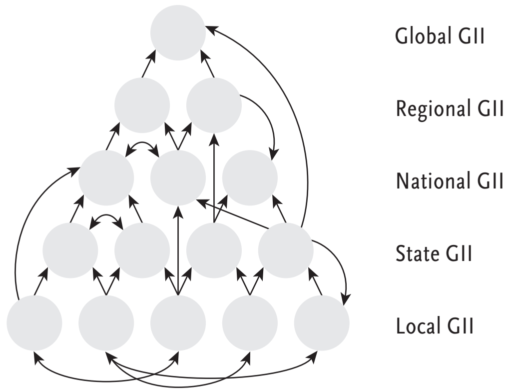
Figure 2.8 makes the conceptual hierarchal levels of GII as provided by Rajabifard (et al., 1999 & 2002a) more explicit (see also Rajabifard et al., 2000). The GII can be considered a network of information resources available throughout different levels of GIIs. The global level may build on information resources available at the state and regional levels. The national level builds on datasets directly available from the local and the state levels.

The exact boundary between different levels of GIIs is, however, difficult to assess. For example, a user at the national level may need highly detailed information, while a user at the local level may need less detailed information. Therefore, it is difficult to define a boundary for information detail that can satisfy all user needs at a specific level (Rajabifard et al., 2000).

2.5.1 Corporate GII

Although most literature focuses primarily on GIIs as a public good, a GII may also exist in the private sector. Rajabifard's (1999 & 2002a) pyramid model intends to demonstrate that the corporate GII is the base for all levels of GII hierarchy. However, these corporate GIIs may only operate at a specific GII level, potentially providing input for other GII levels, in particular the levels immediately below and above that specific level. They are not necessarily the base for all levels of GII hierarchy. These corporate GIIs may perform in similar hierarchies within an organisation. In some organisations all levels may be covered, in others only one specific level may exist. Sometimes these GIIs are producing or containing better information and technology than their public counterparts. The international focus of these companies may be an explanation. Royal Dutch Shell, for example, has one of the world's most comprehensive databases on factors for reference networks (for projections). Access to these private GIIs is, however, difficult because of their private nature. It may be decided that for critical datasets, the private boundaries have to disappear to make them part of a National GII.

Figure 2.8 Information flows in the GII: a bunch of interdepending grapes forming a network



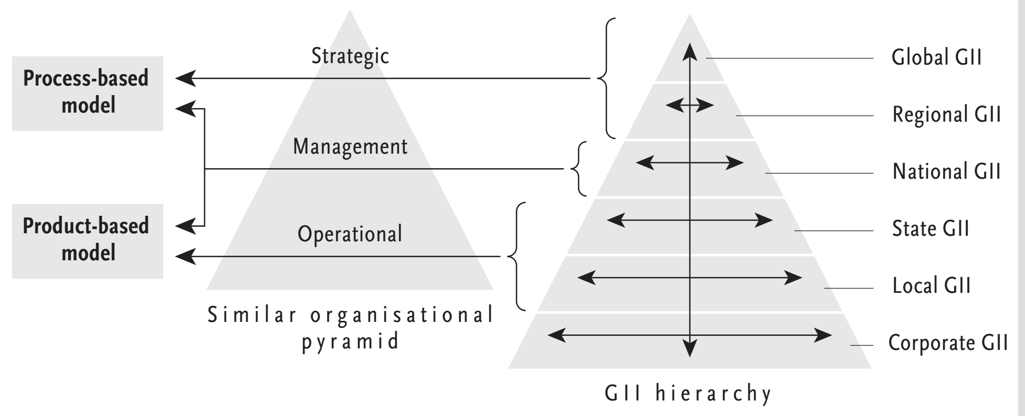
2.5.2 How to decide the hierarchical level of GII?

Another criticism for the pyramid theory is its applicability to GII initiatives. Although the pyramid is conceptually extremely useful, for fitting a specific GII in one of the pyramid layers is subject to subjectivity. For example, the hierarchy levels of GII may be confusing if one wants to fit a specific dataset in the model. Generally, the low levels include large-scale information (information with great detail, scale 1:1,000) as for the higher levels small-scale information (information with scale 1:50,000 and up) is sufficient (see Figure 2.7). But, where does, for example, a dataset at the 1:1,000 scale fit, managed nationally, maintained locally and used at all levels? In addition, regional GII in one situation may compare well with national GII in another. For example, any European would categorise the European geographic information infrastructure as regional GII, where most US citizens would categorise the US NSDI as national GII. The Swedish GII is also national GII, but compares very well with a state GII in the US. Therefore, different users have different perceptions of local, national, and regional GIIs. Consequently, recommended GII strategies for each specific level may be different based on these differences in interpretation or definition (see section 2.4.3). These may not compare with what the researchers had in mind, and misinterpretations may be made. The potential impact of these misinterpretations is, however, unclear.

2.5.3 The objectives for each hierarchical level of GII

Within each hierarchal level of GII, the needs of users may be addressed with different GII objectives. Rajabifard (et al., 2002b) uses the organisational strategic, management and operational tiers to explain the differences. At a strategic level, focus will be on promoting the GII concept, building awareness and commitment, or simply building capacity for GII development. In addition, the strategic levels should facilitate GII development at the management and operational levels. Thus, for those operating at strategic GII levels,

Figure 2.9 Relationships between GII hierarchy and different models of GII development



Source: Rajabifard et al., 2002a

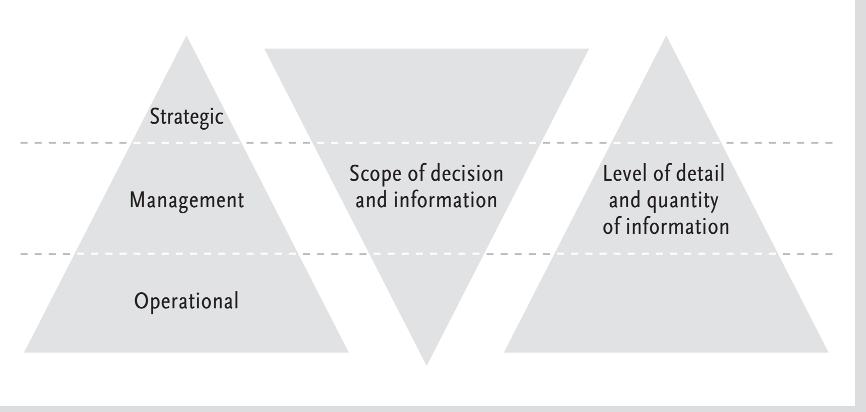
a so-called process-based strategy applies. The process-based model presents the main aim of a GII initiative as "to provide better communication channels for the community for sharing and using information assets, instead of aiming toward the linkage of available databases" (Rajabifard et al., 2002b). At the management and operational levels, to some extent a process-based model may be applied, but focus will be on information creation and linkages: a product-based strategy. Rajabifard (et al., 2002b) associate the organisational strategic level with the global and regional GIIs, the management level with national and state GIIs and the operational level with state and local GIIs (see Figure 2.9).

Again, from a conceptual point of view, the overview may be extremely useful. However, Bemelmans (1994, p. 211) clarifies that within each level of an organisational information infrastructure the strategic, management and operational tasks are performed (see Figure 2.10). Also at the regional level of GII, information issues need to be resolved. And also at the local level awareness and capacity need to be built. Bottom line is that policy makers, managers and shop floor people are operating at all levels of GII. Each of them need, in the context of the level they are operating, different information. Since the information and process approaches are complementing rather than competing approaches, both need to be considered for promoting the GII. Therefore, within each GII level, the GII strategy needs to consider a hybrid concept of both product-based and process-based strategies (see also Rajabifard et al., 2002a, pp. 14, 19).

2.5.4 Next generation GIIs: a hybrid strategy

In order to both meet the needs of users of geographic information and the needs of the geographic information sector at large, GIIs strategies should focus both on satisfying user needs with respect to information content and use, as on promoting the GII concept and capacity building at the respective

Figure 2.10 Relation between organisational tier, the accompanying scope of decision and information, and the detail of necessary information



Source: Bemelmans, 1994

levels. This hybrid strategy is the most promising strategy for the next generation GIIs.

Already, several GII initiatives have taken a hybrid approach of process and product based development. For example, the European Union initiative to develop the infrastructure of geographic information for Europe (INSPIRE, 2004) aims to address both typical information issues as metadata, information specifications and information exchange, and the capacity building and awareness raising function. A similar strategy is found in the Netherlands (Ravi, 2003).

2.6 Components of GII

In this study we use the following definition of a GII: a framework continuously facilitating the efficient and effective generation, dissemination, and use of needed geographic information within a community or between communities (see Figure 2.5). The GII includes the following components:

- (Framework) datasets;
- Institutional framework;
- Technology;
- Standards;
- Financial resources, and
- Human resources.

(see Rajabifard and Williamson, 2002; Van Oosterom, 2001; Holland et al., 1998; GSDI, 1997; McLaughlin and Nichols, 1994).

2.6.1 Framework and thematic datasets

A GII would not exist without information. We distinguish two categories of datasets: framework datasets and thematic datasets. Framework datasets are datasets that are commonly used as a base dataset upon which other datasets can be placed (Phillips et al., 1999), datasets commonly referred to, or a sufficient reference for most geo-located datasets (Luzet et al., 2000). Framework datasets may refer to the fewest number of features and characteristics required to represent a given information theme. Framework datasets are the foundation on which the GII builds. Common framework datasets are topographic datasets, administrative boundary datasets and land ownership datasets (Onsrud, 1998b).

Framework datasets can be used as base for thematic mapping. Specific thematic datasets, or themes are added to the framework dataset. In this way they build on framework datasets (see also Williamson, 2000). In some instances the thematic layer may become a basic layer for other themes. We would call this new framework layer a 'second order' framework layer; a sectoral framework layer (see Chan et al., 2001; Williamson, 2000). This view is in line with Chan et al. (Chan et al., 2001). They argue that GIIs are not static but dynamic. In their view of infrastructure and business systems, it may be that some datasets we consider application datasets (business system) today, will become framework datasets (infrastructure) tomorrow (see also Chan and Williamson, 1999).

2.6.2 Institutional framework

An institution is "an established organization or foundation, especially one dedicated to education, public service, or culture" or "a custom, practice, relationship, or behavioural pattern of importance in the life of a community or society" (website Webster).

The way the collection, maintenance, dissemination, and use of geographic information is organised is important if not the most important aspect of a GII. According to McLaughlin and Nichols "organizational cooperation [is] the critical ingredient that will make or break the best devised plans" (McLaughlin and Nichols, 1994, p. 71). Cultural differences may lead to stati quo that harm all participating cultures or will only harm the least dominant other cultures. The coordination of GII development and leadership at a national level are prerequisites for the establishment and further development of a GII initiative.

2.6.3 Policies

A policy is a plan or course of action, from a government, political party, or business, intended to influence and determine decisions, actions, and other matters (website Webster). Also policies can make or break the development of GIIs: they define the constraints and goals and to a certain extent delineate the means by which the goals will be achieved (McLaughlin and Nichols, 1994, pp. 71-72). Organisations or communities acknowledging the existence of a GII and its importance for an organisation or community, are likely to have policies in place that promote the development of a GII. They may, for example, fund developing standards or promote access to and sharing of certain information.

Policies may exist in different contexts. Some may focus on typical technological or human resource issues of a single organisation, while other issues are addressed in a much broader legal or political environment, for example, privacy, access to public information, or security issues.

Policies do exist in every level of GII development and at each level they are likely to reflect the needs of a specific community. In this respect, policies, together with the institutions, are reflections of the culture of a jurisdiction. As a result, the policies of countries in a same level of GII development may differ from or even conflict with each other. For example, access to public information policies in the US and Europe are said to be significantly different although the countries are considered to be in a similar level of (GII) development. Chapter 5 elaborates in great depth on access to geographic information policies.

2.6.4 Technology

Technology has been one of the driver's of the information society (Borgman, 2000, p. 1). Its development in the last century has been enormous. Technology may be defined as "the scientific method and material used to achieve a commercial or industrial objective" (website Webster). Technology has allowed us to start thinking about the GII concept. The current status of technology offers many opportunities that were too far-reaching in the past. Technology allows us to collect information in a digital form, distributing it very quickly at almost no costs. Further, technology has allowed to publish datasets in portals, accessible from anywhere in the world. So technology contributes to the knowledge of the existence of datasets and potentially to recognising duplicate datasets within a society and especially in government.

Technology also provides us with the opportunity to use existing information sources efficiently and effectively by allowing us to share information and to integrate on-the-spot datasets from distributed sources (Kap et al., 2004). Due to the merge of technological concepts it is now possible to locate the nearest Chinese restaurant, order the main dish from your car, and have your car drive you to a free parking spot at the parking garage of the Chinese restaurant. These location-based services are limited by the lack of supporting legislation, funding and organisation.

The technology component is closely linked with the existence of standards (both in software and hardware).

2.6.5 Standards

Many objectives consider efficiency one of the reasons why a GII should be put in place. Information sharing and information integration within the own organisation and eventually also with other organisations and jurisdictions offer great opportunities for the improvement of the efficient use of information. One aspect of information sharing and integration is standardisation.

Standards are the rules and common conventions that will allow information to pass from source to user (McLaughlin and Nichols, 1994, p. 71). Only when the human resources or the technology of division A understands what the information of division B means, it can be used in the way it is meant to. For information integration also the technology must allow the information to be integrated with other information. Further, a dataset's specifications should adhere to standards in order to be interoperable with other datasets. Chapter 4 elaborates on the interoperability of datasets.

With fully integrated datasets (both horizontally and vertically) and widely shared datasets throughout the communities that need this information, the information is likely to be collected only once, and the interpretation of the information will be without discussion.

The great importance of standards for society has been confirmed by DTI, which has assessed that standards have contributed to 13% of the growth in labour productivity in the UK over the period 1948-2002 (DTI, 2005).

2.6.6 Financial resources

The availability of funding is a critical condition for the promotion of the development of a GII. Without funding, no coordination and without funding, few initiatives in the general interest are likely to start (e.g., clearinghouse).

The question is how to get to the financial resources. Where are they and how may we obtain funding? Again the answer to the latter question is simple: building awareness and commitment among the people that control funding resources. The value of geographic information for society needs to be presented by showing nice pictures, for example, and issues one may resolve with a GIS. Also best practices and providing a business case which puts a dollar figure on the value of geographic information helps the GII. An example is found in *Space for Geo-information* (Ravi, 2003). Awareness will lead to soft money, commitment to continuing sustainable funding.

2.6.7 Human resources

Human resources are a natural element of the GII. The available human resources determine to what extent the full potential of the GII will be utilised and to what extent the needs of society are sufficiently addressed.

In a qualitative way the development of a GII needs a wide variety of human resources. Some human resources will have to build the GII in a rather technical way and need to have qualities to collect geographic information. Others need to have a more comprehensive overview and understanding of geographic information concepts like GIS, surveying, mapping and other aspects of the GII in order to promote the awareness for the GII concept.

Also outside the scope of the traditional geographic information sector there are human resources needed for the development of a GII. One may think of policy makers and decision makers that are not aware of the (full) potential of GIIs nor are they committed to provide funding on a continuing basis for the development of the GII. These laymen have to be convinced of the need of the GII. An interesting approach is the I(mplementation)-teams approach of the FGDC in the US (Moeller, 2002). In a quantitative way, it is clear that without any skilled people the GII will not develop as fast as with educated people.

Finally, there must be education available varying from educating a limited number of aspects of the GII (e.g., surveying), to providing a comprehensive program supporting innovative research and knowledge sharing (Geographic Information Science and Engineering).

From a product-based perspective, the GII players can be characterised by their roles as providers, users, and regulators (King and Kraemer, 1995, p. 15). The providers include (1) owners of the communication networks, (2) makers of information appliances (e.g., TV, computer, telephone), and (3) providers of content (information, information services, education) (King and Kraemer, 1995, p. 15). The third group includes typically the geographic information providers such as cadasters, national mapping agencies, but also private surveying companies, and companies involved in photogrammetry, or remote sensing, for example, Space Imaging.

Users of the GII "will probably be the most mentioned group and yet actually the least considered" (McLaughlin and Nichols, 1994, p. 72). This, however, does not imply that all potential user groups or applications need to be identified. It does mean that the user community has to be considered as part of the total infrastructure, and that real, rather than purely academic requirements are met (McLaughlin and Nichols, 1994, p. 72).

This study distinguishes four user groups:

1. primary users (the collector and major users);
2. secondary users (incidental users for similar purposes as the primary user);
3. tertiary users (users that use the dataset for other purposes than the purposes for which the information was collected and the dataset created), and
4. end-users.

Primary users are those that use the dataset in line with the initial purpose of information collection on a continuous basis. They are typically member of the organisation that has collected and processed the information. Secondary users use the information for similar purposes incidentally and tertiary users are those that add value to the framework dataset. A tertiary use may be the integration of several topographic datasets into one layer for a jurisdiction, or the linkage of a framework geographic dataset with several thematic layers. Other tertiary use may include providing user-friendly access to the dataset (e.g., adding search facilities, explanation, help desk), or intermediary services that help information resources in distributing the dataset. Value-added resellers (VAR) are important private sector professionals using large-scale geographic information. VARs are "integrators that take pieces and parts of many systems, technologies and datasets to form specialised solutions. They 'resell' all of these solutions and their value to their clients" (STIA, 2001, p. 9-4). The products that can be acquired from VAR are commonly referred to as value-added products. A value-added product integrating similar information from various sources may serve cross-jurisdictional users that need information going beyond one administrative boundary. Finally, the end-users are the fourth group of users consisting of citizens, decision-makers, and others that use the end-product of geographic information, for example, an animation, a map or a plain answer, mostly through services provided by the tertiary users. Each of these user groups can be found in government and administrations, in utility and public services, in private sector, in research institutions, in NGOs and not-for-profit organisations.

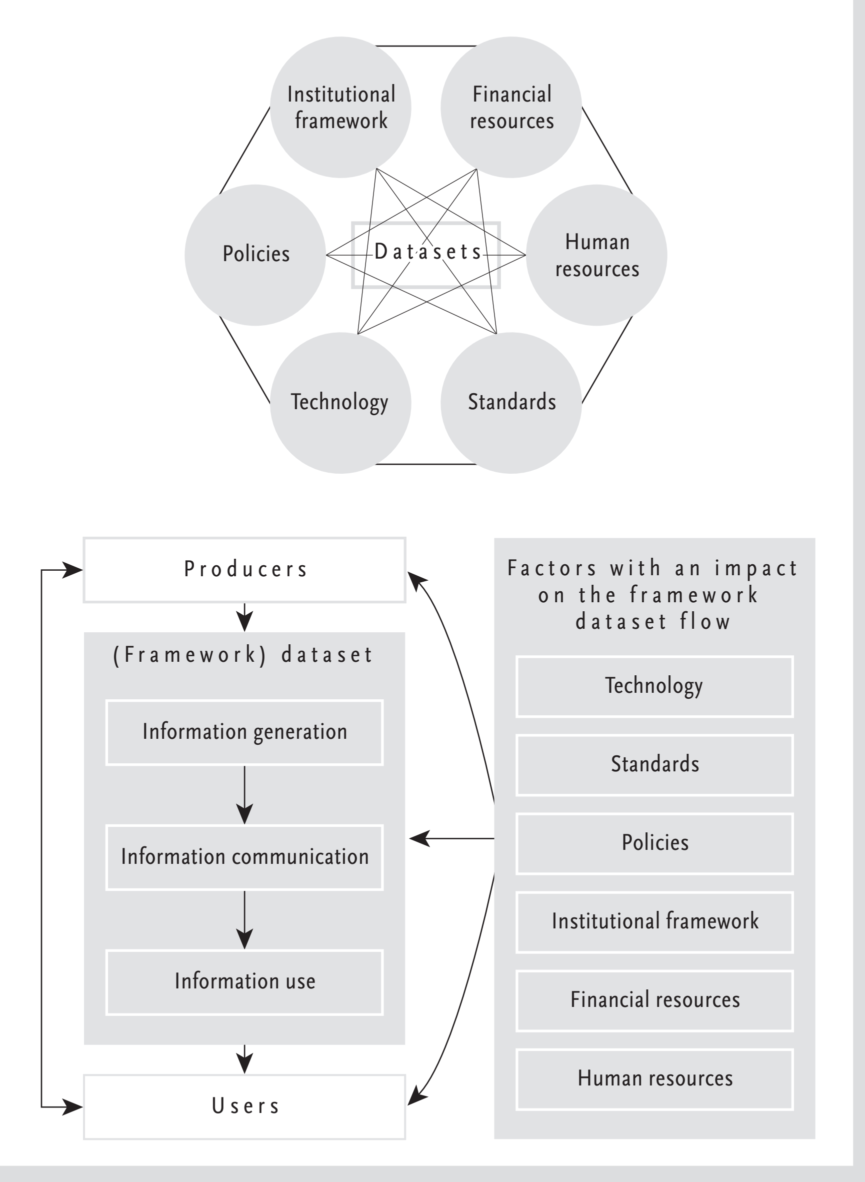
In a process-based GII strategy, human resources typically exist of human beings involved in coordinating the GII, bringing the information producers and user together, and promoting the concept within and outside the geographic information sector. These human resources may exist as high-level bureaucrats, as professors at universities educating the GII concept, or as accepted leaders of the GII (or the geographic information sector).

2.6.8 Relation between core components

Describing the geographic information process clarifies the relation between the core components of a GII. To use framework geographic information layers, they have to be collected. Institutions, policies, and financial resources decide who exactly collects and gathers what information and who may use it. Sometimes they even require certain technology for the collection. Further, policies may decide on the quality of the information, e.g., require adherence to predefined standards. The quality of information collection relies on qualified people and the quality of the used technology. Once the information is collected, it is stored, on paper, or digitally.

The policies decide who may access the information, and ways to promote

Figure 2.11 Components of a GII



the use of the information, e.g., through publication in a clearinghouse. Technology and standards utilise the policy lines. Policies and institutions decide on who may, or may not use the information. Further, they decide to what extent what use is permitted. Technology and standards determine the technical usability. Technology further allows for the means for publication of a dataset in a geoportal and eases searching, accessing and using information.

Figure 2.11 presents a graphical overview. Each one of these components will exist in any GII initiative. However, the exact form, shape or function depends on the culture and needs of the constituents of the initiative. Thus, among initiatives, the GII components will be the same but their manifestation will vary.

2.7 Summary

Within information infrastructures, the geographic information infrastructure is the infrastructure that includes information with a geographic component. Geographic information infrastructures exist in many shapes and sizes. As a result there is a wide variety of dispersed literature and initiatives available defining the GII and its objectives. Every community sets the definition and objectives that fits its needs best. The different perspectives of GII may explain the wide variety of definitions and objectives.

In this study we define a GII as a framework continuously facilitating the efficient and effective generation, dissemination, and use of needed geographic information within a community or between communities. Further, the study will take the user point of view as a starting point of developing a GII. Therefore the objective of a GII should be:

1. to provide users the geographic information they need;
2. in a way needed by these users;
3. in an efficient way.

A GII consists of seven major components: (framework) datasets, institutions, policies, technology, standards, financial resources and human resources. They all have an impact on what information is collected, how it is distributed and how it is used.

GII performs at local to global levels. In order to promote GII development, in each GII hierarchal level focus should be both on satisfying user needs for information content and use, as on promoting the GII concept and capacity building at the respective level. Chapter 3 addresses the GII strategy from an institutional perspective. Chapter 4 and 5 will do this from a dataset and user perspective.

3 Developing GIIs from an organisational perspective

3.1 Introduction

A GII develops gradually. Step by step the needed components are improved and the most pressing issues addressed. In addition to the development of a GII, also the environment in which a GII develops, changes. Innovations result in the introduction of new technology, and new products, which may change the way a GII performs, or the role it plays in society. New insights may result in new policies, and in new activities within an individual organisation or the GII. Further, changes in the GII environment may lead to new needs and new believes, changing the ultimate ideal of a GII. Chan argues that it will never be possible to specify the ideal GII because "SDI development takes place in a dispersed scenario in which the final purposes, functionalities and composition of the GII change dynamically and can only be specified vaguely" (Chan et al., 2001). This argument implies that the needs of communities change overtime and that therefore the ideal will change accordingly. Organisational conditions are relevant in developing a mature and sustainable GII. This is a continuing process that never ends.

This chapter elaborates further on the different stages of GII development. For each stage the organisational components are filled in. This chapter provides an insight in the method of assessment of the level of maturity of a GII, and proposes a way of GII comparison. Chapter 4 and 5 will do this for the technical and non-technical data components. Further, driving forces for GII development are identified and a GII strategy proposed.

3.2 Stages of GII development

The evolutionary growth of GII development may be captured in several stages of an organisational growth model. Watson (et al., 2001, p. 44) acknowledges that:

> "The stages of grow concept is widely used in organizational and information systems research. The fundamental concept is that many things change over time in sequential, predictable ways. It has been used to describe, explain and predict organizational life cycles, product life cycles and biological growth. […] Each stage is uniquely identified by a set of benchmark variable. These variables change their value as the phenomena move through the stages of evolution. The number of stages varies with the phenomena under investigation, but most models have between three or six stages."

In his analysis of automation budgets of several US companies, Nolan first distinguished four stages and extended it later with another two (see Nolan, 1973 and 1979). Bemelmans (1999) identifies four stages of organisational adaptation to new technologies. Graafland's model for municipal geographic information infrastructure development has four stages, while according to Van Kerkhoff (et al., 1999) a municipal as an organization develops through a five stage model. Layne and Lee (2001) distinguish four stages of e-government development in municipalities. Watson (et al., 2001) argue that the developments in data warehousing can be explained through 4 stages of development.

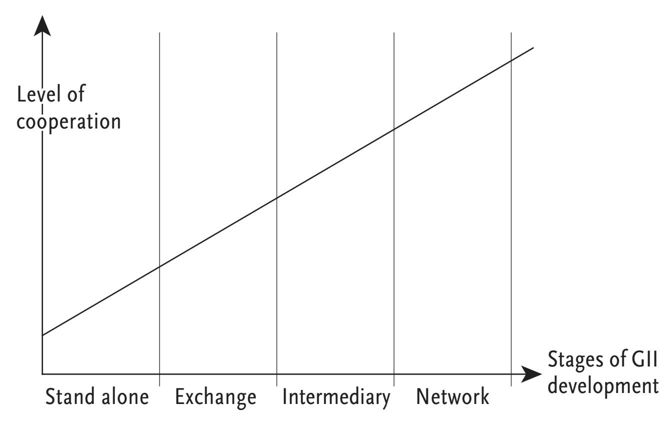
Each of these models have difficulty in exactly describing where one stage ends and another starts. Moreover, within an organisation one department may be in another stage of development than another (Graafland, 1993, p. 142). In practice, the transition of one stage to another will be gradual, and one component may reach a certain stage earlier than another. The central issue that these models aim to address is the question how organisations develop from nothing into a mature organisation (cf. Graafland, 1993, p. 142).

The developed models may be captured under the concept of system integration, even if they are called differently. Camarinha-Matos and Afsarmanesh (2005, p. 5) clarify that systems integration can be addressed and initiated at different levels of complexity and abstraction. They distinguish the cell-level, the shop-floor level, the intra-enterprise level and the inter-enterprise level. At the cell-level the work of several robots may be integrated into one robot. At the shop-floor level the subsystems within a department may be merged into one system. At the intra-enterprise level the objective is to integrate all areas of the enterprise, which may be a municipality. Further, the inter-enterprise level envisions cooperation among various organisations. Together these organisations can be considered a virtual organisation: a network of collaborating enterprises in which each node of the network contributes with some value to the value chain (Camarinha-Matos and Afsarmanesh, 2005, p. 5). Finally, they foresee integration at the global level. The GII would categorize as an inter-enterprise organisation. An interenterprise organisation is a more stable, though not static, group of organisational entities that have developed preparedness to cooperate in case of a specific task: (Kürümlüoglu et al., 2005, p. 11; see also Oosterwijk, 1995, p. 42) developing the GII.

Most of the growth models referred to, apply to single organisations, for example municipalities (e.g., Graafland, 1993 and 1997). The GII concerns a network of organisations, in which individual organisations become a component of the new network organisation. This study assumes in harmony with Oosterwijk (1995, p. 36) that what applies to organisations is of interest of networks of organisations.

In the following paragraphs, four stages of GII development, stand-alone, exchange, intermediary, and the network stage are identified (see Figure 3.1). The description of the stages of the model builds on the work of Camarinha-Matos and Afsarmanesh (2005), Layne and Lee (2001), Van Kerkhoff (et al.,

Figure 3.1 Stages of GII development



1999), Watson (et al., 2001), Bemelmans (1999), Bemelmans and Matthijsse (1995), Graafland (1993; 1997; 1999), Hopstaken and Kranendonk (1991), Greiner (1972), and Kok and Van Loenen (2005). Each stage requires a specific organisational setting. Between stages the organisations need to change their structure and culture (see Graafland, 1999) to develop further. New technology may be one of the key drivers for organisational change. Organisational culture can be regarded as one of the potential barriers (Rezgui et al., 2005, p. 191). In accomplishing successful organisational change, the organisational theoretical framework of Boonstra (2000) (see also Bennebroek Gravenhorst et al., 2003; Boonstra, 2004) was used to identify the characteristics of the stakeholders in an organisation or community in a certain stage of development of the change process. They combined concepts from Organisation Development with concepts of Planned Change and concepts of Organisational Learning (Boonstra, 2004). Also Boonstra's theory aims to fit a single organisational context. Although the multi-organisational setting of a GII may be more complicated than a single organisational environment, conceptually the issues are similar. Therefore, the model was assessed as useful for inclusion in the stages of GII development model (Kok and Van Loenen, 2005).

The grow model aims to explain how the GII may evolve from several 'stand-alone' organisations into an institutionalised network of collaborating organisations (see also Kok and Van Loenen, 2005). Although the stages of development were considered useful for this study, they were not the primary subject of study.

The following section uses the potential development of the collection, delivery and use of a cadastral dataset as an example to clarify the theory.

3.2.1 Stage I: Stand-alone

The first stage is named stand-alone because of the different organisations that build their own organisational infrastructure. These islands of infrastructures may find a commonality in the slumps, which lack infrastructural facilities such as a road network. Everybody is concerned with surviving the slump and nobody recognizes the need to invest in common interests (Bemelmans and Matthijsse, 1995, p. 57): leadership is lacking. This is not only expensive, but especially ineffective (Bemelmans and Matthijsse, 1995, p. 57). In a GII context, every organisation, builds its own 'infrastructure' with organisation specific data models, standards. Further, the organisation's database is filled by the own organisation's source system (see Watson et al., 2001, p. 47; Graafland, 1993 and 1999). Information collection and the organisation's performance is independent of other organisations: individual organisations may have organisational visions, but there is no common vision for the GII.

The internal focus of the (public) organisation (Van Kerkhoff et al., 1999) results in use of the information for a single or a few subject areas (Watson et al., 2001, p. 48), which may be limited to predefined legislated tasks. The internalism of the organisations is synonym to a passive attitude towards new questions arising from society. The ability of the geo-information sector to organize itself to address pressing issues that need a multidisciplinary approach is non-existent because of the lack of awareness of the existence of others and consequently the unawareness of the opportunities of cooperation in a geographic information network.

For example, the Cadastral authority collects independently from others all information that is necessary for the execution of its task, and relies on this information. Thus, ownership transfers are registered including personal information such as name and address. The cadastral map includes physical objects to identify real property at ease. This information is only updated after a new transaction is registered with more current information. Other institutions, which build on the cadastral database, for example municipalities or the national revenue service, may have difficulty in linking their more up-to-date systems to the information provided by the cadastre. This results in redundancies, inconsistencies, and duplicate information collection efforts. Integration of systems is difficult if not impossible if the current situation continues.

In this stage, only a few visionaries understand the potential value of the GII concept, but they lack the means to convince potential key players of the need to participate in the GII. The GII is not a priority of the individual organisations, but rather another development that is followed, but considered not as relevant for the organisation. Communication between organisations is not open and, the commitment of top management to change the internalism of organisation towards a more externally focused one is lacking.

Organisations in the stand-alone stage have the characteristics of Boonstra's 'cynical context' (Boonstra, 2000). In a cynical organisational context the individual organisations potentially participating in the GII experience no bottlenecks. Change is considered unnecessary and almost no support will exist for change. Phrases like "What's new?", "This will not work, do not get involved" are commonly heard in the organisations. The culture within organisations is conservative, pursuing their own interests, and the willingness to change is lacking.

3.2.2 Stage II: Exchange and standardisation on technical level

In the exchange stage, two factors may drive the change of organisations: the increased pressures for organisations to operate efficiently and new technology. In addition, organisations become aware that greater use of other organisations information resources may be more efficient and effective than the internally supplied information (cf. Williamson, 1975). 'Outsourcing' some information supply, allows the organisation to concentrate on its core activities, and to rely on other organisations for the subordinate information. Outsourcing results in a dependency on other organisations, a first step towards a network of organisations working towards a common goal. Cooperation may also be a way to address the increased pressures to reduce costs (Watson et al., 2001, p. 43) especially in an economic climate of recession.

In addition, society's challenges require solutions that go beyond specific organisations' focus and capabilities. Several factors "have forced business and industry to adapt to new challenges triggered by an ever sophisticated society characterized by an increasing demand for customized and high quality services and products" (Rezgui et al., 2005, p. 187). Now also government entities may feel external pressure from citizens (Van Kerkhoff et al., 1999). Citizens are increasingly accustomed to the technological advances and demand on-line services instead of having to go to a specific location to complete paperwork (Layne and Lee, 2001, p. 128). Simple transactions such as renew licenses and pay fines or taxes are beginning to emerge. These applications, however, are localised and fragmented (Layne and Lee, 2001, p. 130). Citizen's demand and changes in society require "integration of underlying processes not only across different levels of government, but also different functions of government. [...] Ultimately a citizen can contact one point of government and complete any governmental transaction – a one-stop-shopping concept. Also, from the viewpoint of all levels of government, this could eliminate redundancies and inconsistencies in their information bases for citizens" (Layne and Lee, 2001, p. 125). Cooperation between departments, and between organisations is required to provide the necessary multidisciplinary solutions. The integration of scattered systems at different levels is required (Layne and Lee, 2001, p. 130): the framework datasets need to be integrated to be the real basis on which society can build. Awareness grows that a GII may address the issues that need to be resolved.

In this stage of GII development, support from the actors is important, especially when a clear hierarchy between the participants does not exist. A common goal and the recognition of a (potential) win-win situation are critical for the further development (Bemelmans and Matthijsse, 1995, p. 64; see also Hopstaken and Kranendonk, 1991, p. 102; Rezgui et al., 2005, p. 188) and to reach the expected synergies (Bemelmans and Matthijsse, 1995, p. 65). Agreement on a common goal is further important since ultimately the actors become interdependent (Bemelmans and Matthijsse, 1995, p. 66). In addition, the reasons of organisations to cooperate do not need to be identical. This may lead to different expectations on all sides of the partners. Therefore agreement on the goal of the GII is essential to the success and satisfaction of the organisations involved (Kürümlüoglu et al., 2005, p. 21).

The GII as a concept gains momentum, but is still fragile. Individual information producers start to experiment with exchanging information. Within these organisations, the difficulties experienced increase the awareness for the need of a GII. The first steps of GII development are the start of coordination activities in informal settings with voluntary participation. Focus is on informing each other, recognizing bottlenecks, potential solutions and exploring ways to cooperate. The recognised bottlenecks are accompanied by acknowledgement of the difficulty to solve all barriers at once: problems are prioritised. Organisations or communities start to think along common lines, which results in a sense of community and develops trust between participants.

At the end of this stage, a first vision is created and priorities set (Watson et al., 2001, p. 47). The dominant role of the information producers in the initiation of the GII, results in the primary focus on standardisation and framework datasets (see also Graafland, 1993, p. 410). Thus, typically a product-based strategy is discussed and agreed upon: the GII is going to be built.

The strategy includes agreements about the content and quality of the framework datasets (Schepers et al., 2001). Further, the definition of a reference architecture for the cooperation process is required and the development of a support infrastructure, including the protocols and services for information exchange, communication and cooperation (Camarinho-Matos and Afsarmanesh, 2005, p. 5).

In the beginning of this stage, the cadastral dataset is difficult to exchange for incorporation in another organisations' system: each of the organisations uses unique exchange formats and data specifications, and supposed identical information is different (e.g., address of owner of real property). At the end of this stage, agreement exists about the responsibility for framework information: for example, the cadastre for ownership information, and the national address register for address information. Further, agreement exists about the exchange formats and protocols to exchange information. Discussion exists about implementation of the agreements and whether they should be institutionalised.

From an organisational perspective, Boonstra (2000) describes this stage as the 'sceptical stage': there is sufficient dissatisfaction about the current situation and/or organisations desire a new situation (see also Hopstaken and Kranendonk, 1991, p. 102). Some concern exists about the change process, but change is supported. In this stage, the existing organisational structures which focus on the internal organisation need to be changed into a structure supporting a more external focus, stimulating cooperation and information exchange (see also Graafland, 1999). Change may encounter resistance from parties that aim to safeguard their position (see Boonstra, 2000). This may be explained by the "institutionalization of managerial attitudes": the behaviour of managers becomes more difficult to change when attitudes are outdated (Greiner, 1972). Such attitudes are likely to be found in the key organisations in the geo-information sector, those responsible for the framework datasets, if they, and their staff, have been around for a long time. However, if the organisation is aware of the need to change and alternative strategies lacking, change is likely to find little resistance (Boonstra, 2000).

3.2.3 Stage III: Intermediary

The intermediary stage is the stage between the stages of problem identification and the envisioned situation. Central in this stage is the implementation of the vision developed in the previous stages. Several components of the visions have been implemented, others still need to be addressed or further developed.

The islands of organisations are becoming a network of organisations, which is led by an accepted leader, for example an independent coordination body, which initiates activities, supervises GII development, informs the network with relevant developments outside the sector, and performs the function of the GII communication channel where stakeholders, both producers and users, are stimulated to discuss, comment on, and suggest improvements for the GII strategy.

The key organisations in this stage have changed from internally centred towards organisations open to external developments, and the individual organisations' strategies align with the GII vision. This may well compare with the infrastructure development in municipalities where a new department is founded responsible for the municipal information supply (cf. Graafland, 1997, p. 61). The responsibilities of organisations, their roles in the GII are made explicit. Participation in the GII is less voluntarily and results in a formal distribution of tasks or responsibilities for information management and system management (Bemelmans and Matthijsse, 1995, p. 64). The distribution of tasks is aiming at more efficient allocation of the sector's limited resources, allowing the sector to grow through coordination (Greiner, 1972).

The potential of new technology gains awareness and new applications emerge. As the number of users and applications of geographic information grows so do the benefits. However, the benefits are largely in the form of time-savings, new and better information, and improved decision making, which are difficult to quantify (Watson et al., 2001, p. 47). However, participants in the GII start to realize the potential of the network now information is available for and is used use in multiple subject areas (cf. Watson et al., 2001, p. 48). Consequently, the strategy is not only focusing on information creation and exchange, but also aims to promote use of the information. The data perspective focuses on fulfilling the initial vision and starts the process to institutionalize the GII framework datasets. This may be aimed at legislation for framework datasets, specifying the custodian, content, quality, and use arrangements. The user part addresses users issues, such a barriers for using framework datasets. These barriers may be technical of nature, but awareness grows that policy issues need to be resolved to meet the needs of users.

The coordination body not only is the communication channel for the parties within the GII, it also seeks recognition of the GII outside the sector, especially with politicians and high-level bureaucrats. It informs these decisions-makers about the potential of the GII, its needs and raises issues critical for GII development. Through influencing the external channels, the GII may obtain high-level support, which helps to smoothen GII development.

The hybrid approach incorporating both the data-centric and process-based strategy has allowed for interoperable datasets, awareness for the GII at many levels also outside the sector, and financial resources specifically dedicated to GII development.

In this stage, the distribution of tasks, and the requirement of organisations to focus on their core tasks, has resulted in far-reaching interdependencies between organisations. For example, the cadastral database is not only filled with information from the own organisation, but the database is directly linked to the database of the more up-to-date national registrations of people and enterprises. This ensures that the cadastral database contents current information, which is nation-wide consistent within government. Similarly, governmental organisations depending on the information of the cadastre have direct access to the cadastral system(s). Users outside these organisations, however, lack the same level of service.

The intermediary context has the characteristics of Boonstra's "desiring context". In the desiring context many bottlenecks exist in the organisation: the organisation desires a new and better situation. The need for change is evident and support for change is high, but has to be communicated effectively, for example through best practice examples. The extent to which organisations are willing to cooperate with each other and the powers of top management to steer the development are critical factors in this stage (Graafland, 1999, p. 17): organisations can in this stage make or break the GII.

3.2.4 Stage IV: Network

In the network stage, the GII has become a network organisation with equal players, a clear vision which operate pro-actively (Van Kerkhoff et al., 1999). The organisations involved are depending on each other because of shared responsibilities for the GII. This uncertainty has been addressed by the institutionalisation of the network and its relations (cf. Oosterwijk, 1995, p. 169).

GII has become a multipurpose system with clear distribution of responsibilities and shared leadership. It includes well-integrated information from multiple systems and sources (Watson et al. 2001, 49). Information is maintained at the source. This implies that information is only collected at the largest scale needed and the consistent framework datasets are generalised to smaller scales. Further, the dependencies require comprehensive metadata documentation (Watson et al., 2001, p. 47). Standardisation has shifted from supplier or product specific to adherence to international standards that are supplier independent (Bemelmans and Matthijsse, 1995, p. 65).

The GII concept is not challenged, but exploited and enjoys broad support since it provides the foundation for the information society. The GII network is the foundation for many virtual organisations (consortia)[2], which temporarily build on the framework the GII provides. Experiments in new applications are promoted through the ease of access to multiple systems and encouraged by the GII (Greiner, 1972). The consortia innovate the GII through applications or solutions for specific needs (see Amit and Zott, 2001, p. 496), which are commonly found and vary widely. For example, the cadastral map is now available for location based services, which allow one to find a nice field (without an address) along a pool, to contact the owner without obtaining her personal information, and obtain directly permission to camp on her land. The automated note further informs the hiker that yesterdays water quality monitor revealed that the quality of the water in the pool is okay for swimming.

In the network stage or Boonstra's 'innovative context' few organisational bottlenecks exist and the change process is driven by innovative motives. "The goals of the change process are clear and there is broad support for them. Technological change is easily realised and the process does not cause tensions within and between organisations. Top managers are actively involved in the process and are stimulating full support from all organisation members. Members of the organisations have positive expectations regarding the development and outcome of the change process, believe that change is necessary and want to contribute to the change process" (Bennebroek Gravenhorst et al.,

2 A virtual organisation is a temporary consortium of partners from different organizations established to fulfil a value added task (Kürümlüoglu et al., 2005, p. 11). An example of such consortia may be in Ravi (2003).

2003). Broad support exists for the GII vision, which is continuously reviewed by various stakeholders through open communication channels. Periodically, the development of the GII is reflected upon. In this stage a proactive community is working together on innovative solutions for societal problems.

The GII has been developed and the mission completed. However, new challenges may arise with extra complexity and new dimensions. An example may be the emerging European geographic information infrastructure (see INSPIRE, 2004), which should build on national GIIs with each their own GII organisation, culture, data specifications and priorities. A further step may be to develop a true global geographic information infrastructure. The development of these new GIIs may follow a similar path from several stand-alone national GIIs to mature networks of national GIIs.

3.3 Organisational aspects determining the organisational development[3]

To move from one stage to another one has to identify organisational characteristics to come to a more advanced GII. A decade of experience of first generation GIIs (see Masser, 1999) enables us to evaluate the success factors, and to come to an organisational ideal in a certain stage of development. The likeliness that an ideal situation will be reached depends on five critical organisational components of the GII:

- leadership;
- a vision;
- communication channels;
- ability of the geographic information community for self-organisation;
- awareness and sustainable resources.

3.3.1 Leadership

Leadership is one of the issues that is considered as critical (see Wehn de Montalvo, 2001). The GII needs a champion, or an entity which promotes, and coordinates the development of a GII. This leader has to initiate an agenda building process and start to bring the sector together. Another important factor that has to be fulfilled for the successful/efficient development of a GII, is the introduction of some kind of a coordination mechanism. In almost every initiative a platform of GII stakeholders exists. In most initiatives only government entities are represented. The Netherlands, however, is one of the few countries where the private sector has participated in the national coordinat-

3 This section is based on Kok and Van Loenen (2005).

ing body. *The Tragedy of the Commons* (Hardin, 1968) provides an example of the results of a lack of coordination. Onsrud describes a similar situation for information policies (Onsrud, 1998c).

A leader can be appointed by a formal mandate, often supported with the highest level of political support. This is recommended in Wehn de Montalvo (2001). A leader can also emerge from existing national coordination activities (Masser, 1999), or from the achievements and enthusiasm of respected individuals: GII champions (Craig, 2005; Rietdijk, 2000, p. 222).

Each approach has its pros and cons. Political support for the GII is important (Craglia et al., 2002, p. 59), but also the workfloor (including management) has to be positive about it. GII developers should strive for continuous support for a GII both in politics and management (see also Craglia et al., 2002).

In the stand-alone stage of organisational development, the individual organisations do not consider the GII as such, and as a result GII leadership is lacking. In the exchange stage the importance of coordination is increasingly acknowledged and potential leaders are discussed. This process would result in the accepted leadership of one or a limited number of entities. If the accepted leader manages to satisfy the geographic community on continuous bases the leadership is likely to be respected.

Key is that at a certain point in time everybody should be aware of the need for a GII and that everybody starts thinking along the same lines.

A top down approach has the advantage that top decision makers believe in the potentials of a GII, but with the pitfall of having no commitment at the workfloor. Bottom up development has the opposite problem: the bottom acknowledges some successful experiences, but without the support from the top, these 'pilots' will never lead to an introduction on a broad scale.

3.3.2 A vision

A vision may be described as a needed or beneficial future situation. A vision shared by stakeholders is likely to direct the activities of the stakeholders in the same direction. This agreement among stakeholders over the goals is important for transforming the abstract goals into concrete actions to be taken. Without a common goal, or objective, initiatives are likely to diffuse in any direction without taking advantage of each other. Or even worse they will do partly or completely the same, wasting scarce resources. One needs a direction for GII development, and the vision provides this direction. Although the wording 'ideal' may sound too promising, the objectives are likely to be aimed at an ideal from the perspective of that specific moment. Once this ideal situation is reached, there may be other problems arising that have to be resolved, and therefore the previous ideal may not be recognised. It is, however, recommendable to have some idea of where to go.

Therefore, an ideal or a vision is a necessary prerequisite for the successful and needed development of a GII. This allows for the pavement of a road towards the ideal. When needs of stakeholders change, the ideal may change (see Chan et al., 2001). But without an ideal or a vision, there is no incentive to move on and GII development will be blocked instead of promoted.

In the stand-alone stage of development, every individual GII stakeholder may have a unique vision, primarily promoting the organisation's objective. Later this becomes part of a negotiated vision shared by all (exchange stage). Ultimately an independent vision should be created and supported by all, and frequently reviewed (network stage).

3.3.3 Communication channels

Communication is very important for the acceptance, perception, and support of a leader. Communication channels may be the means that enable "the exchange of thoughts, messages, or information, as by speech, signals, writing, or behaviour" (website Webster). Communication in the first stages of a GII is limited and directed to every individual organisation itself. Later it may focus on the exchange of information with other organisations, leading to partnerships in projects responding to public or private needs. The increasing focus on external communication leads to the need for standardisation, data exchange and sharing, and one time data collection. Further, political initiatives striving for an efficient government lead to the awareness that information created by one government entity are used by another agency. In such a context it is likely that a GII initiative starts within government. In a next stage (intermediary) other stakeholders, for example the private sector, are invited to participate. Ultimately, open communication channels should be strived for, enabling everyone to express their thoughts, opinions, and to participate actively in the decision making process. In addition, the GII should ultimately be connected to other infrastructures by communicating the value of geographic information for these other infrastructures.

3.3.4 Ability to self-organisation

Self-organisation is a process in which parties in a system spontaneously interact, communicate, give interpretation to events, and through cooperation create new solutions (Boonstra, 2000). Coordination within the system may be an important element contributing to self-organisation (see Küppers and Pyka, 2003, p. 19). The ability of the self-organisation of the community can be explained by the problem solving ability. In the first stages the community will identify problems and leave it to others (the political leaders) to solve them. If help is necessary the geo-information community provides its expertise, but their priorities will be in the execution of their (public) tasks. This is a rather passive role. Later the community more actively identifies problems and offers solutions to the decision makers. This is followed by actively answering questions from society with geographic information solutions. Finally, the community will provide innovative solutions without thinking in problems and solutions, but offering actively better and new user-friendly services meeting the needs of end-users. It is in this stage that all stakeholders recognize their responsibility for their role in the development of the GII.

3.3.5 Awareness and sustainable resources

For the development of a GII, ongoing commitment will be as crucial as initial enthusiasm (McLaughlin and Nichols, 1994, p. 73). Lack of commitment may lead to disappointed and uninspired people working on the GII initiative, finally leading to its end. Awareness of the impact of geographic information (systems) on the well-functioning of society, including businesses, public entities and academic institutions may ease the efforts to participate in the GII and to acquire funding for GII development. Each of the discussed four components attributes to the awareness for the value of GII and consequently the level of funding for its development.

In the beginning stage, the GII as a multi-organisational concept is non-existent. Within organisations, thoughts about organisational geographic information infrastructures may exist. Awareness for GII is in this stage with very few, visionaries. Next, in the exchange stage, the GII concept enjoys more interest, and especially within the geo-information sector the concept is promoted. In the intermediary stage capacity for the GII continues to grow and ultimately respected leadership, open communication channels and a pro-active geographic information sector have resulted in awareness among all levels which has resulted in sustainable funding for GII development. The extent to which awareness has been built for GII development and as a result the moneys that are dedicated to GII development may be useful measures for assessing the overall stage of GII development.

3.4 Organisational maturity matrix[4]

The way a vision, leadership, communication channels, and the ability of the geographic information community for self-organisation are present or perform in a GII depends, on the stage of development. The five organisational development components result in the "organisational maturity matrix" (see Table 3.1). The organisational maturity matrix may be described as an assessment of the coherence of the geo-information community. The more coher-

4 This section is based on Kok and Van Loenen (2005).

Table 3.1 Maturity of GII from an organisational perspective

Aspect	Stage: Stand alone/ initiation	Exchange/ standardisation	Intermediary	Network
Vision	Focus on individual organisation	Developed with all stakeholders	Implementation	Commonly shared, and frequently reviewed
Leadership	Focus on individual organisation	Questioned	Accepted	Respected by all stakeholders "champion"
Communication	Focus on individual organisation	Open between public parties	Open between all stakeholders	Open and interactive between all
Self-organising ability	Passive problem recognition	Neutral problem recognition	Actively helping to solve identified problems	Actively working on innovation
Awareness for GII	Professionals in one organisation: organisational GII	Professionals of organisations together: GII	Awareness at many levels including decision making	Commitment at all levels/continuous support in politics and management
Financial sustainability	Limited to projects	Neutral	Guaranteed for certain period	Sustainable but frequently reviewed

ent the community is, the more likely successful GII development. This may explain why well-intended GII initiatives around the globe are meeting resistance from some organisations within, or outside the geo-information community. For example, from a political-economic perspective, the resistance may be the result of a conflict between the GII vision and an organisation's business model. In such a context the development of a GII may be seen as a threat to individual organisations instead of an opportunity for society.

The GII maturity matrix consists of four stages of GII development (see table 3.1). Ultimately in the most advanced stage, the network stage, it is commonly understood what a GII consists of, and what its objectives and ideal are. Further, leadership, open communication channels and a pro-active geographic information sector have resulted in capacity that is such that the GII enjoys broad support at all levels which has resulted in sustainable funding for GII development. Although the network stage and the beginning stages are largely identifiable, this is less the case for the two stages in between. In this respect, the model suffers from the same characteristics as the other growth models. However, an insight is provided in a way to assess the maturity of a GII, and the model is useful for GII comparison.

3.5 Strategies promoting GII development

3.5.1 Why a strategy?

Geographic information infrastructures are not and should not be considered as a means to an end. Now we know how a GII may be defined, what its objectives may be, what components make up the GII, and how it may develop, we need to know how we could arrive at the objectives: the GII strategy.

Strategies utilize the vision for the GII. A strategy aims to reach the objectives, ideally resulting in the needed GII. It is required to direct the many efforts underway in the public and private sector and to build a solid foundation for the communication and use of geographic information (McLaughlin and Nichols, 1994, p. 63). A GII strategy focuses on one or more components of a GII. A definition for a GII strategy may be: the goals, conditions and starting points for the use of GIIs in communities (after Bemelmans, 1994, p. 83).

All the components of the infrastructure may facilitate the better use of geographic datasets needed for the well-being of that specific society. However, the road towards an optimum is not straightforward (see also Castells and Himanen, 2002, p. 3). Most initiatives recognize that to take full advantage of the GII potential, many interpretations of the current existing components have to be improved. Questions for a rather complex topic like a GII are: how to come to the maximisation of the potential? And: What is the most productive strategy that should be followed?

To develop a strategy, one needs to know the current situation for the components of the GII: what information is available, what is the quality, who are the users, creators, and suppliers, why is it collected, how is the information process funded and how satisfying is the current situation? An evaluation of the current status of the GII will highlight the positives and negatives. Further, it should clarify the new objectives of the GII.

The GII maturity matrix may be used to develop an effective strategy. Each of the five organisational components, together with technical issues such as required data characteristics, need to be part of the strategy. Per stage of development, the progress in development will determine for every component the strategy.

From a GII scholar perspective the necessity of a GII is clear: who can afford not to have it? (Rjabifard et al., 2003, p. 105). However, GIIs come in all shapes and sizes (cf. Masser, 1999). Every initiative will identify their own vision and as a result their own priorities. It may depend on its status and scope. However, how to arrive at what ideal is rather complex: to what extent are parties willing to cooperate, what resources are available, and which information do users need, how may these needs be addressed, and who are the users? Information about the driving forces of GII development may be used to come to a necessary GII strategy.

3.5.2 Driving forces of GII development

What is key in developing a strategy is knowledge about the forces that drive the development of a GII. Once the drivers are known, the strategy can be aimed at influencing these forces resulting in effective and efficient use of resources. Driving forces for GII development may be manifold and complex. What exactly drives GII development may vary from situation to situation.

Chapter 2 has shown that the driving force of the first generation GIIs has been information development where the second generation has focused on information use. Rajabifard and Williamson (2001) have provided six key factors to speed up GII development:

- awareness of use of geographic information and GIIs;
- involvement of the politicians concerned;
- cooperation between the various stakeholders;
- knowledge about the type, location, quality and ownership of datasets;
- accessibility of datasets; and
- the successful widespread use of the datasets.

From an institutional perspective, the first two forces are critical for the success of a GII. Especially high-level political support and strong leadership are commonly considered important (see e.g., Longhorn, 2004; Craglia et al., 2003; Rajabifard et al., 2003, p. 108). Awareness for the value of GII at the decision-making levels is, like any other issue, critical for its successful development (see, for example, Coleman and McLaughlin, 1998; Rhind, 2001; Masser, 1998; Shamsul Abdul Majid, 2000; Williamson et al., 1998). Rajabifard and Williamson (2001) argue that:

> "All stakeholders, including politicians and technical people, should be aware of the potential and advantages of geographic information and GIIs. The organisation responsible for a GII initiative must help to raise this awareness. The development of a GII is a matter of cooperation and partnerships between all stakeholders. The involvement of those politicians concerned with the GII development is essential. The politicians' support provides legitimacy and encourages the necessary financial investment for the GII development."

However, GII development is not without difficulty due to the lack of awareness for its need both inside and outside the geographic information sector. Especially top management is difficult to reach (see Graafland, 1999, p. 15). Their involvement, however, is critical for GII development, especially in the intermediary and network stage. The 'garbage can model' of Cohen, March and Olsen (1972), improved by Kingdon (1995) may learn how awareness for the GII may be developed among high level politicians and/or high-level bureaucrats. Linking the GII to the 'driving forces' of these high-levels may promote the awareness for GII and its development.

3.5.3 The Garbage can model

The 'Garbage can model' identifies three major factors that may lead to political recognition:

1. inexorable march of problems pressing in on the system;
2. a process of gradual accumulation of knowledge and perspectives among the specialists in a given policy area, and the generation of policy proposals by such specialists, and
3. the political process.

Although the model attempts to only explain how the agenda of politicians in the US is built, it may also apply to the development of a GII.

Inexorable march of problems pressing in on the system: problem recognition

Kingdon identifies three types of problems that can be linked to this category:

- a crisis or event that might signal the emergence of such problems;
- change in a widely respected indicator: the number of deaths in traffic goes up or down;
- feedback from the operation of current programs.

Kingdon (1995, p. 173) provides the example of lobbyists of urban mass transit. First urban mass transit was thé solution for the congestion problem in the cities. Then, when the environment was an important political issue, urban mass transit became the solution for the pollution issue. Finally, it was used as the remedy for energy problems. Since geographic information may be linked to almost any problem in society, our lobbyists need to ask themselves continuously: “What will work this year, what’s hot this year that I can hang GII on?” The message here is: have your solutions ready and wait because there is always an issue where one can relate its geographic information solution to. Recent examples are the disaster in New York at 9/11 and the need for high quality geographic information to master effectively the disaster. As a result of 9/11 the Homeland security policy was initiated with a major role for geographic information. Similarly, geographic information can be used for flood control and management (e.g., the 2004 Tsunami in South-East Asia, and the 2005 hurricanes of Katrina and Rita), emergency service improvement, and many more pressing problems.

A process of gradual accumulation of knowledge and perspectives among the specialists in a given policy area

New knowledge may also change the political agenda. New knowledge may result in the accumulation or diffusion of academic arguments among policy makers so they are more receptive to some proposals than others. As a result, alternative policy proposals may be generated. For example, the EU directive on the re-use of public sector information (EU, 2003) was supported by several researches all pointing in the same, yet not existing, direction of open access for public sector information (Pira et al., 2000; Lopez 1998; Weiss and

Pluijmers, 2002). As a result the European Directive aims to promote less restrictive and more transparent policies for public sector information.

Also new technology may bring new insights and policy innovation. For example, according to Moore's Law computer-processing power may double every 18 months, which may lead to faster technology allowing for new applications. In the geographic information sector, new technology has brought the advanced GIS and GPS systems, Location Based Services, and even has brought satellite imagery. These were previously only available to professional users, but are now part of the every day life of many individuals (see, for example, GoogleEarth and VirtualEarth). Other developments in, for example, nanotechnology information storage (website Newsfactor) allowing consumers to download quickly and store geographic information in, for example, a PDA (personal digital assistant), or other device. Both developments may have allowed for the emergence of location based services (LBS) with access to geographic information at any time and any place. New technology has allowed for the inexpensive dissemination of geographic information through electronic means, for means to search for information (clearinghouses), and as a result for the widespread knowledge of the existence of a dataset.

Political process: political events

Kingdon categorises four potential events that may impact the political agenda:

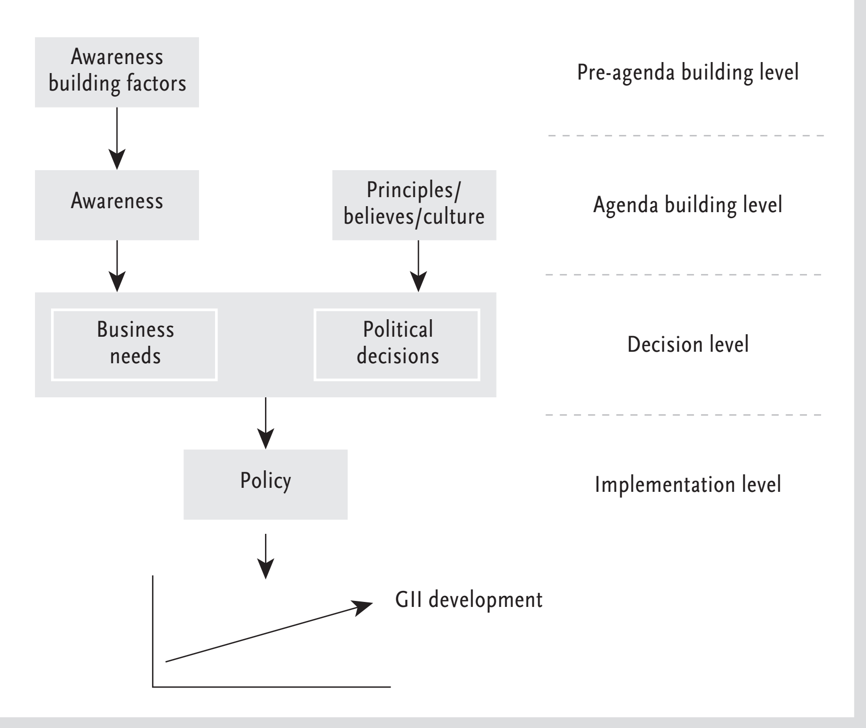
- swing of national mood;
- vagaries of public opinion;
- election results, and
- change of administration.

The political process can have a major impact on the political agenda. For example, after September 11, 2001, many people and governments in the world started to feel less secure. The call to make security a major issue resulted in the introduction in the US but also in the Netherlands of red, orange, and yellow lights for the likelihood of a terrorist attack. Further, the balance between privacy and security information needs was often questioned. The swing of the national mood has resulted in these changes in political priorities.

The (political) believes, culture, or the fads and fancies of decision-makers are not easy to influence, but may certainly be relevant for choices made.

According to Kingdon, the three factors are largely independent of one another, and each develops according to its own dynamics and rules. But at some critical junctures the three streams are joined, and the greatest policy changes grow out of that coupling of problems, policy proposals, and politics. Solutions become joined to problems, and both of them are joined to favourable political forces (Kingdon 1995, 20). This coupling is most likely when policy windows – opportunities for pushing pet proposals or conceptions of problems – are open.

Figure 3.2 Drivers of GII development



The first two factors that Kingdon has identified, new problems and new knowledge, may also be described as awareness building factors. New insights about the importance of geographic information, new technology allowing for new solutions to old problems, and new research results may make people aware of the value of geographic information and the geographic information infrastructure. Figure 3.2 provides the GII drivers based on Kingdon's "Garbage can model".

What specific force is driving the GII at a certain time may depend on the stage of development of the GII. The strategy will help to complete the GII vision. Ultimately this may result in the ideal GII of that day.

3.6 Summary

Geographic information infrastructures exist in many shapes and sizes. Although the short-term objectives may vary each initiative ultimately aims to contribute significantly to local, and national, but also regional or global economic growth and the establishment of preferred social and environmental objectives. The path towards the 'ideal' is, however, initiative specific and no blue-print for arriving at the ideal exists (yet). This chapter has provided the institutional stages of development of the newly developed GII maturity matrix. It should help GII developers in finding a strategy that fits their GII best. A

GII strategy should be aimed at the forces that influence the eight core components: the driving forces. Only from personal experiences the driving forces of GIIs are recognised. These may be awareness building factors, and political principles, resulting in business needs and political decisions that lead to further development of a GII. When developing a GII, one has to remember that the ideal GII will vary among initiatives because the constituents have different needs. Whether an initial ideal will ever be reached depends on how constant the needs of the constituents are, among other issues.

4 Development of a GII from a dataset perspective

4.1 Introduction

The willingness of consumers to pay for a product is determined by the value of the product (Gopal and Sanders, 2000, p. 88). The value of a product may be a sum of its characteristics. Characteristics are relevant for a user if the information acquired contributes to the impro vements of a particular decision making process in which it is used (Krek, 2002). The value of geographic information relies upon its "coverage and on the strengths of its representation of diversity, on its truth within a constrained definition of that word, and on its availability" (Longley, 2001, p. vii). Different categories of information should be treated differently from an access policy point of view. Chapter 2 categorised two types of geographic datasets: framework datasets and thematic datasets. The distinction between framework datasets and thematic datasets is critical for the outcome of the decision on most beneficial access policy.

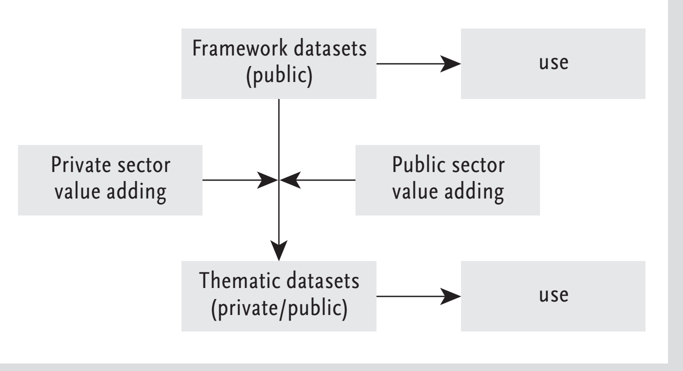
This chapter focuses on framework datasets in general, and large-scale geographic framework datasets more specific. It starts with explaining in general terms what framework datasets are (section 4.2), provides examples of commonly accepted framework datasets, and explains that different levels of GII may regard different datasets as framework dataset. Further, technical data characteristics are described that are considered important for framework information. The second part of this chapter (section 4.3-4.5) elaborates on the technical characteristics of framework information. It identifies from a user and GII perspective the technical characteristics a framework layer should adhere to. This user requirement analysis results in a GII maturity matrix for framework datasets (section 4.6). Finally, section 4.7 summarises the chapter's findings.

4.2 Framework and thematic information

4.2.1 Definitions of framework and thematic information

Framework datasets are datasets that are commonly used as a base dataset upon which other datasets can be placed (Groot and McLaughlin, 2000; Phillips et al., 1999), datasets commonly referred to, or a sufficient reference for most geo-located data (Luzet et al., 2000). A framework dataset may refer to the fewest number of features and characteristics required to represent a given data theme. Framework datasets are the foundation on which the GII builds. Framework datasets are the basis for many geographic information applications. Without reference to a framework dataset the use of other information is often limited. Once the need for specific information is independent of a particular time-frame, it has become geographic framework information. The US National Research Council (NRC) has provided the following criteria for framework datasets within the NSDI (NRC, 1995, p. 26):

Figure 4.1 Framework and thematic datasets



- broadest national constituency of users – spanning the largest geographic area and supporting the greatest number of interests;
- significant return of investment – in the form of increased productivity and efficiency;
- needs to manage critical resources, for developing policies, or administering programs for preservation and use of resources;
- serves as fundamental sources to create or leverage and other geographic information.

Especially the first criterion shows that not every interesting detail should be included in a framework dataset. Focus should be on the content needs of a broad spectrum of users. Additional information required for specific applications can be integrated with the framework layer, but the data quality requirements (e.g., update frequency and coverage region) may differ from the framework and accordingly these data may be better acquired separately.

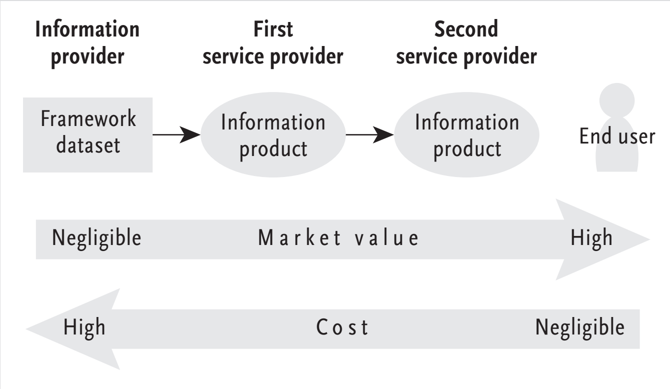
Framework datasets build on the geometric infrastructure including references systems, or geodetic control. Although the geometric datasets are the foundation of the GII, in this study they are not considered framework datasets.

Framework datasets can be used as base for thematic mapping. If specific thematic information, or themes are added to the framework dataset, they build on framework datasets (see Figure 4.1; see also Williamson 2000). The resulting dataset is created for one or limited time use on a project basis, or for multiple uses for a limited group of users. Application datasets is also known as value-added datasets. In some instances, this value adding may be referred to value adding services, indicating that the framework dataset is used and built on to create a product for the (commercial) market. Many government agencies use the thematic information provided by private sector businesses.

4.2.2 Framework datasets as basis for service provision

Framework datasets are not only the basis for thematic datasets, they are also the basis for geographic information service provision. With respect to tertiary use, Micus (2001b, p. 12) noted that the value of framework large-scale

Figure 4.2 The paradox of the value creation



Source: based on Micus 2001a, p. 12

geographic information increases with the number of services added to the information. The more services built on the framework layer the higher its use and value. Adding services is relatively inexpensive, while collecting the data for the framework dataset is expensive. For framework datasets without any services a limited market exists (see Figure 4.2). They are, however, an important basis for added value products (beginning of the value chain). Value-added products represent the true market value for the user, although the creation of these products is relatively inexpensive. This negative correlation between the cost of collection framework dataset and its use value is what Micus calls the 'paradox of the value creation': the creation of value-added products based on a framework dataset is relatively inexpensive, but the market highly values these products.

4.2.3 Examples of framework datasets

What should be considered a geographic framework dataset depends on the needs of a community at a particular time. Framework datasets may be (ortho-)imagery, topographic information, or an application building on the topographic information. Table 4.1 provides examples of a wide variety of core layers used among different national and regional initiatives. The table shows a summary of the outcomes of the GSDI survey of national and regional geographic information infrastructure activities around the globe (Onsrud, 1998b) asking about national framework datasets according to their national GII representatives. The responses to this survey indicate that the primary types of framework datasets are:

- Topography (elevation);
- Cadastral information;
- Geodetic control;
- Government/administrative boundaries.

However, the list provided in Table 4.1 is a little misleading. While in a European context topographic information implies features related to the earth

Table 4.1 Most frequently mentioned framework datasets in surveys of national and regional geographic information infrastructure activities world-wide

Framework dataset	The primary types, categories or forms of spatial digital data being made available through national GIIs (out of a total of 23 countries)
Land surface elevation/topographic	19
Cadastral/land ownership	18
Geodetic	16
Government boundaries/administrative boundaries	12
Hydrography/rivers and lakes/planimetric	9
Digital imagery	8
Land use/land cover/vegetation	8
Transportation/roads	7
Bathymetry	6
Physical features/buildings	5
Place names	4
Ocean coastlines	3
Geology	3
Real estate price register/land valuation	3
Land title register	2
Postal address	2
Soils	2
Bedrock elevation	1
Wetlands	1
Register of private companies	1
Gravity network	1
Zoning and restrictions	1

Source: Onsrud, 1998b

like waterways, buildings, bridges and roads, in a US context topographic refers to the third dimension, i.e., land surface elevation information. Planimetric information in the US context is generally the topographic information in a European context. Since the interpretation of the survey results has been performed from a US perspective, it is likely that the scores for land surface elevation/ topographic are too high while those for planimetric are too low. For example, the categories "Physical features/buildings" (5 counts), "Hydrography/rivers and lakes/planimetric" (9 counts) and "Transportation/roads" (7 counts) can all be considered topographic information. If these categories are merged into one category "Other topography", the score would be 21 hits, a number one ranking.

Table 4.2 provides an adjusted overview of the framework datasets of GSDI questionnaire, the framework datasets of the US federal government, and the

Table 4.2 Framework datasets

Category (adjusted from GSDI survey)	GSDI survey adjusted	GSDI cookbook	United States (fed)	Netherlands
"Other" topography (physical features, water and road networks)	21	Hydrography/ Transportation	Hydrography/ Transportation	Large scale base map/ Topography
Land surface elevation/ topographic	19	Elevation	Elevation	
Cadastral/ land ownership	18	Cadastral information	Cadastral information	Cadastral information
Geodetic control	16	Geodetic control	Geodetic control	Geodetic control
Government boundaries/ administrative boundaries	12	Governmental units	Governmental units	
Digital imagery	8	Ortho-imagery	Ortho-imagery	
Land use/ land cover/ vegetation	8		Land use data	
Bathymetry	6			
Other	–	Geographic feature names		Population register Enterprise register Building register Address register

Netherlands. In addition, it includes the GSDI cookbook recommended framework datasets. The framework datasets summarised are mostly produced and used by government entities.

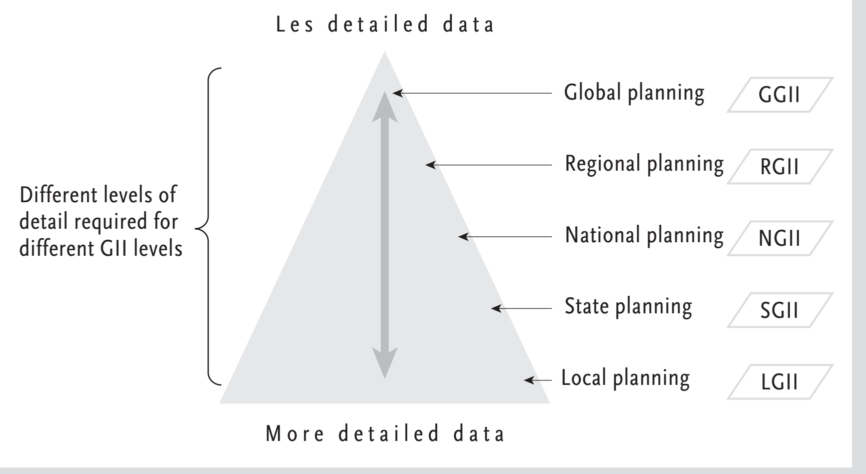
4.3 Scale or resolution of the information

GIIs can exist at various jurisdictional levels. Each level has its own needs. Rajabifard (et al., 1999) stresses that the 'lower' GII levels require more detailed information than the 'higher' levels (see Figure 4.3).

The costs of geographic information collection varies significantly with a variety of factors, scale being one of them. Scale can be defined as "the ratio of distance on the map to distance on the Earth's surface" (Longley, 2001, p. 75). A map with a scale of 1:24,000 reduces everything on the Earth to one 24,000th of its real size. The collection of geographic information at a large-scale, i.e. 1:500 – 1:5,000, offers a detailed overview of a certain area for a variety of objects or items.

In addition, large-scale information needs a higher update frequency to be of use than small-scale information due to the frequency of changes (see Figure 4.4). In general one can say: the larger the scale of the geographic information, the higher the costs of collection, and maintenance. For example, the cost to create the Large-scale Base Map of the Netherlands (scale approxi-

Figure 4.3 Hierarchal levels of GII and level of detail of information



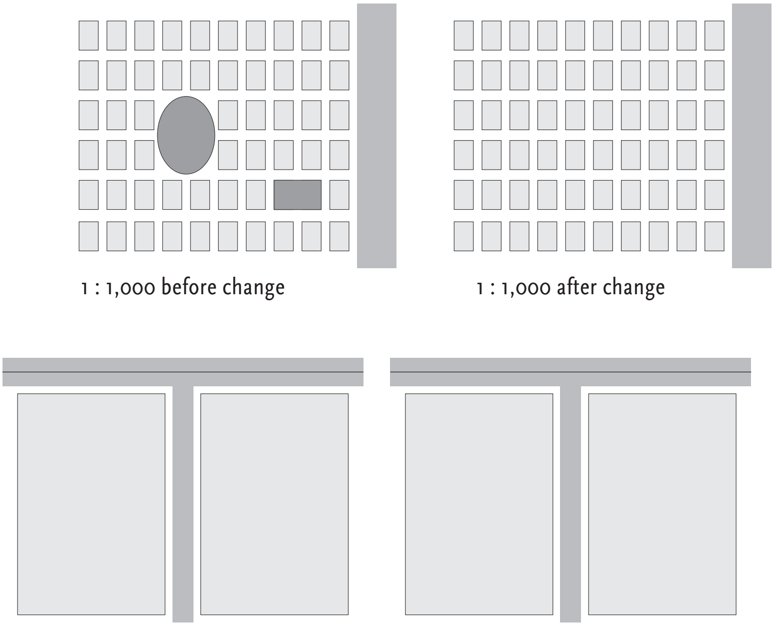
Source: Rajabifard et al., 1999

mately 1:1,000) has been assessed at approximately €230 million (K+V, 2001, p. 11; den Boer, 2005) and its maintenance at €27 million per year (8% of total creation costs: 6% normal maintenance and 2% growth). Creating a topographic dataset of the Netherlands at a 1:100,000 scale would cost significantly less (approximately €6,000,000).

In a digital context, scale is not fixed. The equivalent of scale in a digital environment is the resolution of the information. Resolution refers to the amount of detail that can be discerned in space, time or theme (Veregin and Hargitai, 1995, p. 180-181). Spatial resolution refers to the size of the objects, the level of detail that can be discerned on a digital image. Temporal resolution refers to the minimum duration of an event that is discernible in the database. Thematic resolution depends on the definition of the classification of the attributes. For the temporal resolution they recognise that "the temporal resolution of topographic maps is actually considerably coarser, as they are intended to represent conditions that do not change significantly over a time interval of years. The locations of rapidly-moving objects clearly resolvable on individual aerial photographs, such as automobiles, are not included on such maps. The intent is to produce a map that is, in a sense, free of time, in that the features shown on the map do not change appreciably over time" (Veregin and Hargitai, 1995, p. 181). The datasets subject to this study are framework datasets providing the data elements that are time independent for a certain longer period (e.g., a year).

The differences between the information needed in each GII level, the different use(r)s and the accompanying costs of creation of the dataset would justify a separate treatment for each individual GII level by researchers researching access policies. Discussions on access to government geographic information, however, rarely address scale.

Figure 4.4 Differences in scale and change representation



4.4 Quality of information

The costs of geographic information collection and maintenance rely on the requirements of the quality of the data, among other aspects: the higher the quality, the higher the cost of collection and maintenance. Quality of information may be defined as the level of truthful and objective representation of reality (Veregin, 1999, p. 178). More common is the definition of fitness for intended use (Veregin, 1999, p. 178). It should be noted, however, that it is the user who decides whether he can use the information or not, and it is the user who assesses the quality of the information for his specific purposes. The technical characteristics of the dataset may be decisive for the level of use for a specific group of users. Therefore, this chapter uses instead of quality of information the wording characteristics of information in order to be context independent.

Information characteristics may be split in internal and external characteristics. The internal characteristics decides the extent to which its primary and secondary users can use it. The external qualities may decide then the extent to which other users are able to use the dataset.

This paragraph explains the concept of internal and external data characteristics. Aspects directly linked to the technical characteristics of the information are the characteristics of the GII technology. These aspects are outside the scope of this study and not discussed.

4.4.1 Internal data characteristics

The internal data characteristics may be defined as the characteristics of the data as such: the organisation of the data, the positional accuracy, the semantic accuracy, the completeness, the data structure, the consistency, and temporal information (Guptill and Morrison, 1995, p. 8-9).

Positional accuracy refers to the horizontal, and/or vertical accuracy of the features in a dataset. The positional accuracy can be divided in the relative accuracy and the absolute accuracy. The relative accuracy provides the position of an object in relation to other objects or elements in the dataset; for example, parcel A is adjacent to parcel B. Absolute accuracy provides the position relative to a national grid: parcel A has coordinates x, y, and z, which are 5 centimetres accurate.

An attribute can be defined as a fact about some location, a set of locations, or feature on the surface of the earth (Goodchild, 1995, p. 59).

Semantic accuracy is the quality with which geographical objects are described in accordance with the selected model. It refers to the meaning of the geographical object rather than to the geometrical representation (Salgé, 1995, p. 139). Semantic accuracy may be defined as the degree of uncertainty about the object (Goodchild, 1995, p. 59) provided a certain definition of the classification hierarchy. For example, several lines in a dataset may be classified as roads. The certainty that this classification is correct will be a measure of the semantic accuracy. The following examples show that semantic accuracy depends on the selected classification model. Areas classified as forest should adhere to the same definition of a forest. If this is not the case, a forest in one dataset may not be categorised as forest in another. An example from practice comes from the road information of the Netherlands and Germany. The data model in the topographic dataset for roads in the Netherlands had three categories of road width: 0-2 meters, 2-7 meters, and beyond 7 meters. The German data model had other categories: 0-3 meters, 3-12 meters and beyond 12 meters. Integrating the two road datasets in one dataset would result in uncertainties for roads with a real width between 2 and 3 meters and roads wider than 7 meters. In order to circumvent further difficulties with future integration efforts, the Netherlands now documents the real width of the roads (personal communication Wilko Quak).

Completeness refers to the degree to which the database achieves success as a model of the real world (Veregin and Hargitai, 1995, p. 169). The extent of completeness is directly related to the needs of specific user groups. A road centre line dataset and building centroids with an address may satisfy a food delivery services. Such a dataset will, however, be of less value for emergency services that need to know to the width of a street and the outlines of a building. Figure 4.5 shows an example of two datasets at similar scales with different content.

Figure 4.5 Differences in information content at similar scales (left side topographic dataset of City of Newton, MA (USA); right side road centre line of maps.google.com)

Source: City of Newton, Massachusetts, USA

Further, the data structure can be categorised as an internal characteristic. Data structure is the physical or logical relationship among data elements, designed to support specific data manipulation (website IEEE). Two main categories can be distinguished: spaghetti structures and object-oriented structures. Worboys (1995, p. 192) has described the spaghetti data structure as follows:

> "The spaghetti structure represents a planar configuration of points, arcs and areas. Geometry is represented as a set of lists of straight-line segments. Each such list is the discretization of an arc that might exist independently, or part of the boundary of an area. There is no explicit representation of the topological interrelationships of the configuration, such as adjacency relationships between constituent areas."

Other representations capture explicitly some of the spatial relationships not inherent in the spaghetti representation, they may be considered object-oriented data structures. They, for example, can represent topological relationships such as adjacency (Worboys, 1995, p. 193). Optimised object-oriented structures provides a complete and faithful description of the topology of the object. The key of the representation are the notions of strong and weak connectivity (Worboys, 1995, p. 199). The object-oriented datasets are necessary to model complex situations, such a geometric objects, which can change over a period of time. The complexity of spatial objects requires methods to define and use object-oriented data types (Egenhofer and Frank, 1992).

A consistent database is one for which there are no apparent contradictions in the relationships among the encoded features; the database is free of topological errors (Veregin and Hargitai, 1995, p. 183). In addition, the meaning of the geographical objects should be consistent in the dataset: the data model should be consistent.

Finally, temporal information is important in that out-of-date information is not as useful as current information. Especially in highly dynamic areas geographic information needs to be current in order to be of use.

4.4.2 External data characteristics

External data characteristics may be defined as the characteristics of the dataset that may be relevant for potential users that are outside the organisation that has collected and processed the information. This study considers the degree a dataset covers the area of a jurisdiction, the level of interoperability, metadata documentation, and data characteristics guarantees as external data characteristics.

Coverage of jurisdiction
The coverage of a dataset is an external data characteristics element. The user's needs for a dataset may be for a specific area. If the dataset's internal technical characteristics are sufficient, but only partly covers the area of interest, it would be of less use. The value of a framework dataset covering an entire jurisdiction would be more useful than one only covering a part (see Longley, 2001, p. vii).

Interoperability
The extent to which a dataset is interoperable with other datasets is an external data characteristic. Interoperability with other datasets implies that a dataset is interoperable with datasets with a similar level of geographic detail (horizontal), with datasets including less detail (small-scale datasets, vertical interoperability), and datasets with administrative information. Interoperability allows users to understand without ambiguity the geographic information and the related metadata (ISO/TC211 19115). Interoperability is:

> "the ability of different types of computers, networks, operating systems, and applications to work together effectively, without prior communication, in order to exchange information in a useful and meaningful manner. There are three aspects of interoperability: semantic, structural and syntactical" (website CSUN).

Information that is interoperable with other information, and which can be used in commonly available software packages have more value from a GII perspective than those that are not interoperable. The use of data models and standards are important for a dataset's level of interoperability. Kaletas (et al., 2005, pp. 113-114) has stressed that:

> "Information models provide a means for describing entities and concepts in a domain in a structured way, whereas standards allow collaborators to share and exchange information. Availability of such [information] models will enable the development of generic and uniform mechanisms for managing the information represented by these models.

Standards on the other hand, further allow to overcome semantic heterogeneity (e.g., by standardising elements and their meaning), syntactic heterogeneity (e.g., by standardising data models, query, manipulation languages and exchange formats) and systematic heterogeneity (e.g., by using standard communication mechanisms) that may occur among the information models and information management systems of collaborators."

A special interoperability component is a dataset's metadata documentation. The Open Geospatial Consortium (OGC) and ISO/TC211 are leading the developments in geo-interoperability with specifications supporting interoperable solutions that 'geo-enable' the Web, wireless and location-based services, and mainstream IT (website OGC).

Metadata documentation

Metadata are data about data, telling the user where the data are located, how the data were collected and maintained and by whom, how the data can be accessed, and what their characteristics are (McLaughlin and Nichols, 1994, p. 71). More comprehensive, "metadata is data associated with objects which relieves their potential users of having full advance knowledge of their existence or characteristics. A user could be either a program or a person" (Borgman, 2000, p. 68). Thus, metadata allows users to find and assess a dataset before acquiring the dataset. Documenting the metadata is important for understanding the data: "User and producer may be from entirely different backgrounds, with very little in the way of shared terminology or culture" (Longley, 1999, p. 175). Major uses of metadata are to:

- help organize and maintain an organisation's internal investment in geographic information;
- provide information about an organisation's data holdings to data catalogues, clearinghouses, and brokerages; and
- provide information to process and interpret data received through a transfer from an external source (FGDC, 1997).

Adequate explanatory documentation or metadata can eliminate barriers in the use of geographic information. For example, time to include a dataset in one's GIS and a user's understanding of the data, may be limited to a minimum through extensive and full metadata documentation (see Holland, 1994).

Metadata are one of the key components in the Federal Geographic Data Committee (FGDC) strategy to develop the US National Geographic information infrastructure, as evidenced by a statement made in a 2000 report: "If you think the cost of metadata production is too high, you haven't compiled the costs of not creating metadata-loss of information with staff changes, data redundancy, data conflicts, liability, misapplications, and decisions based upon poorly documented data" (FGDC, 2000). The Infrastructure for Spatial Information in Europe (INSPIRE) initiative also considers the documentation of metadata and the access to metadata as one of the critical components in developing the European Geographic information infrastructure (INSPIRE, 2004). The experience with the Mars Climate Orbiter is an example of how important accurate metadata can be for a specific use. In 1999 the Mars Climate Orbiter was lost due to two teams using different measurement units: one used English units (inches, feet and pounds) while the other used metric units (centimetres, meters and kilograms) (Clark and Canizares, 1999). Another failure, that adequate metadata may have prevented, involved an out-of-date image that ultimately led to the bombing of the Chinese Embassy in Belgrade (Ponce 1999).

However, information system managers may regard the additional costs of cleaning up and documenting the data they collect so that they can be shared with others as outweighing the benefits to be obtained by gaining access to other data sets (Masser and Ottens, 1999, p. 37). Harvey (2001, p. 37), for example, found that local government suppliers of geographic information do not always recognize the documentation of metadata as being of significant importance. They may believe that the knowledge currently in the heads of employees will remain with the organisation, also when employees leave the organisation.

Different types of metadata exist. Borgman (2000, p. 69) distinguishes three types: (1) full text indexes, (2) simple structured generic formats, and (3) formats with a more complex structure and domain specific metadata. A metadata standard in the geographic information domain is the ISO/TC211 metadata standard 19115. It specifies four types of metadata: mandatory core metadata, conditional core metadata, optional core metadata and comprehensive metadata (see Table 4.3). Core metadata are the metadata elements required to identify a dataset, typically for catalogue purposes (ISO/TC211 19115). Mandatory core metadata consists of the following seven elements: dataset title, dataset reference date, dataset language, dataset topic category, abstract describing the dataset, metadata point of contact and metadata date stamp. In addition, the standard specifies conditional core metadata: geographic location of the dataset, dataset character set, metadata language, and metadata character set. Optional core metadata would then be dataset responsible party, spatial resolution of the dataset (scale), distribution format, additional extent information for the dataset, spatial representation type, reference system, lineage, on-line resource, metadata file identifier, metadata standard name and version.

Comprehensive metadata provides a user more detailed information about the dataset needed to make additional judgment (Brox et al., 2002; Bishr and Radwan, 2000; Masser, 2001). It includes metadata about the technical characteristics of the dataset, and metadata about the access restrictions imposed, and standard order process information. Using each of these elements will increase interoperability (ISO 19115; Micus, 2001a, pp. 22-25).

Table 4.3 ISO/TC 211 metadata requirements

Metadata	Requirement
Core metadata	dataset title
	dataset reference date
	dataset language
	dataset topic category
	abstract describing dataset
	metadata point of contact
	metadata date stamp
Conditional core metadata	dataset character set
	geographic location of dataset
	metadata language
	metadata character set
Optional core metadata	dataset responsible party
	spatial resolution of dataset (scale)
	distribution format
	additional extent information for the dataset
	spatial representation type
	reference system
	lineage
	on-line resource
	metadata file identifier
	metadata standard name and version
Comprehensive metadata	detailed information about the technical quality of the dataset
	the use and access restrictions imposed
	standard order process information (contact information)

Borgman's categorisation of three types of metadata can be applied to different levels of a dataset. If applied to the dataset level, only generic metadata is provided: metadata that applies to the dataset. These metadata do not provide specific information per object (or attribute). Object specific metadata provides information about the currency of a specific object, its accuracies, and lineage information such as the data collection equipment, and the surveyor. The availability of metadata at this detailed level is likely to be critical for successful use in emerging web feature services.

In addition to the completeness (content) of the metadata documented, also adherence to a metadata standard would increase the ease to understand the data in the dataset. ISO 19115 is the ISO/TC211 Geographic information/ Geomatics standard for metadata documentation. ISO 19139 is the standard that allows for translating the generic 19115 metadata into specific XML schemas without misconceptions of the interpretation. Another useful standard already mandatory in the federal government in the US is the Metadata Standard of the Federal Geographic Data Committee (FGDC).

4.5 GII requirements for framework datasets at the local level

In chapter 2 the user perspective has been identified as the starting point for developing a GII: once the information fulfils the needs of the user it will be used and the more it is used the greater its value for society (see also Onsrud and Rushton, 1995, p. ix). A GII facilitates the process of data acquisition, information delivery and information usage: the geographic information process. It is the means to enable the collection, flow and use of information. Therefore, it was reasoned that the objective of a GII should be:
1. to provide users with the geographic information they need;
2. in a way needed by these users;
3. in an efficient way.

However, what (geographic) information does society need and how may that information efficiently be acquired, distributed and used? (Groot, 2001, p. 386). Within a jurisdiction users should "reach agreement on what framework datasets are required to meet their common interests, to what standards they should be collected and maintained, and what the priorities are for their collection" (Rajabifard and Williamson, 2001). Agreement about the necessary framework datasets is a first step towards the existence of such a dataset.

This paragraph addresses primary, secondary, and tertiary user needs for finding, assessing, accessing, and using available large-scale geographic framework information. User in this context should be interpreted broadly. It includes users of a single dataset, users of multiple dataset at a same GII level (horizontal integration), users using a single generalised dataset, users using multiple generalised dataset (vertical integration) and an appropriate combination of these users. The by NAPA synthesised GII 'ideal' (NAPA, 1998, p. xii) has been used as a starting point. The needs are further developed with other relevant literature addressing user needs and where applicable interview findings are added to the 'ideal'. The NAPA report addresses both technical and non-technical data characteristics in its GII 'ideal' (NAPA, 1998, p. xii). This paragraph assesses the user requirements for framework datasets. The first requirement is that the framework dataset exists (section 4.5.1). Further the internal (section 4.5.2) and external technical data characteristics (section 4.5.3) for framework datasets are discussed. Where applicable, this paragraph addresses the requirements for large-scale topographic and cadastral datasets. The non-technical aspects will be provided in chapter 5.

4.5.1 Framework datasets must exist

Provided that all users with a specific task operating at the local level, including cross-public-administrative boundary users (e.g., utility companies, school districts, public transport districts, water districts, police or emergency service districts, among others), need information concerning highly dynamic areas, the information has to exist (see also McLaughlin and Nichols, 1994, p. 63; NAPA, 1998). Further, the dataset must be compiled, archived and maintained in digital form (NRC, 1995, pp. 29-30).

4.5.2 Internal data characteristics requirements

The internal data characteristics are defined as the characteristics of the data as such: the organisation of the data, the positional accuracy, the attribute accuracy, the completeness, the consistency, semantic accuracy, and temporal information (Guptill and Morrison, 1995, pp. 8-9). This section discusses each of these aspects from a GII perspective.

A framework dataset needs to be complete
Framework datasets should be complete (NRC, 1995, p. 9). However, what exactly completeness constitutes is user dependent. For topographic information a minimum content may be buildings, topographic boundaries (roads, waterways, dikes, sustainable demarcations), and street names (see, for example, GBKN, 2005). More comprehensive topographic datasets include street furniture, house numbers, building numbers, trees, valves, type of trees in the public area, type of buildings (schools, public offices), type of objects (swimming pool), type of pavement (sand), and type of road (cycle paths).

A minimum content for cadastral information is parcel boundary, parcel-ID, and buildings for the relative accuracy. More comprehensive information includes a linkage to topographic elements as edge of pavement, land-use, or soil assessment.

A framework dataset needs to be accurate
"Most local government functions are in direct service to the public whether it be utilities, police, fire, or other services causing demand for highly accurate, current and transactional data" (STIA, 2001, pp. 8-7/8).

Accuracy needs may differ among different information needs, but generally a positional accuracy at, at least, the metre level is needed to be useful at the local GII levels. For example, in the US, the National Research Council (NRC) has assessed the needs of property surveying and civil engineering survey at 0,01 metre horizontal resolution. Cadastral mapping, and utility location need is 0,10 metre horizontal resolution, and facility management for utilities needs at least 1 metre resolution (NRC, 1995, p. 11). The Ohio Geographic Information Program found that users in urban and near urban areas need a locational accuracy of 0,77 metre (2,5 feet) or better (NRC, 1995, p. 24). Also private sector entities require accurate information due to customer satisfaction, liability and revenue issues (STIA, 2001, pp. 8-8/9).

Further, framework datasets must be geometrically integrated with the GII (NRC 1995, 29-30). This implies that the positional accuracy of the datasets should be similar. From the perspective of a GII, where datasets should be interoperable with each other, only a relative accuracy indication is insufficient: an absolute positional is necessary to link or overlay the information.

A framework dataset needs to be current

Data currency and timeliness and frequency of information updates are also critical for the value of a framework dataset (e.g., critical for disaster management) (STIA, 2001, pp. 8-8/9; see for building information also Micus, 2001a, pp. 22-25). In general, professional end-users working in and responsible for managing certain aspects in densely populated areas need current information. Section 3 of this chapter shows that at a large-scale almost any change in the real world impacts the currency and usefulness of a large-scale topographic dataset. For example, taxi drivers using a dataset from a year old, need to use their local knowledge in changes in the real world, because more recent changes in the real world are not included in the dataset. Therefore, the car navigation system's shortest path may be incorrect, or fail because of a new road block. Similar arguments may be used for cadastral information. Micus has stressed the importance of current information (Micus, 2003, p. 8) and even of daily updates (Micus, 2001a, pp. 22-25).

For many purposes, topographic information accurate for one to two years is sufficient. For cadastral information more current information may be required.

A framework dataset needs to be object-oriented

Use of datasets with spaghetti data structures is limited to almost no more than viewing information comparable with views on paper. Information with full topology can be used for many GIS purposes (viewing, analysing, forecasting). Moreover, object-orientation allows geometric datasets to be fully interoperable with administrative datasets.

A framework dataset needs to be consistent

A dataset needs to be consistent from an accuracy and topological view. Adherence to standard data model and internally clean topological relations are required (see also section 4.5.3 under Framework datasets should be interoperable).

Table 4.4 Internal data characteristics requirements from a GII perspective

	Stage			
Aspect	Stand alone/ initiation	Exchange/ standardisation	Intermediary	Network
Content	Limited	Core		Comprehensive
Horizontal positional accuracy	> metres	Decimetre-metre		Centimetre-decimetre
Attribute accuracy	0-50%	50-80%		80-100%
Currency	>5 years	2-5 years		0-2 years
Orientation	None	Spaghetti	Object	Optimised object
Consistency throughout the dataset	None	Poor	Core	Excellent

The internal data characteristics summarised

Table 4.4. summarises the required internal data characteristics. A framework dataset should ideally be a dataset in digital vector format, with comprehensive, consistent, accurate and current information.

4.5.3 External data characteristics requirements

External data characteristics may be defined as the characteristics of the dataset that may be relevant for potential users, but are not considered internal data characteristics. The external characteristic components of a dataset address this requirement: the coverage of an area of a jurisdiction, the degree of interoperability, metadata documentation, and data characteristics guarantees.

External data characteristic requirements may be operationalised through the efficiency component of the GII objective. Efficiency is "the production of the desired effects or results with minimum waste of time, effort, or skill" (website Webster). In a GII context, efficiency implies for the technical characteristics of a framework dataset that the duplicate collection of a dataset is minimal (see also NAPA 1998, xii); the dataset is shared or commonly used by as many users or communities. In addition, it should be relatively easy to integrate the dataset with other datasets, both horizontally and vertically. This requires the dataset to be interoperable horizontally and vertically. Further, efficiency implies that time needed to understand the dataset is limited to a minimum. Linking these requirements to the technical aspects of a dataset, results in bandwidths of technical data characteristics from a GII efficiency perspective as provided in Table 4.5 at the end of this section. Fulfilling these GII requirements is likely to satisfy the needs of the tertiary users.

Framework datasets should cover a complete jurisdiction

In order to integrate heterogeneous datasets easily into one ubiquitous dataset and to be interoperable with other levels of the GII and other datasets at the local level, the local framework datasets need jurisdiction-wide uniform quality (see STIA, 2001, pp. 8-8/9; Micus, 2001a, pp. 8, 23; Micus, 2003, pp. 8, 24, 45; NAPA, 1998; Holland et al., 1998, p. 8; Meixner and Frank, 1997, p. 11).

One dataset covering a complete jurisdiction available from one source would obviously be the optimum. However, also several datasets that together cover an entire jurisdiction may fulfil the requirements. In such instances, the datasets need clearly demarcated coverage areas, providing for a full coverage of the area of interest without overlaps or gaps. Generally, the complexity of integrating datasets into one dataset increases with the number of datasets that need to be integrated. For this aspect of external data characteristics is a direct link with the institutional organisation of a jurisdiction.

From a cross-administrative boundary perspective, the GII can be beneficial in providing one dataset or one point of access for the complete jurisdiction. It may especially be valuable for users operating in jurisdictions that are subdivided in a wide variety of administrative districts, such as a police district, a water district, a school district, energy supply district, counties, municipalities, and provinces among others. However, "the creation of an integrated [...] digital database is also likely to be a very expensive task that takes place over a relatively long period of time. Meanwhile those involved in [...] SDI development must seek to create partnerships of stakeholders that promote interoperability" (Masser, 2001).

Framework datasets should be interoperable

Framework (or core) datasets should be available from seamless sources and interoperable with datasets produced by other organisations, jurisdictions or nations and they can be integrated with many other kinds or sets of data to produce information useful for decision makers and the public, when appropriate (NAPA, 1998, p. xii; see also Brox et al., 2002; Rhind, 2001; Rajabifard and Williamson, 2001; NRC, 1995, pp. 25 and 27; McLaughlin and Nichols, 1994, p. 68). The format, reference system, projection, resolution and quality of information within a GII should be interoperable (Crompvoets et al., 2004, p. 680; Smith and Kealy, 2003).

In order to disseminate public information in an effective, and economical manner sufficient and appropriate hard- and software programs, standards to communicate between suppliers and requesters of information are required. In addition, adherence to standards for data models, reference systems, information quality, information dissemination and exchange, and metadata documentation promote the interoperability of a dataset (Kap et al., 2004; Smith and Kealy, 2003; website AUSLIG). Standards in the geographic discipline are of significant interest because of the potential for increased access and sharing of geographic data, reduced information loss in the data exchange, reduced duplication of data acquisition, and increased quality and integrity of geographic information (Brewer, 1999, p. 221; Brox et al., 2002; see also Crompvoets et al., 2004). Enterprise wide standards (Johnson 2004; STIA 2001, 5-8) are a first step towards improved interoperability. Next, nationally accepted technical standards (STIA, 2001, p. 5-7; see also NAPA, 1998; McLaughlin and Nichols, 1994, p. 63; Holland, 1994) may be appropriate. However, use of information only adhering to one proprietary standard limits its use to users of one specific system. Datasets adhering to open standards will be interoperable with most software and other datasets. Ultimately, the use of internationally agreed open standards is expected to increase the interoperability of datasets and as a result the development of GIIs (see NRC, 1995, pp. 29-30). The Core cadastral domain model is an example of an emerging international data model in the cadastral domain (see Lemmen et al., 2005). The Dutch OSOSS program (website OSOSS; see also website Opensource) specifies the requirements for open standards as follows:

- The standard is adopted with an open-decision-making procedure (consensus or majority decision);
- The standard is maintained by a not-for-profit organisation that operates a completely free participation policy;
- The standard is published;
- The costs for the use of the standard are low and are not an obstacle to access it. Intellectual property – possibly present – of (parts of) the standard is being made available on a royalty-free basis;
- There are no further constraints on the re-use of the standard.

A transfer format that is open, i.e. every system can be able to use the data, promotes the use and increases its' value from a GII perspective. The Geography Markup Language (GML) is the open standard for the geographic community. GML is an "XML grammar written in XML Schema for the modelling, transport, and storage of geographic information. GML provides various kinds of objects for describing geography including features, coordinate reference systems, geometry, topology, time, units of measure and generalized values" (OGC, 2005a).

Framework datasets need to be documented with adequate metadata

Users of geographic information increasingly acquire information without personal contact with the information provider. Their use of, for example, distributed access for web mapping services, relies largely on the metadata. In order to assess the appropriateness of a dataset, the automated use of geographic information for web mapping services (see ISO 19128), among other services, requires transparency of the technical qualities of the information (see Rajabifard et al., 2003, p. 97; Smith and Kealy, 2003), but also of prices and use restrictions. Adequate documentation (metadata) is likely to satisfy this transparency requirement (see Van Loenen and Onsrud, 2004; Brox et al., 2002; Masser, 2001; Gupta, 2000, p. 495; Longley, 1999, p. 175; Meixner and Frank, 1997, p. 27). Moreover, web feature services (OGC, 2005b) require not only metadata at a generic dataset level, but require metadata to be documented on the detailed object level.

Research by Van Loenen and Onsrud (2004 and 2001) evidenced that academic users of geographic information highly value the existence of metadata. The productivity of the academic researcher with a particular dataset, as measured by task accomplishment with the dataset, satisfaction with the dataset and overall objective accomplishment with the dataset, is positively correlated with the existence of metadata. Statistically significant results support the position held by FGDC and INSPIRE (2004) that documentation of metadata should be a high priority in advancing geographic information infrastructures (Van Loenen and Onsrud, 2004). The better the metadata, the easier the use. Therefore, comprehensive metadata documentation at the object level is the level of documentation that should be strived for.

Framework datasets' technical characteristics needs to be guaranteed

In order to be of value at any GII level, users need to be ascertained that the information provided is complete, current, and accurate (see Micus, 2003, p. 42). Framework datasets with the seal of authority, officially guaranteed datasets (see Brox et al., 2002; STIA, 2001, p. 8-7; Cho, 1998, p. 49) or certified datasets, therefore may reinforce the status of a framework dataset and consequently its use. On the contrary, liability waivers may limit the extent to which the guarantees reach. In the context of a GII, the value of the dataset will decrease.

In addition, the technical characteristics of framework datasets should be sustainable overtime (STIA, 2001, pp. 8-8/9). Institutional arrangements, or some formal arrangement that guarantee the collection, qualities and accessibility of geographic information are a way to promote the development of a GII. "In order to function as a foundation framework datasets should have guaranteed qualities, and central control over these qualities should exist" (Philips et al., 1999; see also NRC, 1995, pp. 25, 27). With respect to guaranteed technical data characteristics, legislation may promote the GII by requiring government to collect certain geographic information with minimum quality requirements. An example may be found in the Dutch' base registrations concept (Stroomlijning Basisgegevens, 2004).[5] In this concept, the responsibility for the collection, processing and dissemination of framework information is in government. Government users are required to use this framework information and to provide feedback about it. Due to the high cost and the direct needs of government for such information, framework datasets are already typically collected and provided by government. It may therefore be the most likely steward for the framework information.

5 One scholar has argued that including data qualities in legislation may be against the interest of the user since the data qualities will be frozen at the standard of a specific timeframe. It implies a risk of not meeting future user needs or standards (M.J.M. Bogaerts personal communication).

Table 4.5 External data characteristics requirements from a GII perspective

	Stage			
Characteristic	**Stand alone/ initiation**	**Exchange/ standardisation**	**Intermediary**	**Network**
Coverage of jurisdiction	0-50%	50-99%		100%
Number of datasets for jurisdiction coverage	>100	50-100	2-50	1
Standard adherence (data exchange, data model, metadata)	None/prototype	Non-standardised/ "Vendor specific"	De facto/jurisdiction wide standard	Open standards
Data model	Stand alone	Limited harmonisation	De facto/jurisdiction wide harmonised	Internationally harmonised
Metadata	None	Poor	Core	Comprehensive
Quality assurance	None	Project based	Seal of authority	Seal of authority backed by legislation
GII categorisation	Poor	Sufficient	Good	Excellent

Overview of the external data characteristics requirements

In order to integrate heterogeneous datasets easily into one ubiquitous dataset or to be interoperable both with higher levels of the GII and other datasets at the local level, the local framework datasets need jurisdiction-wide uniform technical characteristics, a harmonised data model, open data format, similar currency and update frequency, clearly demarcated coverage area, comprehensive metadata, and guaranteed technical data characteristics, which are sustainable overtime. Table 4.5 provides an overview in relation to GII development.

4.6 The GII technical framework datasets' characteristics maturity matrix

The objective of a GII and user needs for large-scale framework datasets provided, the GII demands large-scale framework datasets to have complete coverage of a jurisdiction, to include all necessary attributes, and accurate and current information for its primary purposes (at the very most two years old in dynamic areas). Further, it demands consistency throughout the dataset, adherence to open standards and its data model should be harmonised with international data models. In addition, the metadata should be comprehensive and the technical characteristics of geographic framework datasets should be sustainable overtime, with a seal of authority. Finally, it is recommended to keep up with developments in technology, standards, and demands of users, among other developments. Table 4.6 provides an overview of this data centric approach in the context of the maturity of a GII.

Table 4.6 Development of technical characteristics of framework datasets in the GII maturity matrix

	Stage			
	Stand alone/ initiation	Exchange/ standardisation	Intermediary	Network
Internal characteristics				
Content	Limited	Core		Comprehensive
Horizontal positional accuracy	> meters	Decimeters -meters		Centimeters-decimeters
Currency	>5 years	2-5 years		0-2 year
Orientation	None	Spaghetti	Object	Optimised object
Consistency throughout the dataset	None	Poor	Core	Excellent
External characteristics				
Digital coverage of jurisdiction (vector format)	0-50%	50-99%	50-99%	100%
Number of datasets for jurisdiction coverage	>100	50-100	2-50	1
Standard adherence (information exchange, data model, metadata)	None/ prototype	Non-standardised/ "Vendor specific"	De facto/jurisdiction wide standard	Open standards
Data model	Stand alone	Limited harmonisation	De facto/jurisdiction wide harmonised	Internationally harmonised
Metadata	None	Poor	Core	Comprehensive
Quality assurance	None	Project based	Seal of authority	Seal of authority backed by legislation

4.7 Summary

This chapter focuses on framework datasets in general, and large-scale geographic framework datasets more specific. Within a GII two types of information can be categorised: framework and thematic datasets. Framework datasets build on the geometric foundation and provides the geographic basis. Thematic information and information services may build on the framework datasets. This study focuses on two commonly accepted large-scale framework datasets: topographic and cadastral datasets.

Through a datasets' technical characteristics its value for the GII may be assessed. Two different technical characteristics were identified: internal and external technical characteristics. The internal characteristics were defined as the characteristics of the information as such: the organisation of the data, the positional accuracy, the attribute accuracy, the completeness, the consistency, semantic accuracy, and temporal information. External data characteristics may be defined as the characteristics of the dataset that may be relevant for potential users that are outside the organisation that has collected and processed the information. This study considers the degree a dataset covers the area of a jurisdiction, the level of interoperability, metadata documentation, and technical data characteristics guarantees as external data characteristics.

In order to integrate heterogeneous datasets easily into one ubiquitous dataset or to be interoperable both with higher levels of the GII and other datasets at the local level, the local framework datasets need jurisdiction-wide uniform technical characteristics, a harmonised data model, open data format, similar currency and update frequency, clearly demarcated coverage area, comprehensive metadata, and guaranteed technical data characteristics, which are sustainable overtime.

This chapter has focused on the technical framework dataset characteristics. Chapter 5 elaborates on the non-technical data characteristics such as the ease to find a dataset, and its access policy.

5 Access to government information policies

5.1 Introduction

Geographic information infrastructures consist of geographic information, technology, standards, human and financial resources, institutions, and information policies. There is increasing awareness of the critical role of institutional and policy issues play in developing GIIs. The characteristics of information and policies controlling access to and use of information are important to understand to assess realistically the various options for infrastructure development. Within the context of GII access to government information policies in general and access to government geographic information more specific, are critical for the existence, and successful use of the information and the success of the GII. For meeting user requirements, questions of public access to public information are likely to be a critical factor (Masser, 1999, p. 81). Provided that geographic information, and especially framework geographic information, (a) are expensive to create, (b) may benefit many, and (c) their value is often underestimated at the decision making levels, the question rises how to fund the collection, processing, and dissemination of necessary (framework) geographic information?

Two access doctrines are dominant in the literature: open access policies and cost recovery policies. The open access approach assumes that government information is available for a price not exceeding the cost of reproduction and distribution, with as few restrictions in the use as possible. In the cost recovery approach, the price of government information covers the cost of creation and dissemination, and may include a return on investment. The use of the information is restricted and government may even choose to have exclusive arrangements.

Although the funding mechanisms of geographic information collection and provision have dominated and dominate the access policy discussions, information policies consist of more than just the finances. In this chapter, we evaluate the non-technical characteristics of framework information in the context of the objectives of a GII. Non-technical characteristics are characteristics that do not directly relate to the technical functionality of the dataset, but to the legal, financial, physical, and intellectual accessibility of the dataset (see Bovens, 1999).

This chapter exist of two parts: the first describes information policies in theory. It addresses different types of government information, legal and technical means to enhance, or restrict access and use. Further, it provides an analysis of the open access and cost recovery approaches, including for both regimes best practice examples. The second part of this chapter uses the theory of the first part to develop a GII maturity model from an information policy GII perspective. This part of the matrix provides the base for the framework for researching the impact of access policies aiming to "recommend appropriate combinations of prescriptive and enabling policies to promote effective application of geographic information infrastructure in support of substantial and sustainable economic development" (Coleman and McLaughlin, 1997).

5.2 Government information

5.2.1 Introduction

In practice, one is likely to find different access policies for different types of government information. Branscomb (1994) distinguishes at least four different types of government information: "(1) that which is necessary for citizens acting in their roles as voters engaging responsibility in the electoral process; (2) that which is necessary for law-abiding residents in order to comply with the legislative enactments and judicial decisions that are the law of a land; (3) that which is mandated by the purpose for which the agency is established; (4) that upon which the very essence of the deliberative process rests, and which cannot be collected reliably and accurately in the private sector" (Branscomb, 1994, pp. 164-165). Also Coopers Lybrand recognised four primary reasons for Executive Agencies to collect information on behalf of government (Coopers Lybrand, 1996). These are:

- Information is central to government's role in policy-making and resource allocation (e.g., statistical information);
- Information is essential for reasons of "national interest" and to support the activities of other public bodies (e.g., Ordnance Survey, the Meteorological Office, the Hydrographic Office);
- Information is required for regulatory purposes to support the smooth running of a market economy or to impose standards (e.g., HM Land Registry, Companies House and Registers of Scotland); and
- Information that helps to address 'market failures' and provide data for commercial users.

For the UK, Coopers Lybrand found that different funding models apply to each of these four purposes. Agencies, which collect information central to government economic policy-making, are characterised by low cost recovery. Agencies collecting information for regulatory purposes typically achieve close to full cost recovery; and agencies collecting information for national interest reasons achieve cost recoveries in a range between these extremes (Coopers Lybrand, 1996).

According to this subdivision for government information in the UK, geographic information would classify as information essential for reasons of national interest and to support the activities of other public agencies, or as information required for regulatory purposes. Each class of information would have an associated access policy. However, although this classification and associated access policy may be common and correct for a large part of Europe, it does not apply to many other nations. For example, legislation requires all agencies of the US federal government to disclose records upon receiving a written request for them, except for those records that are protected from disclosure. All federal information resources, and not only a specific category of government information, should be disseminated at the marginal costs of dissemination (see OMB Circular A-130, 1992, or U.S.C. 5 section 552 (a) (4) (iv)).

5.2.2 Shaping the policy: who decides what?

National government sets the outlines of the access to government information policies. It decides whether the activities of government agencies are fully supported with public money or not. It also decides who carries the burden of the costs of the collection, maintenance and dissemination of framework geographic information: a specific user, or society as a whole?

In this respect, the position of individual government producers, or providers of geographic information is often limited. These agencies have to adhere to the national formal guidelines (rules, legislation) and cannot always change their policies unless this is decided in national parliament. This situation of dependency on national government policies applies to many continental European mapping agencies (and to some extent even for the Ordnance Survey of the UK). In addition, government organisations cannot always define their products strictly and solely in terms of the market. They are often bound to their tasks defined by law and regulations. “They are required to produce information covering their whole legal system and not merely of those regions where there is enough market demand to recover all the expenses incurred” (Grelot, 1998, p. 121). However, sometimes it is the agency itself that is blamed for the failure of the access policies applying to their information as if they are in full control of it (see De Vries, 2001). For several reasons this is incorrect. For example, the Dutch Cadastre and Public Registers Agency is responsible for its own financial planning, but legislation requires the Cadastre to recover its costs. The national government does not provide subsidies to enable the dissemination of land administration information at a fee close to zero euros. In France, the national mapping agency, IGN, was facing a decrease in government funding and, hence, pressure to cut costs. IGN cannot recover sufficient costs through the sale of traditional products to traditional users. Therefore, IGN can only meet its financial objectives through the supply of value-added information products at prices for some products and areas that exceed ‘production’ costs (from Coopers Lybrand, 1996).

5.3 Shaping the access policy

This study considers four access issues that shape the information policy: legal, financial, physical, and intellectual issues (after Bovens, 1999, pp. 102-124). Legal access relates to legislation that provides the means to enforce access to information (e.g., freedom of information act) or to restrict its use (privacy act, or intellectual property acts). Financial accessibility concerns the balance between price and potential benefits resulting from using the information. Physical access involves the physical accessibility of information; the ease to find and access a dataset. Intellectual access concerns the ease to understand or use the information. Although these aspects may decide equally on whether the information will be used, in the discussions the legal and financial access components are dominant. Further, most if not all discussions have been on access to government information.

Policy makers have a whole range of choices to make. First they need to decide about the technical aspects of the information, for example, the type of information to be collected (scale, quality), and the coverage of the information (ubiquitous versus limited area). Secondly, they should decide on the access policy, that is, the price of the information, the user category (public inspection versus commercial re-use), and the limitations in the use (intellectual property, liability, no pass on, royalties from value-added products). Further the answer to the principal question: “Is government allowed to compete with the private sector?” is part of the access policy.

This may explain the wide variety of access policies that exist throughout the world. The underlying argument for opting for a specific choice in the access policy is the funding mechanism: who should pay for the collection, use, and distribution of geographic information? Which access policy allows “ready access to high-quality data, low cost geographic information that is necessary to advance GIS development”? (Lopez, 1998, p. 97).

This section provides an overview of the legal and technical means to enhance or control access to information. Further, it elaborates on the financial issues in access policies, and explains the funding mechanisms behind the access policies.

5.3.1 Legal access[6]

The means used to protect a dataset or provide access to it depends on the owner of the dataset. Ownership of information implies having rights to control the information. It implies a complex set of rights: rights to use, sell, rent, give away, abandon, consume, or even destroy (Boonin 1987, 253). In broad

6 This section builds on Van Loenen (2001).

terms two categories of these rights are: rights of access and beneficial use and rights to exclude others from its use without permission.

Ways to protect or provide access to information from legal and technical perspectives are well documented in the literature (for instance see NRC, 2000 and NRC, 1999b). For similar discussions in a geographic information context, see Lopez (1998) and less comprehensive Pluijmers (1998b) or Van Loenen (2001). Legislation provides the bandwidth of the potential uses, and as a result the economic value of a dataset. Lack of legislation widens the bandwidth, while strict legislation may narrow it.

Legal protection can be found in intellectual property rights (e.g. copyright) and in self-help means like contracts or licensing approaches. Other self-help measures may be technical in nature like technical means to control access and versioning of the information (see Varian 1997).

This section describes the legal means and self-help methods to enhance or control information access and use.

Legal means to enhance information access and use

Legal means to enhance access to public information is provided for in freedom of information legislation. "A popular government, without popular information or the means of acquiring it, is but a Prologue to a Farce or a Tragedy or perhaps both. Knowledge will forever govern ignorance, and a people who mean to be their Governors, must arm themselves with the power knowledge gives" (James Madison Letter to W.T. Barry, Aug. 4, 1822 cited in Branscomb, 1994, p. 164).

Freedom of information legislation offers judicially enforceable procedures for compelling government agencies to release information to the public (Branscomb, 1994, p. 167). It provides who may access which government information, and under what conditions. It may, for example, rule that government information can or cannot be copyrighted, and it may set the price for government information. Further, access to certain government information may be limited to certain users, for example, for reasons of national security. Moreover, the legislation may decide on the format of the information to be provided. Sometimes the legislation may go even further in deciding that agencies shall act actively in disseminating certain public information to the public. Finally, the freedom of information legislation may rule that requesters shall be informed about the meaning of the information provided, like in Minnesota.

In several instances, the legislation does only in general wording address the definition of public information to which the legislation applies. In these instances, the applicability to geographic information is not without discussion. For example, in the Netherlands, the freedom of information act (Wet openbaarheid van bestuur) only applies to public sector information that is related to an administrative affair (bestuurlijke aangelegenheid). Two questions rise: (1) what exactly is an administrative affair, and (2) for which administrative affair does one need an entire digital large-scale topographic dataset? The uncertainty has led to the general believe that the Dutch' freedom of information act does not apply to entire digital geographic datasets. Consequently, a request for a digital copy of a complete large-scale geographic dataset is likely to be denied. Even if the freedom of information act would apply, it does not enforce a pricing regime to municipalities (Daalder, 2005), nor does it prohibit to copyright (or claim database rights in) the information.

Generally, freedom of information legislation sets the framework for the access to government information policies. Often, however, other legislation limits access to government information.

Besides freedom of information legislation, or instances without freedom of information legislation, specific legislation may provide the means to enhance access to public sector information. Legislation arranging access to real property information registered at a cadastre is one of such examples of lex specialus legislation.

Legal means to limit information access and use

Legal means to limit information access and use are in intellectual property rights, contracts and licenses, legislation protecting the privacy of individuals, liability waivers, and finally legislation limiting access to government information for purposes of security.

Intellectual property rights (IPR)

Copyright gives exclusivity to the owner of the work for a limited period. Sooner, or later, copyright law directs all protected information goods to the public domain. The TRIPS agreement rules "Copyright protection shall extend to expressions and not to ideas, procedures, methods of operation or mathematical concepts as such (article 9)" (WTO, 1994). It continues in article 10.2 with "Compilations of data or other material, whether in machine readable or other form, which by reason of the selection or arrangement of their contents constitute intellectual creations shall be protected as such. Such protection, which shall not extend to the data or material itself, shall be without prejudice to any copyright subsisting in the data or material itself (article 10)."

Intellectual property rights may not be available for all geographic datasets. Especially for datasets that represent facts rather than expression are not copyrightable. This is likely to apply to datasets that include information with a high level of detail: the large-scale geographic information. Therefore, intellectual property rights, i.e. copyright, may not be available for geographic datasets that provide a high level of detail in their information since the level of creativity or the personal view of the author may not be clearly demonstrated when for example buildings, roads, and trees are mapped on a 1:1,000 scale.

Although the TRIPS agreement has harmonised the extent of copyright protection, many differences among countries exist. In the US, for example, copyright extends to “original works of authorship fixed in any tangible medium of expression, now known or later developed, from which they can be perceived, reproduced or otherwise communicated, either directly or with the aid of a machine or device” (17 U.S.C 102(a) 1988). Until 1991, lower US courts had developed the so-called “sweat of the brow” doctrine, holding that copyright for a compilation was a reward for the hard work that went into compiling the facts, regardless of originality of selection and arrangement[7]. However in 1991, Feist[8] ruled, consistent with the US copyright law, that facts cannot be protected by copyright; only the manner in which the information have been selected and arranged is copyrightable. Facts, data, information, ideas, methods, principles, and systems are in the US directly relegated to the public domain (Reichman and Franklin, 1999, p. 6).

In Europe, however, facts, data and information can be protected through the EU directive on the legal protection of databases (EU 1996). Article 7 of this Directive rules:

> “Member States shall provide for a right for the maker of a database which shows that there has been qualitatively and/or quantitatively a substantial investment in either the obtaining, verification or presentation of the contents to prevent extraction and/or re-utilization of the whole or of a substantial part, evaluated qualitatively and/or quantitatively, of the contents of that database”.

Further, it is in the US possible to transfer full or partial copyright to someone else (17 USC 201 (d)), unlike some other jurisdictions (e.g., Germany see Hugenholtz, 1998, p. 152). This practice of transferring exclusive rights is well known in the publishing sector (see e.g., Okerson, 1996, p. 80; Guernsey, 1998).

Although intellectual property rights are available for geographic information, this does not necessarily imply that copyrighted information is only available against high cost and restrictive use conditions (see also Van Eechoud, 2004, p. 9).

Further use restrictions may be imposed through contractual or licensing provisions.

Contracts and licenses

A contract is an exchange of promises or other things of value between two or

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7 See, for example, Illinois Bell Tel. Co. v. Haines & Co., 683 F. Supp. 1204 (N.D. Ill. 1988), aff’d, 905 F.2d 1081 (7th Cir. 1990), vacated and remanded, 499 US 944 (1991); Rural Tel. Servo CO. V. Feist Publications, Inc., 916 F.2d 718 (lOth Cir. 1990).

8 The US Supreme Court in *Feist Publishing Inc. v. Rural Telephone Service Co.* (499 US 340 (1991)).

more people. Contracts determine limitations on duplications, resale, and derivative products. They also allow information suppliers to receive economic gain at privately negotiated prices (Goldstein, 1977). An online contract can include the right to access a database, services or resources. Contracts provide information suppliers with the means to protect the content of factual datasets. Contracts provide some but not comprehensive protection to a vendor for the actions of a third party. The vendor relies on copyright or other laws to restrict use of the information in the copy.

Traditionally, contracts are used to settle a sale. Sales involve a complete transfer of ownership rights, in particular copies from the vendor to the purchaser, following which the purchaser could largely do whatever he or she wished. In digital environments licenses, a special form of contract, are popular for protecting the interests of the vendor.

A license is a contract imposing express limits on the use of the information (Dreyfuss, 1999, p. 203). One can generally redistribute a licensed copy only if especially contracted for the right to do this (Samuelson, 1998, p. 17). License agreements in the digital era are of two types: bargained agreements for custom software, and unbargained shrink-wrap licenses imposed on mass-market purchasers (Lemley, 1995, p. 1239). A shrink-wrap license is a license agreement for a software or information product not accessible to the user until the box has been opened. Click-wrap licenses may be the digital equivalent of a shrink-wrap license or may additionally require that you affirmatively respond that you have read the terms supplied on the screen and that you agree to the terms by pressing the 'I agree' button.

Privacy legislation

Privacy is the right to be left alone. Legislation protecting the privacy of individuals typically provides the means to these individuals to limit use of their personal information. The EU privacy directive defines personal information as: "any information relating to an identified or identifiable natural person ('data subject'); an identifiable person is one who can be identified, directly or indirectly, in particular by reference to an identification number or to one or more factors specific to his physical, physiological, mental, economic, cultural or social identity" (EU, 1995).

Within a geographic context, privacy limitation will typically apply to the datasets with a high level of detail where, for example, individual houses or addresses can be used to reveal information about individuals. Small-scale datasets are often of such limited detail that it does not provide the ability to link the geographic information to individuals: privacy issues are not likely to limit the use of small-scale information.

Requests for government information may be rejected due to the personal nature of the information. In addition, privacy legislation is likely to hamper the economic value of geographic information. In countries where strong information privacy legislation is lacking, it is likely to find more economic activity in the geographic sector than in those legal systems where strong privacy protection exists. Lack of privacy protection would allow the provision of datasets that are commercially attractive (see Ravi bedrijvenplatform, 2000, p. 24), but interfere with the privacy of individuals. Moreover, sometimes government agencies create datasets for specific public purposes. If these records are subject to freedom of information legislation, then the personal information in these datasets need to be subtracted to fulfil requirements of privacy legislation. This value subtracting may be a costly operation, resulting in expensive information creation, and potentially fewer users.

Liability waivers
A dataset may have guaranteed information qualities. But these guarantees are likely to have a limited timeframe, and may not apply to all uses. Especially uses that are different from the initial goal of collection of the information is likely to be excluded from quality assurances. And even if assurance is provided, a notification will accompany the dataset clarifying that the dataset is not necessarily without error because “spatial data can never be completely correct due to the inevitable measuring errors and to the delay between the data collection and the use of data” (Meixner and Frank, 1997, p. 17). In addition, information represented on a map often does not represent reality at a large scale if it was created at a less accurate, smaller scale (STIA, 2001, p. 8-13). If, for example, information is blown up, and aggregated with otherwise disparate information, use of the information may result in mistakes or damage. Information suppliers, including the public sector, may use liability waivers to minimise potential liabilities.

Security legislation
Freedom of information legislation applies to government information. Often there are exceptions for information that are protected from disclosure. Those typically include documents concerning national security, and trade secrets. While for satisfaction of privacy legislation only the subject information should be removed, for national security the complete dataset will be protected from disclosure. Therefore, datasets concerning the national security cannot be accessed or used in the context of a GII.

5.3.2 Financial access

Financial accessibility concerns the balance between price and potential benefits resulting from using the information. If the expected benefits are outweighing the costs, then it is likely that the dataset will be used. If, however, the costs for acquiring and using the dataset are outweighing the potential benefits then it is likely that the dataset will not be bought and used. Alternatives will then be sought. One alternative may be that the requester collects identical information himself, another may be to use substitute, or inferior information from others. In the worst-case scenario he will not use the dataset and the issue remains unresolved.

Once the financial setting for a government agency is clear, it may be up to the agency to find ways to fulfil its task in this national framework. In many instances it needs to decide on what price it should charge in order to generate a sufficient income stream.

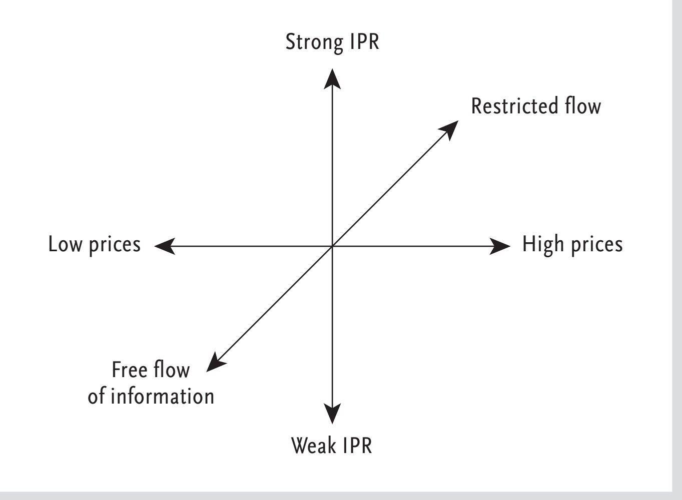
Several business models and accompanying pricing strategies are available. One alternative may be to only generate income from the sales of existing information products. The supplier can rely on the quality of the product and the reputation it has. The price may be high but the quality is better than elsewhere. Suppliers of the information may also add value to collected information in order to fulfil specific user demands. Further, they may provide extra services related to provided information. Another business model that may be used to generate income is the logic of the free version model. A limited version of software or information is given away in order to make people familiar with the product. Once the product has obtained a certain market share, the need for the extended version will grow. Adobe Acrobat successfully used this model. Further, a geographic information producer may give away low quality information, and offer 'heavy' service contracts. Or it may differentiate prices for low quality information and high quality information. Often times, one has to subtract quality from the original dataset in order to introduce this model. Shapiro and Varian, among others, provide an extensive review of pricing strategies and business models for use in the information age (Shapiro and Varian 1999; Schneider 2005).

5.3.3 Relation between financial and legal access

Geographic information is different from other datasets. The choice in funding, and thus pricing the information, results in a specific access policy. Figure 5.1 shows the general relation between price and intellectual property rights (from Pace et al., 1999, p. 22 cited in Weiss and Pluijmers, 2002). The flow of information is represented by the dotted line.

It is unlikely to have strong intellectual property rights and low prices, or vice versa. An exception may be academics accessing government information (see Van Loenen, 2001). Academics generally pay low fees for information, but can only use it for limited (academic) purposes. High prices will be accompanied by strong intellectual property rights. If not, the digital information may be freely resold by the first acquirer for a lower price leaving the producer of the information out of competition. As a result the producer is left without any incentive to collect information again at very high costs without any chance of recovering these costs.

Figure 5.1 Relation between intellectual property rights (IPR) and flow of information



Source: Pace et al.,1999, p. 22

5.3.4 Physical access

Physical access involves the physical accessibility of information. It concerns the ease to find, assess and access information. A wide variety of components may determine the extent to which a dataset can be found and accessed at ease. The time necessary to find a dataset and the acquisition of the dataset may be a useful indicator for the extent to which a dataset was found and accessed at ease.

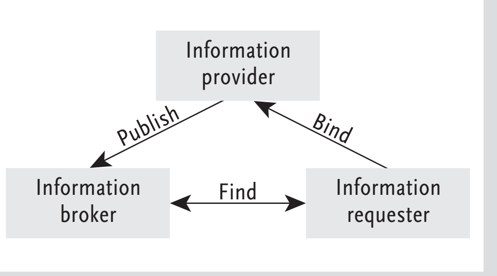
Physical access from a technological perspective is synonym for access network (Rajabifard et al., 2000) or delivery mechanisms (Website GSDI; Crompvoets et al., 2004). New technology has been crucial in the development of GIIs, and it has created opportunities for people to find and access information previously unavailable. However, technology also allows for the means to control access.

This section discusses the technological means that serve the user through allowing for ready finding and access information, and technological means to control access and use of information.

Technical means to enhance information access and use

Generally, information online accessible are likely to promote their use, while information behind bureaucratic doors are not. Affirmative programs by government that anticipate records and information in greatest demand by the public and that actively release such records and information in electronic environments appear to be the most sufficient means for overcoming technical limitations. The concept of a clearinghouse may promote the ease to find and access needed datasets. Crompvoets (et al., 2004, p. 668) defines a spatial information clearinghouse as “an electronic facility for searching, viewing, transferring, ordering, advertising and/or disseminating spatial data from

Figure 5.2 The publish-find-bind concept



Source: Gottschalk, 2005

numerous sources via the internet and, as appropriate, providing complementary services." In his assessment of worldwide developments in national clearinghouses, he distinguished between three classes of clearinghouses (see Crompvoets et al., 2004, p. 673):

1. project;
2. product-portal; and
3. clearinghouse.

A clearinghouse obtains the status of project if it is yet unavailable on the internet, but a project plan for the clearinghouse is available. A clearinghouse becomes a product-portal if it includes the geographic information from primarily one (public) supplier. Finally, a true clearinghouse is a central portal on the internet that facilitates geographic information discovery, access and services (Crompvoets et al., 2004, p. 669). The latter category may be split into clearinghouses passively providing metadata about existing datasets, and clearinghouses including information download and other user friendly services, and user friendly interfaces with clear terminology (see also Crompvoets et al., 2004, pp. 675, 680, 687). These most advanced clearinghouses, or service houses, would allow the user to just-in-time integrate information (or services): the publish–find–bind concept (Gottschalk, 2005) (Figure 5.2). In this concept the information provider publishes his metadata in the clearinghouse. The clearinghouse, which functions as a broker of information, binds the requester of that information to the provider.

A further development would be to include national geographic information clearinghouses in more general clearinghouses, or ultimately to publish–find–bind geographic information (and services) through commonly used and available search engines such as Google, AltaVista, or Yahoo, among others.

Crompvoets (et al., 2004, p. 685) has found a declining trend in the use of clearinghouses. He argues that bad management of the clearinghouse resulting in outdated content, and the diminishing use may be because of the changing demands on the clearinghouses: the current clearinghouses do not fit the expectations of the second generation GII people. The inclusion of web services in the clearinghouse concept may address the declining use figures. The clearinghouse may then extend its initial scope of providing information passively to promoting both information and services actively (see Figure 5.3).

Table 5.1 provides both the delivery mechanism status in a GII and the

Figure 5.3 A comprehensive clearinghouse includes metadata on information and services

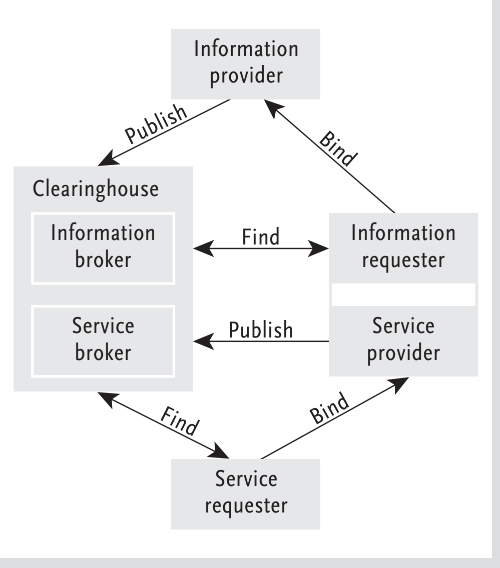


Table 5.1 Development of the delivery mechanism status

	Stage			
	Stand alone	**Exchange**	**Intermediary**	**Network**
Delivery mechanism status	Project	Product portal (geo-portal)	Clearinghouse	Clearinghouse with service provision (e.g., downloads)
Publication dataset	Not published	Limited metadata published on provider's website	Metadata published in clearinghouse	Information, services directly available from clearinghouse

publication status from the perspective of a dataset. A dataset can be published on a provider's site only, even if a clearinghouse is available. If a clearinghouse function is unavailable a dataset can at best be published on the provider's site. The information requester in Figure 5.2 may be the service provider in Figure 5.3.

Technical means to limit information access and use

While technology may promote access to information through many means, also technical methodologies are available to help control information access. These consist of technologies inside the software that help the originator of the information enforce his or her license conditions.

Digital Rights Management (DRM) technologies may prevent infringement of commercially valuable digital content (Samuelson, 2003, p. 41). These technologies manage certain permissions to do authorised operations with digital information. DRM is described as 'code as code' – a private governance system in which computer program code regulates which acts users are (or are not) authorised to perform economically unjustifiable (Lessig, 2000 cited in Samuelson, 2003, p. 42). Programming the software to self-destruct if the license engages in a particular kind of abuse (like copying the data) or embedding a block off code in the program capable of disabling its operation are examples of DRM (Samuelson, 1997, p. 13). Other means that may be used to control access, or use are: encryption of information, watermarking, limitations in downloading information, database access control, and trusted systems (see in more detail NRC, 2000, p. 68).

Technical control gives originators of databases a technical lead-time to recover their investments. The con of it is that "one man's self-help, may be another man's virus of worm" (Samuelson, 1997, p. 13). If a lessee's existence depends completely on the information of the licensor after a certain period, the licensor has the power to enforce conditions, which may be unfair to the lessee. Moreover, if a lessee accidentally uses the dataset in violation with the terms in the license, the technical self-help construction may terminate the program/ dataset without any warning.

5.3.5 Intellectual access

Intellectual access concerns the ease to understand or use the information. Does the user understand the information presented? Understanding the information has many aspects. Apart from the intellectual capabilities of the user, also metadata documentation, and adherence to standard data models are important for understanding the information. Chapter 4 discusses the role metadata may play (4.4.2) and users needs for metadata (4.5.2).

Finally, the language in which the information is presented, published and documented, may or may not promote the use of the dataset.

5.4 Two common access policies

Two access doctrines are dominating the discussions in the literature: open access policies and cost recovery policies. Most other models that may be found in practice are similar to one of these or are somewhere in between.

5.4.1 Open access

The open access approach assumes that government agencies, responsible for the collection and creation of government geographic information, are fully funded with public funds to accomplish their public tasks. These public tasks may vary among jurisdictions. Some jurisdictions may choose to minimise the tasks of government while others may choose for more comprehensive tasks to be accomplished by government. A minimal role for government in achieving a societal objective may result in a minimal quality or quantity requirement within government for needed information.

In the open access model, information within governments are accessible by those outside government for a price not exceeding the cost of reproduction and distribution (marginal cost of dissemination) with the imposition of as few restrictions as possible. The information is available to all (non-exclusive) on a non-discriminatory basis (see also NRC, 1997, p. 15). Accepted restrictions include information concerning national security, trade secrets, and information relating to an individual's privacy. Under open access principles, geographic information suppliers in the public domain do not compete with the commercial sector. When government adds value to its information to respond to mandates or obligations of government as defined by law making bodies, they may opt to add value through the efforts of their own employees but more typically they hire private commercial firms to supply the information or service for government. All public and private entities have access to the resulting information on equal terms, typically with no restrictions, at the cost of dissemination.

Although the open access model may initially have been enacted to control government, "[it] fosters a process for adding value to raw government information resources" (Lopez, 1998, p. 58). This spin-off effect promotes the use of the information, which results in higher quantities of (income, company, or value-added) taxes going towards government (see Figure 5.4).

At least one leading legal scholar argues that to realise the potential of geographic information systems, federal, state and local governments should promote government practices that (1) make electronic formats available, and (2) allow and promote a diversity of channels and sources of public information (Perritt, 1995, p. 455). This is only possible if governments resist the temptation of selling off information to generate revenues and thus they should typically avoid asserting copyright or database rights in their public records. In addition, Onsrud (2004b) believes that it is likely that the needs of commerce and the advancement of science are better fulfilled by the open access approach of the US than more restrictive approaches. While the EU has advanced legislation promoting open access policies (EU, 2003), there is pressure in the US to move towards more restrictive information laws. However, Onsrud (2004b) argues that all leading economic studies to date indicate that current open access policies should remain in place in order to take full advantage of the potentials of a Geographic information infrastructure.

On the other hand, the open access model is continually under discussion with its precepts changing and being challenged as technology and society change over time. At the current time there is concern over terrorism and thus concern over the extent that open access should be tempered through additional exceptions to the general government principle of open access. Homeland Security initiatives in the US bear witness to this concern.

5.4.2 Cost recovery

Cost recovery approaches seek profits from the sale of information to support the development and maintenance of the datasets (Lopez, 1998, p. 43; Onsrud, 1992b). Information collection, maintenance, and dissemination are not fully provided by public funds and the costs must be covered through other means. The agency is forced to generate income from the sales of information or products or through the provision of services. The cost recovery model assumes that it will generate sufficient income for the collection, creation, and maintenance of the dataset.

As a consequence, access to information may be restricted in order to cope with the financial conditions established by the amount of central government funding provided. In practice this implies a charge for the information at more than the marginal costs of dissemination and restrictions are imposed on the use of the government information through the action of copyright and database rights. Further use restrictions are often imposed through contractual or licensing provisions. The cost recovery approach may also result in government agencies competing with private sector entities either on a level playing field basis or not. The expertise within government may be used to respond to private requests for specific geographic products.

The cost recovery model may be summarised as "[it] benefits end-users who are interested and able to acquire high-quality geographic information, directly from government" (Lopez, 1998, p. 58). The cost recovery model is typically found where quality information is *used* for the performance of the public task. The use of quality information within government may be the result of more comprehensive public tasks, or from the demanding requirements of the users. Moreover, in jurisdictions where it is not common practice that organisations operating in the public domain use quality geographic information for their public task, a cost recovery approach is likely to be found. One may ask whether this model is promoting GII development.

Some argue that the availability of means of paying for the creation and maintenance of improved geographic information (products) other than general tax revenues helps to introduce, implement, and operate the geographic information operation (Onsrud, 1992b). Especially situations where the value of geographic information at the decision-making levels is underestimated may force individual organisations to introduce more restrictive policies in order to justify their operations, or to provide a useful signal on the value of information (Coopers Lybrand, 1996). It may be used to help to relieve the pressure on other revenue sources.

The cost recovery model further presumes that government employees are likely to respond better to citizen requests for geographic information services and products when a reasonable fee may be asked (Onsrud, 1992b). The argument may be: "the client will pay for it: let's make him happy" instead of "the citizen gets it for free anyway, why bother?" In addition, research found that reasonable prices for information give an incentive to providers to meet the needs of users and give the users an opportunity to influence what and how information is collected (Coopers Lybrand, 1996; see also K+V, 2001, p. 37); the cost recovery approach as a means for government to provide tailor-made solutions for individual end-users. Therefore the argument is that it is wise for government to enter into the business of responding to private needs of information.

The large group of potential users makes it attractive for government agencies to commercialise geographic information, and to recover some of the costs. At the same time, a recent initiative involving local and state government GIS practitioners in the US reports that experiences to date indicate that few if any local jurisdictions in the US have made money and many have lost money by imposing cost recovery arrangements. Local government jurisdictions have failed to generate through information sales substantial revenues compared with the total costs of maintaining their GIS and geographic information operations. Most local jurisdictions currently selling geographic information would prefer to give it away if there were realistic alternatives for gaining political credibility with high-level budget approvers or funding their GIS operations, and ample alternatives exist for supporting financial and other objectives than that of imposing licensing or other contract restrictions on downstream uses of governments' geographic information (see Joffe, 2005).

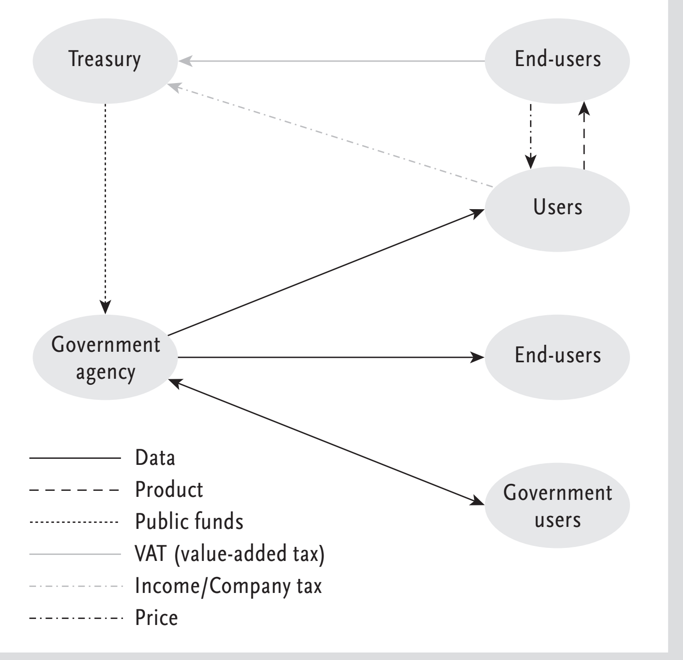
However, in Europe significant higher revenues are generated through the sales of large-scale geographic information. The Dutch cadastre, for example, generates from sales of its information products for the private sector alone over 5% of its total budget, an approximate €10 million. Similar figures are available for Lantmäteriet in Sweden, and the UK Ordnance Survey, amongst others.

5.4.3 Economic reasoning behind the access models

Open access

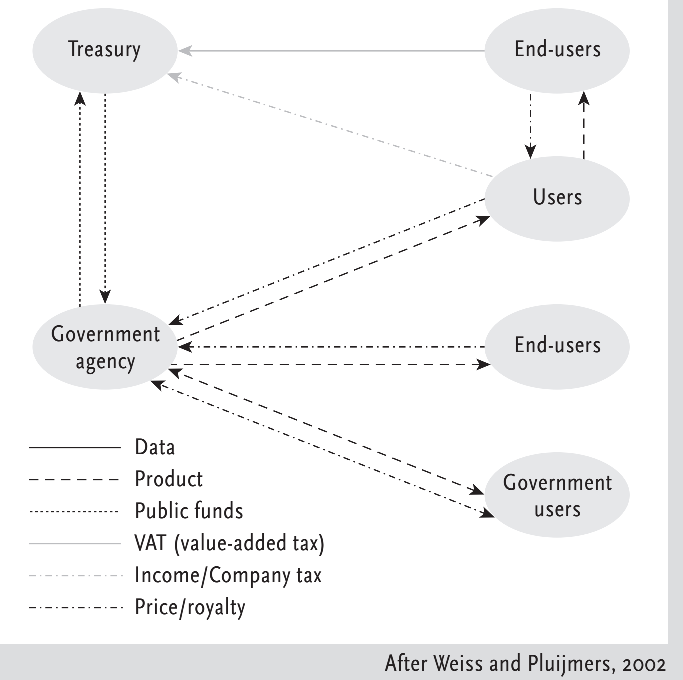
The economic reasoning behind the open access model is presented in Figure 5.4. Government agencies, responsible for collecting government geographic information, are funded with public funds to accomplish their public tasks. Government information is a valuable source for others to create new information products. Especially geographic information is of value (BDO, 1998, p. x). The use of these government datasets is promoted through a limited fee of a maximum of the marginal cost of dissemination, and lack of restrictions in the use. As a result, it is supposed that enterprises initiate a wide variety of value-adding activities (see also Krek, 2000). This information or customised products are used by a variety of end-users, who can choose between providers of similar products. The revenue and jobs the private sector generates will

Figure 5.4 Economic reasoning behind the open access model



After Weiss and Pluijmers, 2002

Figure 5.5 Ecomomic reasoning behind the cost recovery model



After Weiss and Pluijmers, 2002

partly flow into the treasury of the state through income tax and company tax. Further, end-users will pay value-added tax (VAT) when they buy information or a product.

The economic drivers of private sector enterprises makes them flexible, user friendly, and their "specialist skills applied to public sector data can result in products never imagined by the public sector producers of the raw data" (Pira et al., 2000, p. 59). The open access model recognises that private sector enterprises are likely to respond better to citizen requests for geographic information services and products than government employees. Moreover, open access fosters academic and scientific research, effective public sector planning, as well as potentially curtailing commercial development (KPMG, 2001, p. 13; Onsrud, 1998b, p. 141). Finally, open access promotes the efficient collection, use and dissemination of information. It is unlikely that identical information will be collected twice, and net losses in hidden costs are minimised (for example, no extra bureaucratic layer to cash the checks and to enforce the use restrictions).

The open access model's fundamental principle is summarised in the inverse public commons: widespread use of information tends to increase its value (Raymond, 1999; see also Onsrud and Rushton, 1995, p. xiii).

Cost recovery

Figure 5.5 and Figure 5.6 show the economic reasoning behind the cost recovery model. Government agencies creating geographic datasets generate income from the sales of information. In addition, they add value to the information and create information (products), which are sold on the information market. The cost recovery model comes with legislation that allows government to control the use of the information. In practice, some organisations may obtain public funding, and sometimes government agencies are not charged, some organisations restrict the use, others do not. Bottom line is that, in most existing cost recovery models, individual government agencies are in control of their budget, making them independent of fluctuating budgets in national government (see also Onsrud, 1998b, p. 146). They thus may allow for the advantage of having (access to) accurate, consistent, standardised databases that provide national coverage (Aslesen, 2002). The cost recovery model provides sustainable funding to individual government agencies, allowing them to maintain their information collection activities overtime (Onsrud, 1992b).

In the worse-case cost recovery model government agencies are forced to recover their cost through the sales of their information, but the income directly flows into the treasurer's pocket (see Figure 5.7). In this scenario the government agency still depends on the fluctuating budgets in national government. Guarantees on the quality of the information is lacking, and only few users can afford the price of the information.

Figure 5.6 Cost recovery: government charging for information and restricting its use

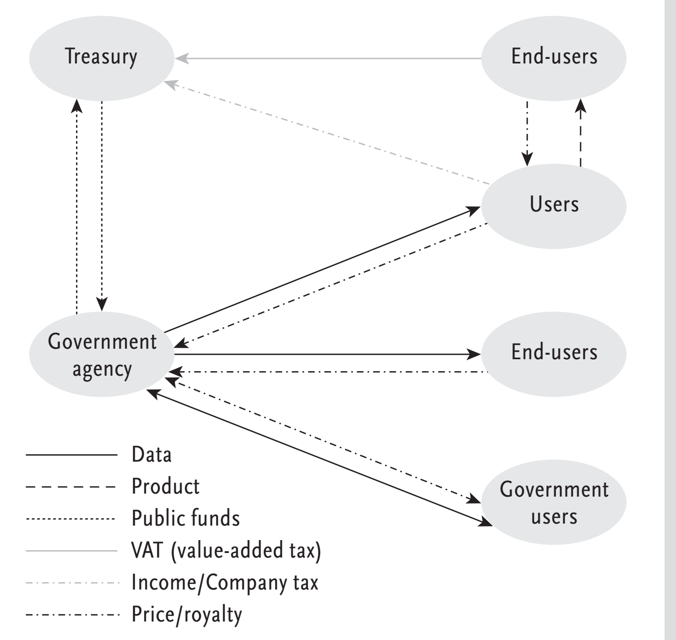


Figure 5.7 Worse-case scenario cost recovery model

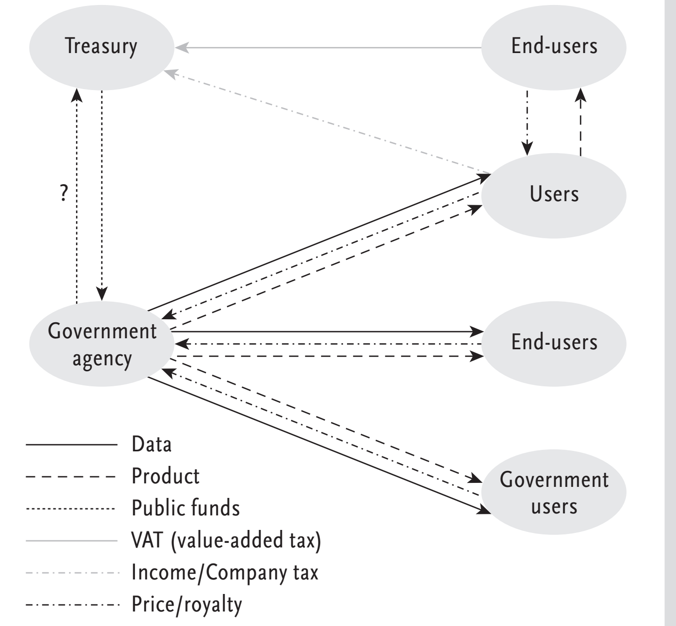
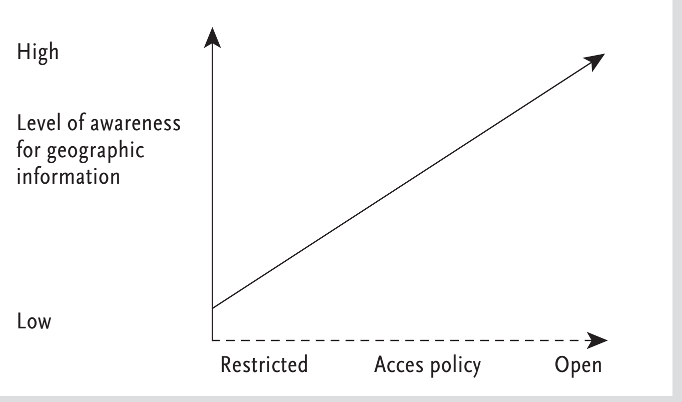


Figure 5.8 Suggested relation between level of awareness for geographic information and the likelihood of a feasible open access regime (dotted line to highlight that the relation is not mutual)



5.4.4 Micro-economic versus macro-economic perspectives

The crux of the information policy debate is provided by Joffe (2005): "Most local jurisdictions currently selling geographic information would prefer to give it away if there were realistic alternatives for gaining political credibility with high-level budget approvers or funding their GIS operations." As long as there is insufficient awareness of the value of geographic information for a specific jurisdiction within the decision-making levels, cost recovery may be a way to allow for sustainable quality geographic information. If sufficient awareness exists among politicians or high-level bureaucrats, and sustainable funding has been agreed upon, open access policies are likely to satisfy the GII objectives better than cost recovery policies (see also Van Loenen, 2003b and 2005b). Figure 5.8 shows the dilemma graphically.

In the legislative process of the Directive for re-use of public sector information (EU, 2003), the EU showed the access policy dilemma for public sector information in its member states. The EU did not propose to introduce one single approach for access to public sector information: "The present proposal takes into account that certain public sector bodies depend on the income from the sales of their information resources to finance part of their operations. It does not impose any radical change as to the charging policies. Although it incites Member States to stimulate public sector bodies to adopt the marginal cost for reproduction and dissemination approach where possible, it leaves it to the Member States and public sector bodies to define the charging policies" (EU, 2002, p. 6).

One of the EU Member States, the Netherlands, has developed a great body of documents concerning the question "who is going to finance the collection, and processing of public sector information?" (see, for example, Van Loenen, 2000; Kok, 1999; De Jong, 1998; Pluijmers, 1998a and 1998c; Berends, 1997; Berends and Kok, 1997). Generally, public sector information is provided on the basis of the marginal cost of dissemination. Also national information policy lines were directed at open access (see Kohnstamm, 1997; Cohen, 1997; Van Boxtel, 2000). However, the public geographic information sector has managed to be exempted from these policies. The main reason for the exceptional position is the fear that with the change from cost recovery towards open information policies, budgets for information collection will decrease, which may result in loss of current information qualities and ultimately result in the disappearance of these datasets (e.g., Van Boxtel, 2000, p. 20; Reinsma and Van der Sluijs, 2002, p. 159). Research that followed the Van Boxtel initiative assessed that a price change for the 1:10,000 topographic vector dataset from partly cost recovery to the marginal cost of dissemination would result in a yearly budget deficit for the national mapping agency of €1.18 million (2,6 million guilders). A change to free access was assessed to 'cost' €3,36 million (7,4 million guilders) per year (Berenschot and NEI, 2001). These numbers may be small from a macro-economic perspective. However, from a micro-economic perspective a policy change is likely to have had a major impact on the Dutch national mapping agency, its employees, and the information it provides. And although the numbers are small from a macro-economic perspective, they were apparently too big for anyone to compensate the potential budget deficit. This impasse in one of the European Member States is exemplary for the information policy discussion, which remains in most of Europe.

5.4.5 Principle arguments favouring each model

Apart from the economic arguments, academic scholars and others provided also principle arguments favouring either policy. For example, people in a democracy have a need and a right to know what their government is doing (Onsrud, 1998b, p. 141; Epstein, 1991). Moreover, they need to know why government did what they did: transparency of government is one of the fundaments of a democracy. Information acquired at taxpayers expense should be free to anyone who has an interest in them and requests them (Onsrud, 1992a). Further, government should only be in business of collecting and analysing information in support of their legislated public mission (Onsrud, 2002).

Those who advocate a cost recovery approach for government information often argue that only a small percentage of private citizens and businesses currently have any desire to acquire, for instance digital geographic products from their local government (Onsrud, 1992b). Why should government allow private individuals or businesses benefit at the expense of the general taxpayer (Onsrud, 1998b; Rhind, 2000)?

5.4.6 Alternatives between the poles of open access and cost recovery

Several alternatives exists to bridge the two poles of open access and cost recovery policies. Two alternatives that may be beneficial for GII development are described here: the creative commons and the US Federal Technology Transfer Act (FTTA).

The creative commons (website Creative Commons), conservation commons (website Conservation Commons), or in the geographic domain the public commons of geographic information (Onsrud, 2004a) aim at using open-source and open-access technology to remove technical and legal barriers blocking the use of information. The aim of the geographic information commons is specifically targeted at unlocking locally generated geographic information. The commons include both public domain information, which is free of intellectual property rights, and open access information, which is copyrighted. However, the commons allow use without obtaining prior consent since a general license is granted ahead of any specific use, provided that the attached conditions of use are met. This information invokes copyright law and licensing restrictions to help ensure that they remain freely available (Onsrud et al., 2004, p. 224; see also Onsrud, 2004a). The commons is thus a portal with freely accessible information, which can be used if open-access license conditions, for example, are adhered to. In this way, the user obtains the information at ease, and is confronted with transparent use conditions, which may include copyrights.

Another example for a, from a GII perspective, beneficial access policy for large-scale topographic datasets collected through public-private partnerships may be in the US FTTA. The FTTA allows the public sector to withhold datasets produced together with private companies for five years from the public domain. The feasibility for application of such a policy at the local level needs further investigation (see also Pluijmers, 1998a, p. 54).

5.4.7 Access models for different user groups

Above a general access model classification is provided. Both models, however, might exist at the same time in one legal system, because of the variety of users. In chapter 2, four user groups were identified: primary and secondary users and tertiary (value-adders), and end-users (citizens and decision makers). It may well be that tertiary users have to cope with open policies for raw information while citizens are confronted with more restricted policies for their information. In this context also the nature of the user's request may be of importance. A user may be working for government, private sector, non-profit sector, an academic institution, or someone requesting information as a citizen. The access model may differentiate between these groups. In Sweden, for example, the model that applies to citizens would be categorised as open, as the model for private sector users would be restrictive.

5.5 Best practices of access policies

5.5.1 Cost benefit of open access GIS

The tale of two counties by Don Cooke, founder of Geographic Data Technology, Inc. (GDT)[9] is exemplary for the benefits open access policies may bring to communities. It clarifies that GII is an infrastructure that helps society to grow and develop in an efficient way (see Cooke, 2003). The tale is about two counties A and B. Both have comprehensive digital datasets in place. County A adheres to open access policies as B charges for its information a market price. A real estate company is retained to search for a suitable location in one of the two counties. It starts with County A because the information is readily available for a modest cost. The real estate company finds three suitable locations in county A. The client chooses one of them and spends $40M redeveloping it. As a result the renovated mill brings an extra $400,000 per year in property taxes to County A. The GIS guy in County B is still wondering why that real-estate person didn't come back…

The example of open access to government information policies is found in the federal government of the United States.

5.5.2 Open access example: The United States' federal government[10]

Federal United States public information policies are based upon an attempt to guarantee broad access to information as a precondition to economic and political opportunity (Onsrud and Lopez, 1998, p. 160). The genius of the American system is that it balances public and private rights in such a way as to provide a rich collective source on which to base new and valuable production (Karjala, 1995). In this respect, Gupta (2000, p. 494) notes that:

> "The United States Geological Survey (USGS) 1:24,000 scale topographic maps are the basic scale maps for the USA and are not protected by copyright. They comprise some 57,000 sheets. Projections for integrating and updating them into coherent digital topographic database do not foresee completion until the early 21st century. It is technically and

9 In 2004, GDT was acquired by TeleAtlas.

10 This section is partly extracted from Van Loenen (2001).

> legally feasible for a lowlabour cost developing nation to purchase the maps and digital files at minimal cost, update them from commercially available remotely-sensed imagery according to market priorities (there would be no need for them to deal with remote and sparsely populated areas unless it was profitable), and resell the maps now claiming commercial copyright."

Although several states and local governments in the US have policies in place adhering to the federal model, it does not necessarily apply to all States or local governments in the US (see, for example, NRC, 2004, p. 86; Van Loenen, 2002b; STIA, 2001, pp. 5-7 and 8-10/11; Pira et al., 2000, p. 53).

Information collected or created by the federal government[11] is subject to several legal restrictions and obligations. Three Acts mark the legal framework for access to federal government information: the Copyright Act (17 USC 1976), Paperwork Reduction Act 1995 and Freedom of Information Act (1966).

Copyright Act

For copyright a distinction must be made between information collected by the federal government, state government and local (county) government. Unlike most European countries (e.g., The Netherlands, Great Britain, France), the US does not recognise copyright protection for federal government information: "Copyright protection is not available for any work of the US Government, but the US Government is not precluded from receiving and holding copyrights transferred to it by assignment, bequest, or otherwise" (17 USC 105 1988). However, this does not extend to state or local government agencies. They can claim copyright in their datasets.

Paperwork Reduction Act 1995

The Federal government is held to the Paperwork Reduction Act 1995 (44 USC 3506 (d) Paperwork Reduction Act 1995). It rules about the dissemination of federal government information. Each federal agency shall ensure that the public has timely and equitable access to the agency's public information. For example, government should encourage a diversity of public and private sources for information based on government public information. Further, in cases in which the agency provides public information maintained in electronic format, government should provide timely and equitable access to the underlying information (in whole or in part). The PRA establishes a framework of active dissemination and public review of the dissemination process. Finally PRA rules that, except where specifically authorised by statute, federal government agencies shall not:

11 See for an overview of free spatial data provided by the US government: website HUNT.

a. establish an exclusive, restricted, or other distribution arrangement that interferes with timely and equitable availability of public information to the public;
b. restrict or regulate the use, resale, or redissemination of public information by the public;
c. charge fees or royalties for resale or redissemination of public information; or
d. establish user fees for public information that exceed the cost of dissemination.

Freedom of Information Act

Since the enactment of the Freedom Of Information Act (FOIA, 5 USC 552) in 1966, records of the federal government are subject to the federal Freedom of Information Act. It offers judicially enforceable procedures for compelling government agencies to release information to the public (Branscomb, 1994, p. 167). States and local governments records are subject to State Freedom of Information Acts. These acts are nor identical with FOIA, or is state court interpretation of similar language in such state statutes necessarily the same as federal court interpretation of FOIA (Perritt, 1999A, p. 479).

The federal FOIA provides that agencies shall act actively in disseminating certain public information to the public (5 USC 552 (a) (1) and 552 (a) (2)). Moreover, it provides that any person has the right to request access to federal agency records or information (5 USC 552 (a) (3) (A)). This right of access is enforceable in court (5 USC 552 (a)(4)(B)). In making any record available to a person, an agency shall provide the record in any form or format requested by the person if the record is readily reproducible by the agency in that form or format (5 USC 552 (a)(3)(B)). Although FOIA does not specifically identify datasets as a governmental record, the federal courts have consistently held that computer records are public records for the purposes of FOIA (Onsrud and Lopez, 1998, p. 160; Perritt, 1994, p. 13).

All agencies of the US federal government are required to disclose records upon receiving a written request for them, except for those records that are protected from disclosure by the nine exemptions and three exclusions found in the FOIA. Those include documents concerning national security, trade secrets, and information relating to an individual's privacy.

FOIA also allows a federal agency to withhold materials if the materials are exempt from disclosure by statute other than the FOIA, as the Delorme[12] case confirmed. Delorme ruled that the agency must possess and control the dataset in order to be able to disseminate the information on the terms in FOIA.

12 Delorme Publishing Co. v. National Oceanic & Atmospheric Administration of United States Department of Commerce, 917 F. Supp. 867 (D. Me. 1996).

The plaintiff, an electronic map publisher, sought disclosure of digital nautical charts from the defendant under the FOIA. The defendant used the Federal Technology Transfer Act (FTTA) to justify its refusal to disclose the material. The FTTA (and the judge) allowed the agency to withhold the materials for five years because it produced the material with a private company (extracted from Perritt, 1999b, p. 232).

The federal FOIA also does not provide a right of access to records held by Congress, the courts, or by private businesses or individuals.

Cost-recovery under FOIA

Federal government agencies are able to recover their costs of dissemination in accordance with the guidelines of the Office of Management and Budget. Agencies shall provide that "fees shall be limited to reasonable standard charges for document duplication when records are not sought for commercial use and the request is made by an educational or non-commercial scientific institution, whose purpose is scholarly or scientific research" (5 USC 552 (a) (4)(A)(ii)(II)). The most recent version of the guidelines recommends that Federal information resources be disseminated at the marginal costs of dissemination in order to encourage access and use through a diversity of channels (OMB Circular A-130, 1992). Marginal pricing allocates the smallest nonzero cost to users and thus is consistent with the principle of full and open exchange of information.

However, a federal government agency like the USGS does not always apply the open access model to its information. It divides its information products into two categories: public goods and private goods. Public goods are multipurpose information: information the nation needs and that are paid for through tax revenues. Private goods are special products and services requested by outside customers. Public goods are available at the marginal cost of dissemination as for private goods the full cost of information development is charged (Lopez, 1998, p. 117). The reasoning here is: if more information is accessed, more private businesses add value to government information and provide this value-added product for a competitive price on the market, resulting in lower revenues. "Commercial VAR (value-added resellers, BvL) activities have, however, led to declining agency revenues from the sale of electronic information. Although the USGS will continue its dissemination of both hardcopy and digital products at the marginal cost of dissemination, the agency does have some concerns for funding future dataset development" (Lopez, 1998, p. 119).

In addition, the open access model in the US has not been without discussion. In 1995, after the executive order of Clinton introducing the GII initiative, there was a political threat to privatise the US National mapping agency, USGS: "In the early 1995, legislation was proposed to abolish the USGS and have all national mapping activities undertaken by the private sector. This proposal was an outcome of the Republican's Contract with America. After considerable support from stakeholders including small and large commercial firms, state and local governments, academic institutions, and professional organisations, the proposal was dropped. Because of strong public support for the agency, Congress funded the agency at its previous level, with the National Mapping Division (NMD) benefiting from a slight budget increase" (Lopez, 1998, p. 119). However, in later years USGS suffered from significant real budget reductions and has caused USGS to scale back updates of the 1:24,000 map series (NRC, 2003b, p. 22).

5.5.3 Cost recovery example: Ordnance Survey in the United Kingdom

The best practice example of cost recovery policies is the Ordnance Survey (OS) of the UK. OS has undertaken the official topographic survey and mapping of Great Britain since 1791.

In 1990 OS became an Executive Agency of government. In April 1999, it became a Trading Fund, enabling it to focus on the development and exploitation of its commercial activities. OS is now responsible for balancing their revenue and expenditure. They have to make a return on capital and cannot go to government if they fall short of funds. However, they have more freedom to invest money in the business. In 2002, the government has reviewed OS' status and decided to continue OS' Trading Fund status with some added freedoms and flexibilities (Lawrence, 2002).

OS has also entered into an agreement with the government, the National Interest Mapping Service Agreement (NIMSA). This is designed to ensure the continuation of the non-commercial (i.e. national interest) elements of OS's business (OXERA, 1999, p. 2). The establishment of the Trading Fund recognises the private-good element of OS activities (where it is expected to be commercial), while the NIMSA provides official recognition of the public-good role of OS, and the need to ensure that it continues into the future.

Thus, "OS's activities are to some extent split between those which have elements of natural monopoly (the collection, storage and maintenance of geographic information), and those which are potentially competitive (converting the base geographic information datasets into products and services, and the sale and marketing of these products and services to customers). Where there is a natural monopoly, there are difficult choices about pricing since there are many ways of recovering fixed costs, each with different implications for demand" (OXERA, 1999, p. 4).

The OS reserves Crown copyright, and database rights in its products and information. Further, use may be subject to various custom-made contracts or licensing provisions. Table 5.2 summarises the ten primary users of OS' products.

The OS policy has resulted in almost full cost recovery of the ongoing cost

Table 5.2 Ten primary users of OS products
Utilities
Central government
Local government
Architects, engineers, survey and construction
Real estate
Legal and environmental consultancy
Transport
Computer and related activities
Farming and forestry
Mining, drilling and quarrying

Source: OXERA, 1999, p. 17

of running the Ordnance Survey by revenues generated from users (Rhind, 2001, p. 372). And the main elements of the database were guaranteed never to be more than six months out-of-date (Rhind, 2001, p. 372). Further, the restrictions enabled the accuracy, integrity, and official status to be protected, along with revenue generation (Rhind, 2001, p. 375). The OS is now responsible for providing and marketing topographic information and mapping at scales of 1:10,000 to 1:1,500, depending on the type of area, for Great Britain. This includes the geodetic and topographical surveys, and the associated work necessary for their completion. The OS also produces national series in paper and information products at a range of other scales. In this perspective, the OS provides high-quality information products (see GITA, 2005; Lopez, 1998, p. 79), which jurisdictions that opted for the open access model may not have.

5.5.4 Cost recovery example: Road centreline dataset in MetroGIS

Another best practice example for GII development is found in the US in the public private partnership between the public sector and a private firm in the Metropolitan region of Minneapolis and St. Paul (US).

Several public entities in Minnesota create road information. The state department of transportation has the major roads (highway to city level) in their database. Each county has some version of road information, but they generally do not maintain address attributes required for geocoding. Private roads are also generally not included.

One private company had created a street centre line dataset for several school districts, but too many of the cities that needed the information couldn't afford it. This information was digitised from paper maps from local government and has been adjusted to match coordinate geometry information from the counties. The private company further improved these datasets, aligning them and adding addresses (geo-coding).

In 1997, the strategy endorsed by the Metropolitan GII coordination body, MetroGIS, resulted in a partnership with the private company, which had built a road centre line dataset and was willing to share this information with MetroGIS participants for a fair price. The dataset was purchased with funds from the Metropolitan Council and the state Department of Transportation (Craig, 2001). The Metropolitan Council signed a five-year maintenance agreement with the private company; under the agreement that the information is made available to all state and local government at no cost (Craig, 2001). To use the information at no cost, MetroGIS members have to sign an individual license agreement with the private company and the Council. There are 149 government and academic licensees of the private dataset.

By getting the information to local government, local government became much more cooperative in getting new subdivision and street information to the company – information which is also used in a street atlas of Minneapolis and St. Paul (Craig, 2001). Whenever possible the cities and counties share new subdivision information actively with the company in either electronic or hard copy files. This cooperation assures users that the information is current. Several counties sell their own centre line dataset, but they also share that information with the private company for use in the MetroGIS dataset.

Despite the restrictive access policies for the road centreline dataset, the partnership between the private company and the MetroGIS stakeholders has been beneficial for developing the road centreline dataset for the Metropolitan region. The partnership resulted in a higher quality dataset, a more efficient information collection process, and more use(r)s of the dataset. In this way it contributes positively to the development of the Metropolitan GII. The Metropolitan GII is further discussed in the Chapters 7, 8 and 9.

5.6 Assessing the value of geographic information through its non-technical characteristics

In Chapter 2 the user perspective has been identified as the starting point for GII development: once the needs of the user are fulfilled the information will be used and the more it is used the greater its value for society (see also Onsrud and Rushton, 1995, p. ix). Therefore, it was reasoned that the objective of a GII should be:

1. to provide users the geographic information they need;
2. in a way needed by these users;
3. in an efficient way.

In this section the non-technical characteristics are addressed in the context of the development of GIIs and the objectives of a GII. We aim to provide an ideal situation for non-technical GII aspects from the perspective of the user.

It addresses user needs for finding, assessing, accessing, and using geographic framework information. Here, we evaluate the non-technical characteristics of framework information in the context of the objectives of a GII. The technical characteristics are used in the technical ideal as provided in Chapter 4. Non-technical characteristics are characteristics that do not directly relate to the technical functionality of the dataset, but to the legal, financial, physical, and intellectual accessibility of the dataset (see Bovens, 1999). These aspects are important for the user to be able or to decide to use a specific dataset, or to seek alternatives. The non-technical characteristics directly relate to user-questions like:

- Do I care about the imposed use restrictions?
- Can I acquire the dataset (privacy), and where, how?
- Is this price worth the dataset?
- Do I understand the dataset?
- Is help available?

First, the legal access requirements are addressed, then the physical access requirements, the financial issues, and finally the intellectual aspects and extras.

5.6.1 Legal access requirements

Chapter 4 provides that the first technical characteristic for framework information is the existence of the dataset (see also McLaughlin and Nichols, 1994, p. 68). However, the dataset also needs to be accessible in order to be used (see NAPA, 1998, p. xii; NRC, 1995, pp. 29-30). "Spatial data need to be equitable accessible to all parties and the wider community and widespread use of these data need to be facilitated by appropriate infrastructure such as suitable intellectual property laws and proper human resource development" (Rajabifard et al., 2003, p. 97). For public sector information, public records acts may decide whether a public dataset can be accessed or not, and under which conditions the information is available. In order to provide users the geographic information they need, the information needs to be accessible. Information to which access can be legally enforced is preferred over information for which access legislation is lacking. In addition, to ease access it would be beneficial to not require users to identify themselves and to not require them to specify their intended use of the information.

Moreover, from the user perspective it is beneficial to have as few use restrictions as possible. This implies that the user is in full control of the use of the dataset. The user is free to share it with friends, or resell it in a value-added product to other commercial parties without having to ask permission from the dataset supplier. Paragraph 5.6.2 elaborates on the link between access policies, pricing and use restrictions, and the required awareness for geographic information at the decision-making levels.

On the other hand, often sufficient legal means should be available to allow for the control of the use of an information product. Although intellectual property rights and licenses provide the owners the means to control the use, as such they are not necessarily harming GII development. They may, for example, only be used to ensure proper reference to the source without other restrictions on the re-use of the information.

Privacy issues are difficult to assess from a GII point of view. Lack of pri-

Table 5.3 Legal access issues from a GII perspective

GII score	–	+
Access constraints	Yes	No
Use constraints	Yes	No
Redistribution allowed	No	Yes
Intellectual property claimed	Yes	No
Access legally enforceable?	No	Yes
Identification?	Yes	No
User dependent policies?	Yes	No
Explain intended purpose?	Yes	No
Specific request?	Yes	No
Privacy constraints	Yes	No
Liability waived	Yes	No
Transparency of policies	No	Yes
Consistency of policies in government	No	Yes

vacy may increase the commercial value of a dataset, while strong privacy legislation may decrease it. However, the values of privacy are of another order than the GII and it should be on a case-by-case basis decided which one is preferred.

Further, users require transparency of the information policies (e.g., Ravi bedrijvenplatform, 2000, p. 13) and require consistency in the access policies throughout government (see STIA, 2001, pp. 8-10/13; KPMG, 2001, p. 16; Ravi bedrijvenplatform, 2000, p. 11; Pira et al., 2000, p. 76). Differences in pricing, use restrictions, liability regimes may result in confusion and ultimately limited use of the dataset (Meixner and Frank, 1997, p. 2). The user is, for example, uncertain about the cost he should calculate for complete jurisdiction coverage. A consistent or harmonised access policy throughout government may promote the use of framework information. Table 5.3 summarises the legal issues from a GII perspective.

5.6.2 Financial access requirements

Although users may require the highest quality for the lowest price several researches found that a maximum price for government information of the marginal cost of dissemination promotes use and economic development (e.g., Pira et al., 2000). Also Onsrud (2004b) argues that all leading economic studies indicate that current open access policies should remain in place to take full advantage of the potentials of a Geographic information infrastructure. Open access fosters academic and scientific research, effective public sector planning, as well as potentially curtailing commercial development (KPMG, 2001, p. 13; Onsrud, 1998b, p. 141). Finally, open access promotes the efficient collection, use and dissemination of information; it is unlikely that identical information will be collected twice, and net losses in hidden costs are minimised. Also NAPA (1998, p. xii) recommends that framework information be available at no or little cost.

However, in most existing cost recovery models, individual government agencies are in control of their budget, making them independent of fluctuating budgets in national government (see also Onsrud, 1998b, p. 146). They thus may allow for the advantage of having (access to) accurate, consistent, standardised databases that provide national coverage (Aslesen, 2002). The cost recovery model provides sustainable funding to individual government agencies, allowing them to maintain their information collection activities overtime (Onsrud, 1992a).

Table 5.4 Financial access from a GII perspective

	Stage			
Aspect	Stand alone/ initiation	Exchange/ standardisation	Intermediary	Network
Price	No access	Market price – full cost recovery	Partial cost recovery	≤ Marginal cost of dissemination

Table 5.4 provides a suggested development of financial acces from the perspective of a GII.

5.6.3 Physical access requirements

Physical access can be defined as the means that allow for finding and accessing geographic information. For reasons of economy it should be assured that framework information is collected only once: overlap and duplication among participating organisations should be avoided wherever possible (NAPA, 1998, p. xiii). Further, knowledge about the types of information, its location and quality and the ability to access the information easily are also important "as the measure of success of the GII will be the widespread use that is made of it and an appreciation by its users that it is providing the promised benefits which were the justification for establishing the GII" (Rajabifard and Williamson, 2001).

Finding geographic information

The efficiency implications result in bandwidths for the technical requirements of information. To minimise duplicate efforts, and to promote the use of a dataset, the existence of a dataset should be commonly known. Therefore, delivery mechanisms should be in place to promote the knowledge of the existence of framework information: users require transparency of available information (see Johnson, 2004, p. 3; Rajabifard et al., 2003, p. 97; Brox et al., 2002; Masser, 2001; Ravi bedrijvenplatform, 2000, p. 13; Gupta, 2000, p. 495; NRC, 1995, p. 27; McLaughlin and Nichols, 1994, p. 65; Holland, 1994). Further, awareness of the existence of the information access should be provided through electronic means (find and obtain data) (NRC, 1995, pp. 29-30). The existence of a clearinghouse (see Micus, 2003), open to all datasets available in a jurisdiction is likely to satisfy this transparency requirement (Crompvoets et al., 2004, p. 669). A clearinghouse including all framework datasets covering a jurisdiction is more valuable than those including only a subset. Organisations should be stimulated to disseminate actively their information through the publication in a clearinghouse. Information from organisations with a mandate to do so are likely to welcome more users (see Meixner and Frank, 1997, p. 1). An experimental way of promoting the knowledge of the clearinghouse would be to offer free content to ensure knowledge of the portal (Micus, 2001a, pp. 22-25).

Accessing geographic information

The efficiency component in the objective provided, information should be easily and readily accessible for transferring the information from supplier to the user. The GII mechanism should allow the user to readily obtain information (STIA, 2001, p. 9-7; NAPA, 1998, p. xii; NRC, 1995, p. 27; McLaughlin and Nichols, 1994, pp. 67-68).

The time between a request and the receipt of a requested dataset may be decisive for a user in his decision to use the dataset. Therefore, the time between request and access to a dataset should be minimised. Ideally, access would be immediate. To promote ready access, information providers could choose to allow for direct downloads from a publicly accessible website (NRC, 1995, pp. 29-30). On the contrary, paper maps behind bureaucratic doors are not promoting access. In addition, sufficient query, searching, notification and investigation tools (STIA, 2001, p. 8-9) may promote the use, while insufficient or poor search facilities barrier the use. In addition, standard order procedures are likely to ease access contrary to ad hoc procedures.

Further, an ideal situation would provide for as few contact points as possible (see Micus, 2003, p. 9), preferably one (Crompvoets et al., 2004, p. 669) per framework dataset, even if the dataset were integrated from several other datasets. The existence of a one-stop-shop concept may promote the use. Even if the information is collected by many different organisations, one stop for all needed information with one information policy, limits the transaction costs for the user and adds to the efficiency component. The user does not have to contact each one of the many organisations, and is preferably not confronted with as many different information policies. Therefore, including a dataset in a clearinghouse in a network stage of development would promote the extent to which a user is likely to find, access and use a dataset.

Access to information alone may not always satisfy user needs. Holland (1994) has provided several additional user needs:

- Users not only need data, but education about the data or how to make use of the data;
- Users need specialised manipulation of the data or other value-added services;
- Users need specific advice on what data to request, i.e., matching the data available to their data needs.

User friendly access (STIA, 2001, p. 8-9; NAPA, 1998, p. xii) may be one option to address these user needs, an available help desk for technical assistance another. Customised packaging for specific industries or types of users (STIA, 2001, p. 8-9), the notification of updates, an online manual, help for interpreting the information, free software, and finally courses on geographic information use may all promote the use of the dataset. However, users that need to be educated about their geographic information needs would probably be categorised as quartiary users, which are likely to be better of with services based on framework information. Table 5.5 summarises the physical access aspects from a GII perspective.

Table 5.5 Physical access issues from a GII perspective

Physical access	Stage			
	Stand alone	Exchange	Intermediary	Network
Publication dataset	Not published	Limited metadata published on provider's website	Metadata published in clearinghouse	Information, services directly available from clearinghouse
Acquisition procedure	Not applicable	Ad hoc bureaucracy	Standard order procedure	Online orders
Time between request and access	Not applicable	Inadequate	Adequate	Immediate
Number of points to contact for maximum coverage of jurisdiction	>100	50-100	2-50	1

5.6.4 Assessing geographic information: Intellectual access

For the assessment of a dataset, metadata documentation is critical. Chapter 4 section 4.2 has elaborated on metadata and chapter 4 section 5.3 has addressed the needs of the user with respect to metadata documentation.

5.7 The GII non-technical framework dataset characteristics maturity matrix

The non-technical characteristics are determined by the legal, financial, physical, and intellectual access characteristics of the dataset and by the extras that come with the use of the dataset. The preferences of the professional users may vary but most will agree with the so-called information perspective for the non-technical characteristics in an ideal situation:

- the information should be available;
- the information should be findable: publication in a clearinghouse;
- the information should be easily assessable: sufficient metadata documented
- The information should be readily accessible:
  - few (legal) restrictions;
  - one stop shop;
  - time between request and access is immediate;
  - the information can be used with as few (legal) restrictions as possible
  - cost should be affordable.

Further, the information should have a transparent access policy, which is consistent with other policies within the jurisdiction. Table 5.6 presents these requirements in the context of the GII maturity matrix.

Table 5.6 Development of the non-technical characteristics of framework datasets in the GII maturity matrix

	Stage			
Aspect	**Stand alone/ initiation**	**Exchange/ standardisation**	**Intermediary**	**Network**
Access policy				
Legal enforceability	No	Yes, for insignificant parts of the dataset	Yes, for significant parts of the dataset	Yes, for complete dataset
Use restrictions	No access	Use restricted to internal purposes	No redistribution (resell)	Only privacy and security limitations
Financial access	No access	Market price – full cost recovery	Partial cost recovery	≤ Marginal cost of dissemination
Physical access				
Publication dataset	Not published	Limited metadata published on provider's website	Metadata published in clearinghouse	Information services directly available from clearinghouse
Acquisition procedure	Not applicable	Ad hoc bureaucracy	Standard order procedure	Online orders
Time between request and access	None	Inadequate	Adequate	Immediate
Number of points to contact for maximum coverage of jurisdiction	>100	50-100	2-50	1
Policy				
Policy from a user's perspective	Not applicable	Minimum and maximum use conditions 'controlled'; harmonisation, some transparency		Uniform transparent policies throughout government

5.8 Summary

This chapter evaluated the non-technical characteristics of framework information in the context of the objectives of a GII. Non-technical characteristics are characteristics that do not directly relate to the technical functionality of the dataset, but to the legal, financial, physical, and intellectual accessibility of the dataset.

First, information policies from a theoretical point of view were described. This included different types of government information, legal and technical means to enhance, or restrict access and use. Further, the chapter analysed the open access and cost recovery approaches, including best practice examples. The second part of this chapter used the theory of the first part to develop a GII maturity model from an information policy GII perspective.

Ideally, the non-technical characteristics exists in datasets published with comprehensive metadata and accessible from one central point: one-stop-shop allowing for immediate access, with restrictions that are limited to protecting the individual's privacy and national security, a price not exceeding the marginal costs of dissemination, and consistent and transparent information policies.

6 The GII maturity matrices

6.1 Introduction

The first objective of this research has been developing a model that describes the different stages of development for geographic information infrastructures. In chapter 3 a development model from the institutional perspective was developed. Focus in chapter 3 was on the geographic information infrastructure. Chapters 4 and 5 developed a grow model from a technical and non-technical framework dataset perspective. It describes different levels of dataset qualities and relates these to geographic information infrastructure development.

This chapter brings the different models together and links the GII maturity matrix with the GII framework dataset maturity model.

6.2 The GII maturity matrix

The research has developed a model that describes the different stages of development for geographic information infrastructures: the GII maturity matrix. The matrix focuses on development from an institutional perspective (see Table 6.1).

The central issue the GII maturity matrix aims to address is the stages through which organisations develop from nothing into a mature GII organisation. The GII maturity matrix consists of four stages of GII development. The infrastructure develops gradually from a vague concept of stand-alone organisations into a mature network of collaborating organisations. The beginning stages of limited focus to single organisation's objectives without considering the world outside the organisation, are followed by stages of increased cooperation between organisations in the sector. Eventually in the most advanced stage, the network stage, organisations depend on each other for the information supply, outreach is coordinated, and framework datasets are the foundation for many value-added products. Further, leadership, open communication channels and a pro-active geographic information sector may result in capacity that is such that the GII enjoys broad support at all levels which may result in sustainable funding for GII development.

Although the network stage and the initial stage can be identified rather easily, this is less true for the two intermediate ones. There is no clear demarcation between the different stages: the transition of one stage to another will be gradual, and one component may reach a certain stage earlier than another.

Further, the stage of GII development does not imply anything about individual datasets. For example, a qualification of poorly developed GII may be despite excellent characteristics of one framework dataset.

The GII maturity matrix does not consider information issues, but focuses

Table 6.1 The GII maturity matrix

Aspect	Stage: Stand alone/ initiation	Exchange/ standardisation	Intermediary	Network
Vision	Focus on individual organisation	Developed with all stakeholders	Implementation	Commonly shared, and frequently reviewed
Leadership	Focus on individual organisation	Questioned	Accepted	Respected by all stakeholders "champion"
Communication	Focus on individual organisation	Open between public parties	Open between all stakeholders	Open and interactive between all
Self-organising ability	Passive problem recognition	Neutral problem recognition	Actively helping to solve identified problems	Actively working on innovation
Awareness for GII	Professionals in one organisation: organisational "GII"	Professionals of organisations together: GII	Awareness at many levels including decision making	Commitment at all levels/ continuous support in politics and management
Financial sustainability	Limited to projects	Neutral	Guaranteed for certain period	Sustainable but frequently reviewed
Delivery mechanism status	Project	Product portal (geo-portal)	Clearinghouse	Clearinghouse with data/ service provision (e.g., downloads)

on the processes around information creation production and use. This process-based GII strategy aims "to provide better communication channels for the community for sharing and using information assets, instead of aiming toward the linkage of available databases" (Rajabifard et al., 2002b, p. 15). Focus is on capacity building and to provide better communication channels for sharing and using. An example of a communication channel promoting GII development is the delivery mechanism of geographic information: a clearinghouse. A clearinghouse typically results from a common understanding that only together the needed transparency of available information and their characteristics may be reached. Therefore, the status of a delivery mechanism may be used as a measure of success of GII development. Section 5.3.4 has provided in-depth information about different ways clearinghouses may manifest.

6.3 The GII framework dataset maturity matrix

Besides the GII maturity matrix, the research also developed a framework dataset maturity matrix. To assess the usefulness of a dataset, the dataset maturity matrix accounts for both its technical (information quality, resolution) and non-technical characteristics (information policy, delivery mechanism, among others). The GII framework dataset maturity matrix is a data-centric matrix in that its main focus is to promote the existence of datasets deemed necessary for GII development. A further aim is to link these datasets with each other to the extent needed: the product-based strategy for GII development (see also Rajabifard et al., 2002b, p. 14). The section also links the stage of development to different user categories that in a certain stage of GII development are likely to use the dataset.

6.3.1 The GII framework dataset maturity matrix: technical characteristics

Table 6.2 provides the technical framework dataset maturity matrix for large-scale geographic information. The large-scale dataset ideally has excellent technical characteristic, including a harmonised content, full jurisdictional coverage and current and accurate information. In addition, the metadata documented should be comprehensive and the quality of geographic framework datasets should be sustainable overtime, with a seal of authority.

The GII framework dataset maturity matrix assesses a framework dataset from a GII perspective. A GII framework dataset may be assessed to be in a stand-alone stage of development despite the existence of several individual datasets with excellent technical characteristics. For example, one technical criterion is jurisdiction coverage. For a specific jurisdiction one hundred datasets may be integrated into one dataset for full jurisdictional coverage. Several of these datasets may have excellent technical data characteristics (accurate, current and object-oriented, adherence to standard information model, comprehensive metadata). However, the characteristics of the other datasets may not be as good, resulting in an overall assessment for framework datasets as stand-alone.

6.3.2 The GII framework dataset maturity matrix: non-technical characteristics

The legal, financial, intellectual, physical access characteristics of the dataset and by the extras that come with the use of the dataset determine its non-technical characteristics. The preferences of the professional users may vary, but most will agree with the so-called information perspective for the non-technical characteristics in an ideal situation:

- the information should be available;
- the information should be findable;
- the information should be easily assessable;
- the information should be readily accessible;
- the information should have a transparent access policy;
- the information can be used with as few (legal) restrictions as possible;
- the information acquisition should cost an affordable price; and
- the information access policy should be consistent with other policies within jurisdiction.

Table 6.2 Maturity of GII from a technical framework dataset perspective

	Stage			
	Stand alone/ initiation	Exchange/ standardisation	Intermediary	Network
Internal characteristics				
Content	Limited	Core		Comprehensive
Horizontal positional accuracy	> meters	Decimeters -meters		Centimeters-decimeters
Currency	>5 years	2-5 years		0-2 year
Orientation	None	Spaghetti	Object	Optimised object
Consistency throughout the dataset	None	Poor	Core	Excellent
External characteristics				
Digital coverage of jurisdiction (vector format)	0-50%	50-99%	50-99%	100%
Number of datasets for jurisdiction coverage	>100	50-100	2-50	1
Standard adherence (information exchange, data model, metadata)	None/ prototype	Non-standardised/ "Vendor specific"	De facto/jurisdiction wide standard	Open standards
Data model	Stand alone	Limited harmonisation	De facto/jurisdiction wide harmonised	Internationally harmonised
Metadata	None	Poor	Core	Comprehensive
Quality assurance	None	Project based	Seal of authority	Seal of authority backed by legislation

Ideally, the non-technical data characteristics of a framework dataset include comprehensive metadata and immediate access from one central access point. Further, access to the information is legally enforceable, costs no more than the marginal cost of dissemination, and is without restrictions in the use other than those that protect the individual's privacy and national security. Finally, the access policies are transparent and consistent throughout the jurisdiction. Table 6.3 provides the development of the non-technical characteristics of framework datasets from the perspective of GII development.

Finally, also the awareness for the value of a specific framework dataset is important for its technical and non-technical characteristics (see Table 6.4). A dataset which needs are well-known is likely to be collected and maintained, while datasets that do not enjoy high levels of awareness are likely to only exist for a limited period. Ideally, the value of a framework dataset is well-known, and if it is embedded in legislation, it is likely to have a secure future existence.

6.4 Use of framework information

The research hypothesizes that the technical and non-technical data characteristics of a framework dataset determine the use. The development in the use may be as provided in Table 6.5. In the beginning stages of a datasets'

Table 6.3 Maturity of non-technical characteristics of framework datasets

	Stage			
Aspect	**Stand alone/ initiation**	**Exchange/ standardisation**	**Intermediary**	**Network**
Access policy				
Legal enforceability	No	Yes, for insignificant parts of the dataset	Yes, for significant parts of the dataset	Yes, for complete dataset
Use restrictions	No access	Use restricted to internal purposes	No redistribution (resell)	Only privacy and security limitations
Financial access	No access	Market price – full cost recovery	Partial cost recovery	≤ Marginal cost of dissemination
Physical access				
Publication dataset	Not published	Limited metadata published on provider's website	Metadata published in clearinghouse	Information services directly available from clearinghouse
Acquisition procedure	Not applicable	Ad hoc bureaucracy	Standard order procedure	Online orders
Time between request and access	None	Inadequate	Adequate	Immediate
Number of points to contact for maximum coverage of jurisdiction	>100	50-100	2-50	1
Policy				
Policy from a user's perspective	Not applicable	Minimum and maximum use conditions 'controlled'; harmonisation, some transparency		Uniform transparent policies throughout government

Table 6.4 Institutional issues for framework datasets

	Stage			
Issue	**Stand alone/ initiation**	**Exchange/ standardisation**	**Intermediary**	**Network**
Awareness for geographic framework dataset (and information policy options)	Project based	Awareness among professionals within sector	Need commonly understood	Formalised in (flexible) legislation
Financial resources	Limited to projects	Neutral	Guaranteed for certain period	Sustainable, but frequently reviewed

development, the typical user is within the information producer. An access policy for other users may be non-existent. Next, it becomes obvious that other users may need the dataset for similar purposes. Some of these needs are incidental while others have a permanent need. The latter group of users may enter a partnership programme with the initial information provider. In the intermediary stage tertiary users require access. Finally, all potential users of the dataset are reached either directly or through a wide variety of services.

Table 6.5 Development of use of framework datasets

Aspect	Stage: Stand alone/ initiation	Exchange/ standardisation	Intermediary	Network
Internal technical data characteristics	Poor	Sufficient	Good	Excellent
External technical data characteristics	Poor	Sufficient	Good	Excellent
Access policy	No access	Cost recovery, use restricted to internal purposes	Partial cost recovery, no redistribution (resell)	Open access
Physical access	Poor	Sufficient	Good	Excellent
Users	Primary	Primary and secondary	Primary, secondary (cross-jurisdictional) and tertiary	All

The stages are roughly correct for this matrix, but we did not research where one stage ends and another begins. For example, the point at which information quality and access policy will be used by tertiary users remains unanswered by this research. However, the matrix does suggest that framework datasets with poor technical data characteristics and open access policies are unlikely to attract all users groups. Similarly, many users will not consider using datasets with restricted access policies, but excellent technical characteristics.

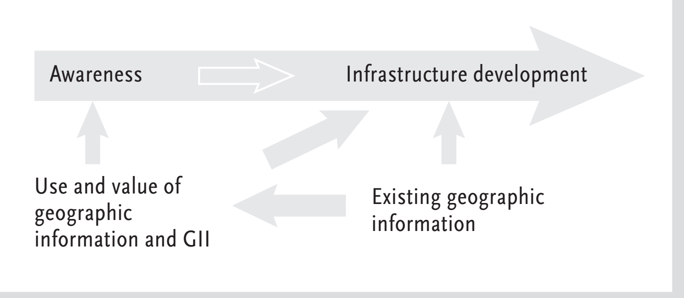
It should be noted that progress in the development as provided in Table 6.3 depends on the context in which the dataset develops. Both the maturity of the GII and the jurisdiction specific context determine to a major extent the ability for a specific dataset to develop towards its' ideal.

6.5 Linking the matrices

The GII maturity matrix and the GII framework dataset maturity matrix are linked to each other. A change in a stage of development in the GII framework dataset matrix may impact the stage of development of the overall GII.

One of the links between the process and product based maturity matrices is provided in Figure 6.1: the awareness for the GII. The GII development depends for a major part on the awareness at the decision-making levels. Geographic information lobbyists, coordinating agencies and academics, among others, and users of geographic information feed the awareness. High levels of (especially end-)use imply increased levels of awareness. Especially increased use of Location Based Services, the services based on geographic information, will promote the GII and the value of a specific geographic framework dataset. It would not be surprising that a decision maker starts using it on a frequent (daily) basis and starts wondering why she cannot link her dataset with another. She may further wonder why her GPS track linked to a digital map shows that she has walked in the river (inaccurate data), or why the map she wants to use for overlaying her GPS track is so expensive. These examples may be exemplary for the role awareness for the GII may play. Awareness for

Figure 6.1 Use of framework datasets contributes to infrastructure development



Based on Rajabifard et al., 2002b, p. 15

the GII promotes the development of the infrastructure.

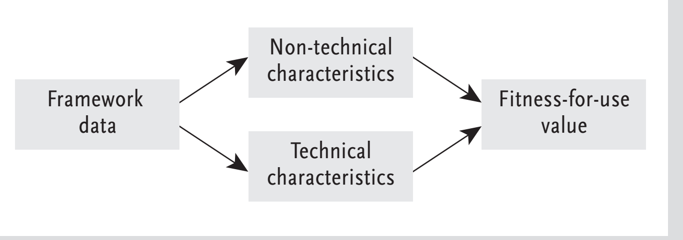
A framework dataset may promote the awareness for GII through advanced technical and non-technical characteristics. The dataset ideally has excellent technical characteristic, including a harmonised content, full jurisdictional coverage and current and accurate information. Further, consistent and transparent open information policies promote the use. Through these characteristics, the framework dataset is likely to be the basis for the pro-active geographic information sector, which best practice solutions continue to enlarge support for the concept of the GII.

In addition, the use by professionals may also contribute to the GII development. These professional users continue to identify and discuss the technical and non-technical improvements for a specific dataset for further GII development.

Moreover, a common vision and agreement, and sufficient leadership addressing the need for a harmonised framework dataset may in fact promote the development of several stand-alone datasets into one jurisdiction-wide harmonised framework dataset adhering to the requirements of the GII. Another example may be the level of communication between GII stakeholders and the non-technical dataset characteristics. Communication between public producers and private users may stimulate the awareness that the non-technical framework dataset characteristics need to be improved, for example through less restrictive use conditions, to be GII 'proof'. Many other examples may be available that show the linkages of the two matrices.

Both maturity matrices attempt to model GII development from an institutional perspective as well as framework data characteristics and an access policy perspective. The relation between these three components is not completely apparent. Full adherence to the institutional ideal may result, for example, in a high level of awareness for geographic information. There are no guarantees, however, that a high level of awareness will also result in high-quality framework datasets or open access policies. Therefore, the model presented should be regarded as a first attempt to show GII development. The research performed five case studies to assess the relation between the components in general and the relation between the framework dataset characteristics component and the information policy component more specifically.

Figure 6.2 Framework information Valuation Model at the producers' side



6.6 Researching the role of access policies in GII development

6.6.1 Introduction

This section introduces the research framework of this research that provides for assessing the value of geographic information in the development of a GII. The framework distinguishes the producers' side of the geographic information and the users' side in order to come to a model for assessing the value of geographic datasets for the GII.

6.6.2 Geographic Information Valuation Model: assessing the fitness-for-use value

The research framework involves the technical and non-technical characteristics of a framework geographic dataset and its use characteristics as a measure of success of an access policy. The technical characteristics are type of data, scale of data, and quality of information (see chapter 4). The non-technical characteristics are determined by the legal, financial, physical and intellectual access characteristics of the dataset (see chapter 5). It is believed that together these technical and non-technical characteristics result in an expectation of likelihood that a potential user is going to use a dataset: the fitness-for-use value (see Figure 6.2).

Chapter 4 and 5 provided the foundation for the Geographic Information Valuation Model. Chapter 4 summarised the development in the technical characteristics of a framework dataset in the context of a GII. Chapter 5 provided the non-technical characteristics development of a dataset. At one point, Geographic Information Valuation Model differs from the developed theory. One of the non-technical dataset characteristics, the physical accessibility, was split in the ability to find a dataset and the ability to access a dataset. The Geographic Information Valuation Model only addresses the access component and therefore the focus in the physical accessibility is on the ease to access a dataset.

In addition to the fitness-for-use value, a use value may be assessed (see Figure 6.3). The technical and non-technical characteristics of the datasets are important for the users' decision to access and use a dataset. By measuring

Figure 6.3 Framework information Valuation Model at the users' side

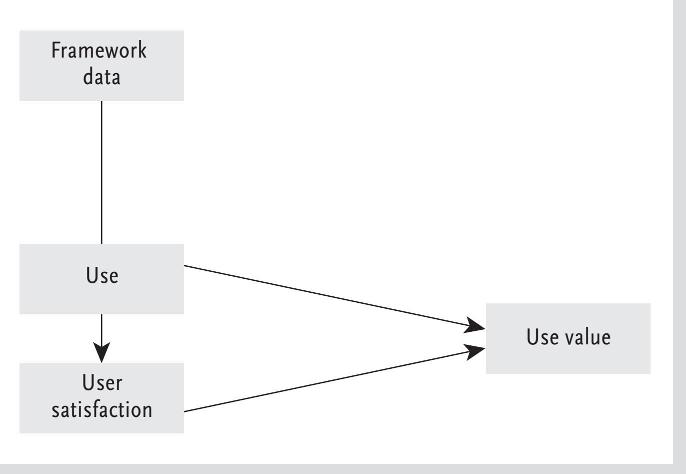
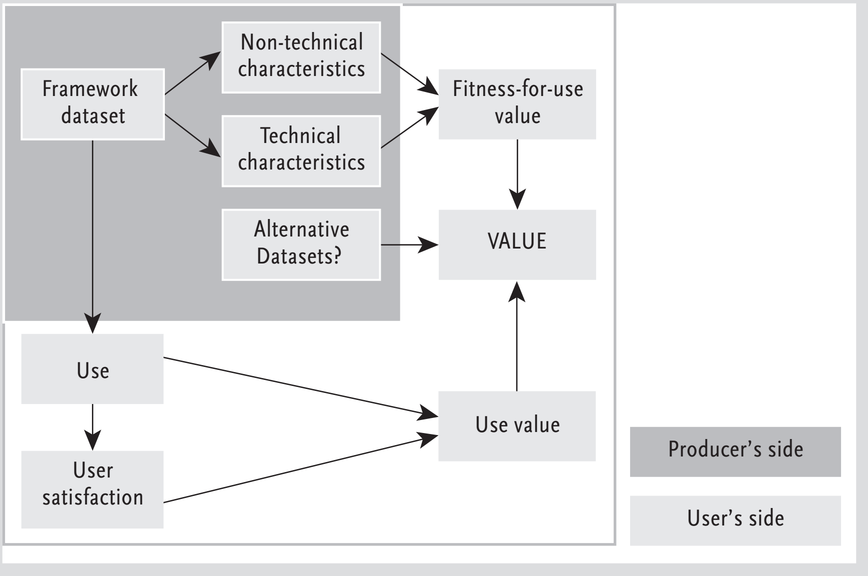


Figure 6.4 Framework Information Valuation Model



the use of the dataset and the satisfaction with the dataset a use value is acquired. The use value also includes the variety of products on the geographic information market, either provided by government or private sector.

The research model assumes that in a given setting the more, and more satisfied uses of the dataset, the higher the use value as a percentage of the people in the area covered. High use and satisfaction results in a high overall value of the dataset. This value is an *indication* for the contribution of the framework information to the development of the GII.

Figure 6.4 shows a graphical overview of the complete research framework.

It consists of a non-technical and technical part of framework data, and a use part. The producer of the information controls the technical and non-technical part, while whether the information is used is mostly a decision of the user. The producer's side adds up to a fitness for use value, and the user side into a use value. The research distinguishes between primary, secondary, and tertiary users of a dataset, and citizens (see chapter 2). Primary users collect the information and use it for the execution of a specific (public) task. Secondary users may use the dataset for purposes in harmony with the initial purposes of the dataset creation. Tertiary use is then defined as uses that serve a different goal than the initial purpose of the information collection. Finally, the end-users may be the fourth category of users. These users, however, are not considered in this study.

An additional checkpoint for the estimation of the value of a dataset is the number of alternative (identical or similar) datasets that are available. A high number may be an indication of an insufficient fitness-for-use value: too restrictive access conditions for the quality provided, among other reasons. If the access policies outweigh the cost for others to collect the information themselves, they increase the likelihood of the collection of identical or similar information.

Additional aspects

Other factors of importance in assessing access policies include the costs to create the dataset, and the economic impact of the use of the dataset. These aspects were, however, not considered in this research. For the first issue, the research assumed that jurisdictions similar in socio-economic development, size and population density, have a similar need for framework datasets. Consequently, the cost of the collection and processing the framework dataset would be comparable.

The second aspect, the economic impact, is complex and difficult to assess. It is potentially subject to speculative outcomes. Such an approach should be the subject of another academic exercise.

6.7 Summary

This research has modelled the different stages of development for geographic information infrastructures. This chapter has brought the GII development models of chapters 3, 4 and 5 together and has linked the GII maturity matrix with the GII framework dataset maturity model.

Further, the chapter presented the research model that has been the basis for the case study researches. Chapter 7 provides an elaboration on the case study research. Chapters 8 and 9 present the case study results for respectively parcel datasets and large-scale topographic information. Focus of the research is the access policy accompanying a large-scale framework dataset. The chapters that provide the case study set-up and results (chapters 7, 8, 9 and 10) also assess the applicability of the matrices to GIIs in practice.

7 Case study research

7.1 Introduction

This chapter lays down the research strategy that was followed in accomplishing the field research. It provides the theory behind the research strategy, and the research design that was judged to be most appropriate in assessing access policies in the context of a GII.

A case study approach was used to compare the impact of different access policies for large-scale geographic framework datasets on GII development. This chapter explains why a case study strategy was used, and justifies the selections the research made in its focus on two framework datasets in five jurisdictions. Finally, this chapter provides a brief overview of the GIIs in the five case study jurisdictions.

7.2 Research strategies

Yin (1994, pp. 3-6) identifies five distinct research strategies: surveys, histories, archival analyses, experiments, and case studies. Majchrzak (1984, p. 63) adds cost-benefit and cost-effectiveness analyses to these. Researchers administer questionnaires to some sample of a population to learn about the distribution of characteristics, attitudes, or beliefs (Marshall and Rossman, 1995, p. 95). A history is an account of some past event or combination of events. Historical analysis is, therefore, a method of discovering, from records and accounts, what happened in the past (Marshall and Rossman, 1995, p. 89). An experiment divorces a phenomenon from its context so that attention can be focused on only a few variables. Typically, the laboratory environment controls the context (Yin, 1994, p. 13). A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly defined (Yin, 1994, p. 13). Finally, cost-benefit and cost-effectiveness studies refer to the set of methods by which a researcher compares the cost and benefits to society of alternative policy options (Majchrzak, 1984, p. 63).

Yin (1994, 4) proposes three conditions to determine an optimal research strategy. The first and most important condition for differentiating among the various research strategies is to identify the type of research question being asked. In general, 'what' questions may either be exploratory (in which case any of the strategies could be used) or about prevalence (in which surveys or the analysis of archival records would be favoured) (Yin, 1994, p. 6). In contrast, 'how and why' questions are more explanatory and likely to lead to the use of case studies, histories and experiments as the preferred research strategy (Yin, 1994, p.6). This is because such questions deal with operational links needing to be traced overtime, rather than mere frequencies or incidence. The second condition is the extent of control an investigator has over behavioural events. Experiments, for example, require the researcher to control the event being researched. Finally, the degree of focus on contemporary as opposed to historical events is important for the choice of the research strategy. Historical research, for example, studies historical events.

In addition, Stake (1995, p. 41) explains the differences between quantitative and qualitative research:

> "In quantitative studies, the research question seeks out a relationship between a small number of variables. [...] Efforts are made to operationally bound the inquiry, to define the variables, and to minimize the importance of interpretation until the data are analysed. At the beginning, it is important for quantifiers to interpret how relationships between variables would reduce weaknesses in explanation, and at closing, it is important for the researchers to upgrade their generalizations about the variables. In between times it is important not to let interpretation change the course of the study."

He continues with:

> "In qualitative studies, research questions typically orient to cases or phenomena, seeking patterns of unanticipated as well as expected relationships. [...] The dependent variables are experientially rather than operationally defined. Situational conditions are not known in advance or controlled. Even the independent variables are expected to develop in unexpected ways" (Stake, 1995, p. 41).

Therefore, case study research allows for a more complete understanding of a phenomenon by examining behaviour in context (Majchrzak, 1984, p. 63). Case studies further allow for identifying behaviours and other variables that were not expected to be related to the social problem (Majchrzak, 1984, p. 63). Finally, case studies using interviews allow the researcher to notice body language, and to listen to opinions, which can be important for understanding or interpreting the content. Marshall and Rossman (1995, pp. 100-101) provides a comprehensive overview of the strengths and weaknesses of information collection methods.

For the overall approach to the study Marshall and Rossman (1995, p. 42) cites Zelditch (1962), who has proposed that research strategies should be judged on two criteria:

> "The first is informational adequacy. Does the research design maximize the possibilities that the researcher will be able to respond to the questions thoroughly and thoughtfully? Will the strategy elicit the sought-after information? The second criterion is efficiency. Does the plan allow

adequate data to be collected at the least cost in terms of time, access and cost to participants?"

7.3 This study's research strategy: case study

This research centres on the following question: "What role do access policies play in the development of a geographic information infrastructure (GII)?" The research question is explanatory in the sense that it aims to assess to what extent access policies impact the GII development.

The context of the research issue is complex. The GII consists of eight core elements, which are likely to be interrelated (see chapter 2 and 3). Moreover, the development of a GII is extremely complex and research on its development has only recently emerged (Kok and Van Loenen, 2005; Delgado et al., 2005; Steudler, 2003). Although access policies are assumed to be critical for GII development, it is not ascertained or confirmed by research. It may very well be that other aspects are equally or more important for the development of a GII than the access policies. These other factors are, however, unknown but may be related to both the GII and the access policy. Further, in the context of GIIs the researcher does not control the actual behavioural events. Finally, the research concerns contemporary events.

The ability of surveys to investigate the context is extremely limited (Yin, 1994, p. 13). This makes it difficult to interpret the research information correctly. For example, through a survey research may find poor technical characteristics in geographic datasets with open access policies in four jurisdictions. The conclusion may then be: open access policies result in poor datasets. However, other variables may be at stake, for example, lack of technological means in one jurisdiction, poor coordination in another, and limited human resources in the third jurisdiction. Thus, surveys may be appropriate to research the relation between access policies and the quality of the information but are unlikely to provide for a full understanding of how the access policies relate to the development of the national geographic information infrastructure. Moreover, for statistical analyses a minimum number of responses must be obtained. In this research, many users should be identified. It was unclear whether such amounts of users did exist.

The research question, the complex nature of a GII, and the limitations of the survey instrument, resulted in a choice for the case study instrument as the strategy of the research. A case study allows to study access policies for large-scale geographic information in their full context. Further, through the case study strategy it is expected that adequate information for addressing the research question and the study's hypotheses can be collected. Finally, a case study is expected to be cost-efficient in terms of time, access and cost to participants.

7.4 Designing case study research

Case study research is a way of investigating an empirical topic by following a set of pre-specified procedures. The case study inquiry copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result benefits from the prior development of theoretical propositions to guide data collection and analysis (Yin, 1994, p. 13). The case study constitutes of three stages: (1) define and design, (2) prepare, collect and analyse, and (3) the analyse and conclude stage.

7.4.1 Define and design the case study

A case study research design should include five components:

- A study's questions;
- Its propositions;
- Its unit(s) of analysis;
- The logic linking the data to the propositions, and
- The criteria for interpreting the findings (Yin, 1994, pp. 20, 26).

Together the complete research design embodies a 'theory' of what is being studied. The complete research design will provide strong guidance in determining what information to collect and the strategies for analysing the information. The development of a theoretical framework is also important for the generalisation of the research findings. Therefore, theory development prior to collecting any case study information is an essential step in doing case studies (Yin, 1994, p. 28).

Four tests have been commonly used to establish the quality of any empirical social research:

- Construct validity: establishing correct operational measures for the concepts being studied;
- Internal validity: establishing a causal relationship, whereby certain conditions are shown to lead to other conditions, as distinguished from spurious relationships (for explanatory or causal studies only);
- External validity: establishing the domain to which a study's findings can be generalised, for example through replication;
- Reliability: demonstrating that the operations of a study – such as the data collection procedures – can be repeated, with the same results (Yin, 1994, p. 33).

7.4.2 The prepare, collect and analyse phase

For the information collection efforts some overriding principles are relevant in doing case studies:

- Use multiple sources of evidence, but converging on the same set of facts or findings. Multiple sources of evidence provide multiple measures of the same phenomenon, addressing the construct validity issue sufficiently.
- Use a case study database, i.e. a formal assembly of evidence distinct from the final case study report. A case study database is likely to increase the reliability of the research. Further,
- Use a chain of evidence, i.e. explicit links between the questions asked, the information collected and the conclusions drawn. In this way also the reliability of the study increases.

Incorporating these principles into a case study investigation will increase its quality substantially (Yin, 1994, p. 78).

When you know something about a case, you may also know something about other similar cases. Yin (1994, p. 31) states "The method of generalisation in case study research is 'analytical generalisation', in which a previously developed theory is used as a template with which to compare the empirical results of the case study. The framework needs to state the conditions under which a particular phenomenon is likely to be found (a literal replication) as well as the conditions when it is not likely to be found (a theoretical replication). If two or more cases are shown to support the theory, replication may be claimed. The empirical results may be considered yet more potent if two or more cases support the theory, but do not support an equally plausible, rival theory" (Yin, 1994, p. 31).

The generalisation is not automatic, however. A theory must be tested through replications of the findings in a second or even a third case, where the theory has specified that the same results should occur, or not. Once such replication has been made, the results might be accepted for a much larger number of similar cases, even though further replications have not been performed (Yin, 1994, p. 36).

7.5 This research' case study design

The research framework has been laid down in chapter 6.5 (see Figure 6.4). It involves the technical and non-technical characteristics of a framework geographic dataset and its use characteristics as a measure of success of an access policy. The technical characteristics are type of information, scale of information, and quality of information (see chapter 4). The non-technical characteristics are determined by the legal, financial, physical and intellectual access characteristics of the dataset (see chapter 5).

The following sections detail the research question, criteria for interpreting the findings, the possible generalisation of the research results, and the case study information acquisition methods.

7.5.1 Research question and hypotheses

This research centres on the following question:

What role do access policies play in the development of a geographic information infrastructure (GII)?

The unit of analysis, access policies for large-scale geographic framework information, has been studied through the three objectives of the research: (1) to develop a model that describes the different stages of development in geographic information infrastructures; (2) to provide a framework for researching access to geographic framework information policies in the context of the development of geographic information infrastructures, accounting for the level of development of such infrastructure; and (3) to assess the impact of access policies on the characteristics and use of large-scale geographic framework datasets.

The first objective has resulted in the theoretical framework for assessing the development of a GII, which was developed prior to the case study research (see chapters 3 throughout 6). The second objective builds on this theoretical framework and provides the theoretical basis for accomplishing case study research for assessing the impact of access policies on the development of a GII. Finally, the third objective is being addressed through the examination of four hypotheses, which were presented in chapter 1.

The study examines four hypotheses concerning the role of access policies in the development of a GII.

Hypothesis 1: *The extent to which a dataset is used is determined by both the technical and non-technical characteristics of the dataset.*

Hypothesis 2: *The technical characteristics of a dataset and its access policies are balanced: excellent technical characteristics are accompanied by datasets with restrictive access policies, while poor technical data characteristics are accompanied by datasets with open access policies.*

Hypothesis 3: *The stage of development of the components of the 'GII framework dataset maturity matrix' is decisive for the most appropriate access policy for framework datasets.*

Hypothesis 4: *At an advanced level of GII development only a policy of open access to public information enhances further GII development.*

The research framework as provided in chapter 6 has been the core framework in addressing these four hypotheses. Hypothesis one and two were addressed through a literature study, both in books and on the Internet, which provided on the technical and non-technical dataset characteristics. The interviews with employees of the information producing organisations and other knowledgeable people sought confirmation of the literature study findings. In addition, the interviews provided information about the use (number of users, user groups) of the researched datasets. This information allowed for testing hypothesis one. Further, the assessment of the fitness-for-use value provided the information for addressing hypothesis two.

The third and fourth hypotheses link the most appropriate access policy to the level of development of a dataset, and put the hypothesis one and two in the perspective of GII development. Analyses of the case study findings in the context of GII development were used to address these hypotheses.

7.5.2 Criteria for interpreting the findings

To set the criteria for interpreting the findings of the research, the question is often how close the findings have to match the developed theory to be considered a match. One hopes that the different patterns are sufficiently contrasting that the findings can be interpreted by comparing at least two rival propositions (Yin, 1994, p. 26).

The developed Framework Information Valuation Model, incorporating the GII geographic framework dataset maturity matrix, has been used as the theory for interpreting the findings. Chapter 4 and 5 provided the foundation for the Geographic information Valuation Model. Chapter 4 summarised the development of the technical characteristics of a framework dataset in the context of a GII. The criteria provided in chapter 4 deciding the internal and external technical dataset characteristics are fully used in interpreting the findings. Chapter 5 provided the development of the non-technical characteristics of a dataset. It identified the legal, financial, physical and intellectual accessibility of a dataset. Finally, the Framework Information Valuation Model was provided in chapter 6.

A highly mature framework dataset has a high fitness-for-use value while a dataset in the beginning stages of development has a low fitness-for-use value. It is reasoned that datasets with excellent technical GII characteristics and excellent non-technical GII characteristics (e.g., open access policies) are highly welcomed by the user communities. Contrary to these 'ideal', datasets with poor technical GII characteristics with restrictive access and use conditions are expected to be less popular. The technical value of a dataset has a

Table 7.1 Relating stage of GII framework dataset development to fitness-for-use value

Aspect	Stage			
	Stand alone/ initiation	Exchange/ standardisation	Intermediary	Network
Fitness-for-use value	– –	–	+	++

scoring range between ++ (excellent) and – – (non-existent). The non-technical value of a dataset has a scoring range between ++ (excellent) and – – (non-existent). A dataset with an excellent technical value and an excellent non-technical value scores a fitness-for-use value of ++. The scores of the technical and non-technical dataset characteristics are directly derived from the stage of development of the GII framework dataset (see Table 7.1). It is expected that a high fitness-for-use value is attracting more users, resulting in more value-added products than datasets with a low fitness-for-use value: a high fitness-for-use value results in a high use value (see Table 7.2).

The technical and non-technical characteristics of the dataset are assessed and marked with a value varying from – – (poorly developed), to 0 (neutral), to ++ (excellent). The same logic is used for the use assessment (use value). This results in an overview similar to what is shown in Table 7.2. In the example table the conclusion will be that an open access policy for government end-users of geographic framework datasets increases its value for society.

The access policy may treat all users alike, or specify among specific user groups. In chapter 5 it was recognised that access policies within a jurisdiction may differ for different user groups. Therefore, this study also considers the differences in affiliation of the users. Table 7.2 shows an example of interpreting case-study findings. In the Table 7.2 both the internal and external data characteristics are assessed to be good for all users (+). The access policy and the ease to access the dataset vary among user groups. In the example, government users are confronted with open access policies (++), which are sufficient for their use. Further, the dataset is accessible through an intranet portal allowing for a positive ease to use score (+). Together with the technical data characteristics this results in a positive fitness-for-use value (+). The dataset is used within government and therefore the use value is also positive (+).

Utilities and commercial users are confronted with restrictive access policies prohibiting the re-distribution of the dataset. Further, these users cannot take advantage of the government intranet portal, resulting in a (-) score for ease to access. Tertiary commercial users did not use the dataset and this has resulted in a (- -) score for the use value for this user group..

7.5.3 Generalisation of the research results

We are looking at the hierarchal level of geographic information infrastructures where the large-scale framework datasets are created (see chapter 2.4). This may sometimes be at the national level, in other cases at the sub-national level and in others at the local level. Comparing the situation in one jurisdiction with the situation in another may provide information about the success of the access policies in both systems. The information is especially valuable if the jurisdictions are comparable from a socio-economic, institu-

Table 7.2 Example findings specified by user group

User group in sample jurisdiction	Access policy	Ease to access	Internal dataset characteristics	External dataset characteristics	Fitness-for-use value	Use value	Conclusion
Government							
Primary users	++	+	+	+	+	+	+
Secondary users	++	+	+	+	+	+	+
End-users	++	+	+	+	+	+	+
Utilities and public services							
Primary users	–	–	+	+	0	–	0 –
Secondary users	–	–	+	+	0	–	0 –
End-users	–	–	+	+	0	–	0 –
Commercial users							
Secondary users	– –	–	+	+	0	0	0
Tertiary users	– –	–	+	+	0	– –	0 – –
End-users	– –	–	+	+	0	– –	0 – –
Research community							
End-users	+	0	+	+	+	+	+
Professionals	+	0	+	+	+	+	+

tional, and geographic perspective.

For datasets in GIIs with similar environments as the GIIs in the case study research, the research findings may be used as a means to assess the current status of a dataset in the light of the development of a GII. Accordingly the success and justification of the GII strategy may be assessed.

7.5.4 Case study information acquisition

Information about the cases was acquired through a literature study both on the internet as through traditional ways, and e-mail conversation with knowledgeable experts from the jurisdictions involved. In addition, each case included face-to-face interviews with key individuals within a jurisdiction representing a specific group of users and producers, and included a study of relevant documentation, for example an assessment of the dataset in question. The interviews sought confirmation of the literature study findings.

We expected that through interviews with key individuals, both users and producers, we would get a hold on how many requests for information were received, how many value-added products based on the framework dataset were created, and how the current practices of the producer satisfied the user community.

The interviews can be characterised as semi-structured. First, the purpose of the research was explained and a general question about the GII involved asked. Generally, the interviewee started to address the research question and hypotheses from his perspective, animated discussion followed, unpublished and personal views were acquired and the interviewer checked through the checklist of topics and must-ask-questions whether all relevant issues were addressed.

Through e-mail, the interviewees were provided the interview report with the request to confirm the correctness of the content, and in the e-mail it was explicitly stressed that the final report will be provided to anyone requesting the report. Finally, to a limited number of interviewees the full jurisdictional GII report was sent and asked for feedback on the content, its completeness and correctness.

The research used the case study results to further develop the GII maturity matrix and the GII framework dataset maturity matrix. Although all components of the GII maturity matrix were addressed in the case studies, focus has been on the access policy component. The case studies provide input for the assessment of the role of access policies in the development of a GII.

7.6 Selections for the case study

This section presents the outcome of the selections for the case study. Out of over ten potential jurisdictions, five jurisdictions were selected for this research. The selection process and criteria are provided in the first paragraph. Further selections were made in the datasets subject to this research: their theme, type and scale.

7.6.1 Selection criteria for the jurisdictions

The research strives to research different access policies for similar framework datasets in similar jurisdictions. Jurisdictions similar in their level of socio-economic development, with a similar system of government, similar level of population density, and geographic size are expected to have similar geographic framework information needs.

The Netherlands is the starting point of the research. Many countries qualify for comparison with the Netherlands. In addition, the research strove to have maximum variance in the unit of analysis, the access policy. Therefore, jurisdictions were selected with open access policies in place, and jurisdictions with cost recovery policies. Finally, in order to address the institutional component of the GII the selected cases should have some form of coordination mechanism in place, which would be an indication for the activity in GII development. It is expected that the GIIs of the selected cases are in the same

Table 7.3 Key socio-economic characteristics of jurisdictions of interest

Jurisdiction	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Level of economic development	High (2002)	High (2001)	High (2002 Germany)	High (2001 US)	High (2001 US)
GDP per capita	$29,000	$25,800	$26,600	$38,907 (Mass 2001)	
GDP composition by sector*	(2004)	(2004)	(2002 Germany)	(2004 US)	(2004 US)
- agriculture	2%	2%	1%	1%	1%
- industry	26%	25%	31%	20%	20%
- services	72%	73%	68%	79%	79%
Human Development Index 2001 ranking*	11	5	18 (Germany)	7 (US)	7 (US)
Networked Readiness Index 2001-02 ranking*	7	6	17 (Germany)	1 (US)	1 (US)
Networked Readiness Index 2003-04 ranking*	5	13	11 (Germany)	1 (US)	1 (US)

* Information between brackets applies to the year and the entire country mentioned.

Source: website The World Factbook, 2003; Fukuda-Parr et al., 2003; Kirkman et al., 2002; Dutta et al., 2004; Dutta and Jain, 2004

stage of development as the Dutch GII, but adhere to different principles for access to public information

The following jurisdictions were selected: the Netherlands, Denmark, Northrhine Westphalia, Massachusetts (US), and the Minneapolis-St. Paul Metropolitan Area in Minnesota (US). This section provides core information about these jurisdictions that were the basis for the case selections.

Socio-economic criterion

All jurisdictions have a relatively high income, with Massachusetts with a relatively high GDP per capita. The contribution of the service sector to the GDP is for all cases at least 68%. They further score all in the top 20 both of the Human Development Index (Fukuda-Parr et al. 2003), and the Networked Readiness Index (Kirkman et al., 2002; Dutta et al., 2004; Dutta and Jain, 2004) indicating a high level of socio-economic development (see Table 7.3).

Geography: size of jurisdiction and population density criterion

For this research, we selected jurisdictions that are in the same order of magnitude[13] for area of the country, population density and population. Table 7.4 provides the geographical characteristics of the selected jurisdictions. Denmark is with 43,094 km^2 the largest jurisdiction, followed by the Netherlands, Northrhine Westphalia, and Massachusetts. Metro is the smallest jurisdiction

13 Two quantities are of the same order of magnitude if one is less than 10 times as large as the other.

Table 7.4 Key geographic characteristics of jurisdictions of interest

Jurisdiction	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Surface (km^2)	43,094	41,526	34,060	27,337	7598
Population	5,352,815	16,067,754	18,060,211	6,379,304	2,697,410
Population density	126	474	530	320	355

Source: World fact book, 2003; website netstate; website Census; website nationmaster

Table 7.5 Key characteristics of jurisdictions of interest

Jurisdiction	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Government type	Democracy; Constitutional monarchy; Member of EU	Democracy; Constitutional monarchy; Member of EU	Democracy; State in Federal republic; "Member" of EU	Democracy; State in Federal republic United States	Democracy; Region in State in Federal republic United States
Number of regional governments	–	–	5	–	1
Number of counties or provinces	14	12	54	14	7
Number of municipalities	271	467	396	351	191

covering 7,598 km^2. Northrhine Westphalia has the highest population density (530 people per km^2), followed by the Netherlands, Metro, and Massachusetts. Denmark has the lowest population density with 126 people per km^2.

The Metropolitan Region of Minneapolis and St. Paul is almost 6 times smaller than Denmark and population density in Denmark is more than four times smaller than the population density in Northrhine Westphalia.

Type of government criterion

The jurisdictions of interest have different types of government (see Table 7.5). The Netherlands, and Denmark are constitutional monarchies and member of the EU. Northrhine Westphalia is part of a federal system within the EU, as Massachusetts is part of the federal system of the US. The area of MetroGIS is also part of the federal system of the US, but has in the state of Minnesota and the Metropolitan jurisdiction an extra administrative layer to cope with. As such federal, state, regional, and local rules apply to this area. All selected jurisdictions are democratic societies.

The number of regional, county and municipal government entities in each jurisdiction provides some insights about the way government is organised. Denmark consists of 271 local authorities and 14 counties. The city of Copenhagen, the Borough of Frederiksberg, and the regional local authority of Bornholm have dual status as both local and county authorities (website KL).

The Netherlands consists of 12 provinces, and 467 municipalities.

Northrhine Westphalia is one of the 16 states of the Federal republic

Table 7.6 Expected access policy for large-scale geographic information

Jurisdiction	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Expected access policy for geographic information	Cost recovery	Cost recovery	Cost recovery	Open	Mixed

Germany. Northrhine Westphalia consists of 5 administrative regions (Regierungsbezirke), divided into 31 districts (*Kreise*) and 23 urban districts (*kreisfreie Städte*). Northrhine Westphalia has 396 municipalities (1997), including the urban districts, which are municipalities by themselves (website Nationmaster).

Massachusetts consists of 351 towns and cities and 14 counties. From 1997 to 1999 seven of the 14 counties were abolished and their responsibilities transferred to the state government. The local communities vary heavily in size. The city of Boston has approximately 600,000 inhabitants, where the town of Gosnold counts less than one hundred people. The median community population is 9,707 (Ware) (website MMA).

The Metropolitan Council has jurisdiction over the Metropolitan area. The Metropolitan area consists of seven counties. The area consists of 191 cities and townships (website MetroGIS).

Access policy criterion

Table 7.6 shows the expected acces policy for large-scale geographic information in the cases (see also Figure 7.1).

Denmark has strong freedom of information regulation in place, but its government geographic datasets are generally available against prices based on cost recovery principles. Government agencies may also charge each other and compete with private sector.

The Netherlands and Northrhine Westphalia cope with similar situations. Both have fragmented policies throughout government and both are aiming at more open access policies.

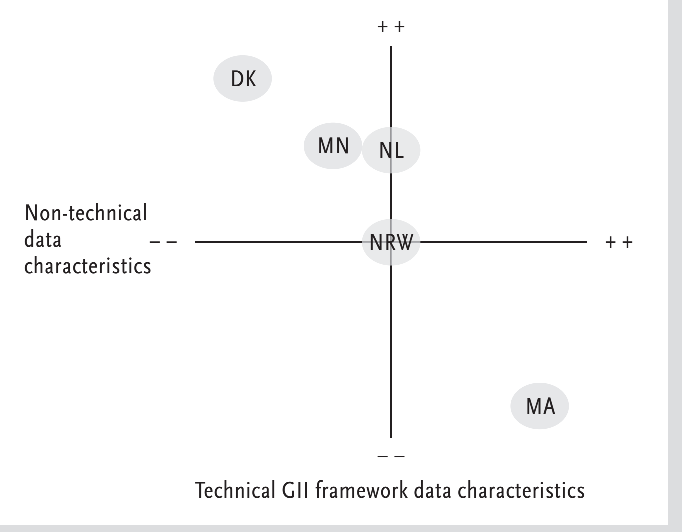
Many states in the US have more open access to public information policies than the Netherlands, and some have more restrictive policies. The access policies within the jurisdictions of interest are very different. Massachusetts offers through MassGIS (the Commonwealth's Office of Geographic and Environmental Information) free downloads of raster and vector datasets at scales varying from large-scale (1:5,000) to small-scale (1:250,000) (website MassGIS) including topographic and administrative boundary datasets.

In Minnesota, the public records act rules that in general public information should be open to the public, but in instances where public information represents a commercial value more restrictive access policies and cost recovery fees may be applied.

7.6.2 Selection of the large-scale datasets

Focus of this thesis is on large-scale-spatial-information in densely populated jurisdictions (approximately of scale 1:1,000). The appropriate resolution to meet user needs varies per user category.

Figure 7.1 Expected access policy and quality of information in selected jurisdictions



The scale of a dataset, its quality and type are among the factors that determine the level of information collection costs of geographic information collection. These costs may vary heavily: a 1:1,000 dataset with comprehensive content for a complete jurisdiction is expensive in relation to a 1:1,000,000 dataset with only one theme included for a sub-part of a jurisdiction. In addition, framework datasets are costly to collect and to maintain, but its existence benefits many. Therefore, framework datasets are the fundament of the GII and need to be treated differently than the other data types. Thematic datasets use the framework dataset for reference purposes. They are not as expensive to create as framework datasets, but they benefit few.

Scale, information quality and type of datasets are rarely addressed in the discussions of access to government geographic information so far. The conclusions of accomplished research are used as general statements on the success of a policy. Successful policies for one range of scales, however, do not necessarily apply to other ranges of scale.

This research focuses on the cadastral dataset and large-scale topographic datasets for four reasons:

1. Parcel and large-scale topographic information are considered important for the local levels of GII (see, for example, Rajabifard et al., 2000);
2. As a framework layer for the local levels of GII, the high level of detail of the information can be used as the basis for other hierarchal levels of GIIs;
3. These datasets are relatively expensive to collect, process and maintain; but
4. They have barely been addressed in research assessing the success of access policies.

7.7 GII context in researched jurisdictions

The research has selected three European cases, Denmark, the Netherlands and Northrhine Westphalia, and two US cases, Massachusetts and Metropolitan region of Minneapolis and St. Paul. In both instances, the selected jurisdictions may be subject to initiatives at the higher level, being the EU or US federal government. An overview of these higher-level jurisdictional policies is provided in this section.

7.7.1 European Union

In Europe, every jurisdiction is typically responsible for its own information collection and processing efforts. The efforts conform to the needs of the stakeholders in that specific jurisdiction. In this way content and quality criteria were agreed upon, the funding mechanisms created were thought to be sufficient, and if needed, other policy measures were introduced. Each country, or even each smaller jurisdiction in federated countries, did this for their specific situation. This process resulted in the current European situation of the existence of many different national standards, high quality information collected at a variety of scales, and differing information policies. Partly due to the increasing influence of information technology, awareness has grown in Europe that harmonising information collections, specifications, and policies may be beneficial.

Several developments within the EU contributed to the increasing need for cross-boundary information within Europe, and the need for cross-border geographic information. The European Parliament, Commission and Council continuously aim to promote the transportation and free mobility of goods and services, and the movement of people within the EU (see, for example, the Schengen Agreement).

Also the harmonisation of national law in many areas has resulted in harmonisation on, among many others, the protection of individuals with regard to the processing of personal information and on the free movement of such information (EU, 1995), the legal protection of databases (EU, 1996), and the re-use of public section information (EU, 2003). Although these Directives created some harmonisation in national law, it is unclear whether the harmonisation de facto exists in the member states of the EU (see Korff, 2002; Laarakker and Gustafsson, 2004; Van Loenen, 2002a). Moreover, the stage of GII development within Europe varies from an advanced GII in Sweden, with high quality information and online services, to less advanced GIIs in some of the accession countries. These aspects make it difficult to have a single strategy to develop the European GII.

The GI2000 proposal of 1995 was the first attempt to create the conditions for a European geographic information infrastructure (EC 1995). This proposal of the Information Society Directorate General never reached the European Commission and as recently as the end of 2001 a new proposal for a European GII was initiated. Under the responsibility of the Environment Directorate General of the European Commission, the INfrastructure for SPatial InfoRmation in Europe (INSPIRE) was introduced. INSPIRE (2004) promotes metadata documentation, service provision by government and information sharing within government. INSPIRE is among (proposed) legislation that is likely to determine the direction in which the national GIIs in Europe may develop.

Many other projects have been accomplished all directed at the development of a European GII, the Geographic Information Network in Europe (GINIE) (see Salgé, 2004; Craglia et al., 2003), the Methods for Access to Data and Metadata in Europe (MADAME) project (Craglia et al., 1999), and the European Land Information Service (EULIS) (Laarakker and Gustafsson, 2004), which is a first step towards improved access to information from the Land Registry and/or Cadastres in Europe.

Denmark

The Service Board for Geodata (*Servicefællesskabet for Geodata*) was established in 2002 as a coordination body, but includes only representatives from the public sector (website DK XYZ). Some of the objectives of the Service Board are:

1. to develop and formulate a vision and a strategic framework for development of geodata in Denmark;
2. to secure co-operation on data, access to data modelling; and
3. to promote development of coherent geodata services. (SADL, 2003a).

The Director of KMS is the chairperson of the service board. The secretariat of the board is placed within KMS. The participation in the service board is on a voluntary basis. This has resulted in a loose cooperation, with a small secretariat, and no money specific for its activities.

Denmark is developing a vision for their GII. The current developments can best be characterised as common sense. In Denmark several clearinghouses, or portals exist, all serving different purposes. Geodata-info.dk is the official clearinghouse with comprehensive metadata for many both public and private datasets. Another portal of interest may be the portal for municipal geographic information (website Kommunekort).

The Netherlands

In the Netherlands, since 1990, the Minister of the Spatial Planning, Housing and the Environment is responsible for coordinating the NGII (Ministerie van Binnenlandse Zaken, 1990). The formal coordination of the GII has been divided between the coordinating minister and the Ravi, between which a formal agreement existed until 2002. Ravi, which member organisations are public, is focusing on the field coordination. It initiates and stimulates the commitment within and outside the geo-information community, and promotes the concept and development of the national geographic information infrastructure (NGII).

As a result of the need to respond to private user needs, the Ravi Business Platform was founded in 2001. The Ravi Business Platform is the private sector equivalent of the Ravi, and performs as a geographic information platform of private entities. The objective of the GII has been "to ensure the widest possible access for members of our society to communication media and the rich divers information sources". Since the beginning of the nineties, the sector is working towards establishing uniquely defined, ubiquitous, and interlinked core datasets (registration of parcels, natural persons, enterprises, and buildings) (see Ravi, 1992). The vision has been reviewed several times (Ravi, 1995; VROM, 1998; Ravi, 2003), but the core of the initial vision still holds. The new strategy document (Ravi, 2003) provided a more comprehensive view on the NGII.

The Dutch clearinghouse, Nationaal Clearinghouse Geo-informatie, is available since 1995. The metadata in the service is limited, outdated and the service not frequently used.

Northrhine Westphalia

In Germany, geographic information attracts increasingly attention, both at the executive and political decision making levels. Political support came at the start of 2001 when the German Parliament (the *Bundestag*) passed a resolution implement rapidly the German GII and promote the interdepartmental use of GI in the public sector. Further political support was received in 2003 when the use of geo-information was discussed in the German Parliament (Deutscher Bundestag, 2003). The *Bundestag* acknowledges the economic, political, and societal importance of the availability of geo-information. It urges for further harmonisation of the geographic framework information and their qualities, and further fulfilment of the GDI.DE concept. It further urges for better coordination within the geo-information sector in Germany, for increased transparency of information and to ease the use for third parties, to build a German emergency information system, the start of a conference bringing together federal and state interests, and to promote the economic significance of geographic information in Germany (see also Ganswindt, 2004).

The federal program Deutschland on-line has incorporated the GII, and the implementation of the GII at the federal level is coordinated by the *Agency and Co-ordinatic Centre of the Interministerial for geoinformation* (IMAGI, see website IMAGI). IMAGI is supported by the Committee and set about developing collaborations with the private sector and academia (SADL, 2003b).

Each of the 16 states in Germany is responsible for its own topographic service, land and property register (nevertheless the *Grundbuchordnung* is a federal law), environmental and statistical information collection, and in general for information policies. Information collection is largely decentralised and carried out mostly on the regional and local level. The different states have issued laws ('Surveying and Cadastral Acts') that regulate the work, and the authorities of the surveying and mapping authorities.

In the German States the use of information, in this context (public) geographic information, is restricted by federal laws (e.g., the law regarding information protection) and additional state laws (e.g., cadastral law). These laws regulate the use, trade and transfer of information (SADL, 2003b).

Northrhine Westphalia is one of the sixteen states of the federal republic of Germany. With regard to GII development, the developments of the GDI.NRW is closely watched by other states and IMAGI, as it may be an example for other state GIIs and the German GII.

In Northrhine Westphalia, coordination of the GII is in the Centre for Geoinformation (CeGI), a public-private-partnership. The overall goal of GDI.NRW is to enable the geographic information market and to enhance the access to geographic information (website CeGI). In addition, a permanent decision-body has been appointed by the state government; the GI-Committee NRW (Committee for Geographic information in Northrhine Westphalia). It creates strategies for the creation of GII, judges incoming project proposals referring to GII, and advices the Minister President's office on geographic information (Riecken, 2000).

In NRW, the GDI.NRW also attracts increasingly attention from the parliament. The Ministry of the Interior was the initiator and supporter of the GDI.NRW. A conference fully dedicated to the GDI.NRW, the *Tag der Geoinformationswirtschaft im Landtag NRW* (Geo information science day)(23 November 2004) was an initiative of the representatives of all four political parties represented in the Northrhine Westphalian parliament and the DDGI (website CeGI1). It attracted over 600 participants. At this conference, four political parties acknowledged in a statement the high potential of geo-information for the economy and public administration for NRW (Landtag, 2004). It further assessed the status of the GDI.NRW through its successes and issues that need to be resolved.

Finally, with the Cadastre modernisation act of 1 March 2005 (Katastermodernisierungsgesetz, 2005) several framework datasets requirements have been changed to meet GDI.NRW requirements. For example, it promotes documenting metadata, and the geographic framework datasets are generally freely available for governmental use and other non-profit uses.

In Germany, the geocatalog (see website Geocatalog) performs the function of a national clearinghouse since September 2003. It includes datasets from both public and private parties. Information concerning Northrhine Westphalia can be found through this service. CeGi and Conterra GmbH maintain the service. In Northrhine Westphalia two portals are available that may function as a clearinghouse: *Geobasisdatenportal*, and the *Geodatenzentrum*. The *Geobasisdatenportal* (website Geobasisdatenportal) is the clearinghouse for the geographic framework datasets. Access is limited to the state authorities through the intranet of the LDS (Küpper, 2003). The *Landesvermessungsamt* runs the *State Geodatenzentrum Liegenschaftskataster* (Centre for cadastral data) (website Geodatenzentrum).

7.7.2 United States

In the US, the principal lead for the development of the NGII is in the Federal Geographic Data Committee (FGDC). The main focus of FGDC is at the national level. The US NSDI started in 1990, when the Office of Management and Budget (OMB) issued Circular A-16 that identified all federal mapping agency's responsibilities with respect to coordination of federal surveying, mapping, and related geographic information activities (OMB 1990). The management of this activity was directed to the Federal Geographic Data Committee (FGDC). The OMB expanded the A-16 processes to include specific responsibility and accountability for the mapping agencies engaged in surveying, mapping, and geographic information collection, archive and distribution.

In 1994, the Executive Order 12906 called for the establishment of a coordinated National Spatial Data infrastructure (NSDI) as one of the President's principal programs that it was going to pursue through his administration. FGDC was charged with coordinating the federal government's development of the NSDI. In the Executive Order, FGDC was given a mandate to involve state, local and tribal governments, academia and the private sector in coordinating the development of the NSDI.

Although the Circular A-16 and the Executive Order were well conceived, criticism has been accumulated over time. NAPA (1998, p. 110), for example, stressed that the Circular and Executive Order are relatively weak policy bases, compared with mandates having the force and effect of law, for fulfilling goals as ambitious as those set for the NSDI. Further, the FGDC chairperson "has no formal authority over fellow committee members. He also has no means to compel attention by political leaders at the state and local levels. They have their own constitutional and statutory mandates to guide their actions" (NAPA, 1998, p. 63). These relatively weak policy bases make it difficult to implement the NSDI vision.

Although FGDC stimulated participation in FGDC's actions by state and local government organisations, state and local government organisations are not full partners with the federal government: "Neither academia nor the private sector are formally represented, except as members of stakeholders groups. Federal agencies active in FGDC also do not reflect the full range of federal agencies active in geographic information and some FGDC members are not fully active" (NAPA, 1998, p. 65; see also Koontz 2003, p. 10; STIA 2001, Williamson et al., 2003; Rajabifard et al., 2002b, p. 20; Kok and Van Loenen, 2005).

The National Research Council called in 1993 and again in 2003 for participation from state and local government to fulfil the NSDI vision (NRC, 1993 and 2003b). There are at least two important reasons for involving these lower levels of government: (1) the federal agencies do not have sufficient resources to fulfil their existing information gathering goals, (2) state and local governments have the finer resolution information necessary to make local decisions (Craig, 2001).

The US states enjoy a high level of independency from federal government; each state has its own political and administrative power. Access policies for public information and large-scale geographic information collection are purely responsibilities of the states. The GII developers of Massachusetts and Minnesota can operate independent of the GII efforts on a federal level, and can make or break the success of the national GII. For example, the cadastral one stop shop does not include cadastral information from 45 states (see website geo-one-stop: website US landuse), which may limit the use and success of such a service.

Massachusetts

In Massachusetts, legislation has established MassGIS as the official state agency assigned to the collection, storage and dissemination of geographic information (see G.L.M. c. 21A, s.4b). MassGIS is the Commonwealth's Office of Geographic and Environmental Information, within the state's Executive Office of Environmental Affairs (EOEA). MassGIS was founded in the late 1980s.

The legislation gives MassGIS the mandate: "to collect, consolidate, store and provide geographic and environmental information in order to improve stewardship of natural resources and the environment, promote economic development and guide land-use planning, risk assessment, emergency response and pollution control" (G.L.M. Chapter 21A: Section 4B Office of geographic and environmental information, see website MassGov). Legislation specifies 12 tasks for MassGIS. These include the following four tasks:

a. fostering cooperation among local, state, regional and federal government agencies, academic institutions and the private sector in order to improve the quality, access, cost-effectiveness and utility of geographical and environmental information as a strategic resource for the state;
b. coordinating data sharing and executing data sharing agreements among all levels of government and private users;
c. identifying, developing, correcting, updating, distributing and assembling geographical and environmental data;
d. setting standards for the acquisition and management of geographical and environmental data by any agency, authority or other political subdivisions of the commonwealth.

The central point for access to geographic information in Massachusetts is the MassGIS' website (website MassGIS1). It includes many datasets that have been collected by MassGIS, or with the support of MassGIS. Large-scale geographic information and information from private sector is lacking at the site.

Metropolitan region of Minneapolis and St. Paul (Minnesota)

In 1967, the Metropolitan Council was created in order to coordinate the activities of the seven-county metropolitan area of Minneapolis and St. Paul (website Minneapolis Chambre of Commerce). The Metropolitan area is part of the state Minnesota.

In Minnesota, the Land Management Information Center (LMIC) functions as a coordinating agency for the Minnesotan GII, but many of its responsibilities result from historic precedent, not explicit legislative language (Warnecke, 2000b). The Minnesota Governor's Council on Geographic Information (GCGI), and the Minnesota GIS/LIS consortium also have a hand in coordination (Craig, 2001). The Minnesota coordination model scored a shared tenth position in the NSGIC state coordination assessment (NSGIC, 2004). Minnesota established its first clearinghouse node in 1997 (website Geogateway). Now three nodes operate in the state: LMIC, the Department of Natural Resources (DNR) and the Arrowhead Regional Development Commission (ARDC) (Warnecke, 2000b). Already in September 1996, the GCGI introduced the Minnesota Geographic Metadata Guidelines (MGMG) (website GCGI). Most geographic information is considered public government information, and in many instances it can be downloaded without cost and without restrictions in the use.

MetroGIS is an initiative that helps local governments in the seven county Twin Cities metropolitan area to carry out their operations more effectively and manage costs through collaboratively addressing GIS-related needs. It started in 1995 and aims to institutionalise information sharing so its stakeholders can easily obtain accurate and reliable information in a useful form.

MetroGIS has no legal standing but relies on an informal voluntary structure for participants to develop collaboratively and implement regional solutions to common geographic information needs. MetroGIS relies upon stakeholders for funding, contracting and legal services, and official standing to receive and spend funds.

DataFinder is the clearinghouse for the Metropolitan area (website DataFinder). It includes a registered node of the US NSDI Geospatial Data Clearinghouse, complying for information documentation, indexing and searching (see website US clearinghouse). It has comprehensive metadata documented, but does not include private sector datasets.

Table 7.7 Core information about selected jurisdictions

Jurisdiction	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Expected access policy for large-scale public geographic data	Cost recovery	Cost recovery	Cost recovery	Open	Mixed
Expected quality framework datasets	High	High	Neutral	Poor	High
Coordination	Service board for GI	Ravi/VROM[1]	CeGI/ Landes-vermessungsamt[2]	MassGIS[3]	MetroGIS[4]
GII stakeholders	Public (private)	Public (private)	Public and private	Public	Public
Clearinghouse content	Public and private	Public and private	Public (private)	Public	Public

1 Ravi is a national coordinative body comprising most public GI-organisations.
VROM is the Ministry of Spatial Housing Planning and the Environment.

2 CeGI is the centre for GI, a public-private partnership coordinating the map for GDI-NRW.
Landesvermessungsamt is the state mapping agency.

3 MassGIS is the government agency for geo-information (state).

4 MetroGIS is the coordinating body comprising public organisations.

7.7.3 Overview of key GII information in case study jurisdictions

Table 7.7 provides an overview of the core information of the jurisdictions that resulted in selection of the jurisdictions. It shows that all cases have some form of coordination for their GII, and that a central portal for geographic information exists. It also shows that Massachusetts is expected to be the only jurisdiction with open access policies for all public geographic datasets.

7.8 Summary

This chapter has provided the research framework that has been used in the case study research. It explains the selections of the researched jurisdictions, datasets and user group focus. For each jurisdiction, a brief overview is provided of the context of its GII and its current status. Chapter 8 and 9 provide the case study findings for cadastral and large-scale topographic datasets and chapter 10 links these findings to the theory developed in chapter 3 throughout 6.

8 Case study results for parcel information

8.1 Introduction

This chapter provides the results of the case study findings for the parcel datasets in Denmark, the Netherlands, Northrhine Westphalia, Massachusetts and the Metropolitan region of Minneapolis and St. Paul.

Parcel mapping is closely related to the system of land administration. Therefore, this chapter starts with a brief overview of different systems of land administration, and the land administration system that is operational in each of the cases. Secondly the findings of the technical and non-technical parcel data characteristics assessment are presented and a fitness-for-use value is provided. Finally, the use characteristics are described and conclusions drawn.

8.2 Systems of land administration

8.2.1 Introduction

Land administration consists of two major components: cadastre and land registry. All achieve the same end: a system that provides security of ownership, facilitates property transfer and supports a secure mortgage and loan market. National mapping to high geodetic and topographic standards is the basis for effective land administration systems incorporating land registration, land valuation, and land use (Manthorpe and Walker, 2001). Here briefly the terms cadasters and land registry are explained.

8.2.2 Cadastre

Larsson (1991, p. 16) describes a cadastre as follows:

> "[A] cadastre is a systematic description of the land units within an area. The description is made by maps that identify the location and boundaries of every unit, and by records. In the records, the most essential information is the identification number and the area of the unit, usually differentiated by land use class. […] Furthermore, the classical cadastre provides information concerning owners, land classes and values or land taxes. Additional information may sometimes be found in cadastral records or in adjacent records. Databases are often established for buildings, physical plans, etc.[…] Sometimes such an extended cadastre will be referred to as a multi-purpose cadastre".

A cadastral framework describes and defines the interests and rights in real property. It supports the security of the rights of owners of real property.

A cadastre functions as the entrance to the land registers. It may consist of an index, which lists the recorded documents, for example, by real property number, or address. A map showing the approximate location of the real property may also ease the search for a specific property, especially if no other information is available. Apart from the entrance function, a cadastre may consist of the most up-to-date information concerning ownership and value of the real property. In such instances it may be used as a basis for taxation purposes, and be used by those interested in or associated with transferring ownership rights such as notaries public, real estate agents, mortgage providers, and citizens. Larsson (1991, pp. 12-13) recognises the special value of information that relates to land units:

> "Land units are effective sources of information about ownership and other property rights, about credit, taxation, assessed value etc. They can also be used in conjunction with many other types of information, such as population information. If land units are related to a general spatial reference system, all this information can then be positioned geographically. In many countries such accurate information is important as a means of increasing public revenue by fair land taxation."

Moreover, the cadastre may become a basic land information system of great variety and complexity for planning, environmental protection, and a lot more issues (Hawerk, 2001; Brox et al., 2002; Larsson, 1991, p. 13). It is potentially the basis for various other purposes. It should meet the requirements of legal dealings, administration and business. In particular, it should consider the requirements of state planning, urban and rural planning, urban redevelopment and land consolidation, the valuation of fixed assets and of environmental and nature protection issues appropriately (website AdV; MassGIS, 2003; NRC, 1995, pp. 37-38). In instances where large-scale topographic information is lacking, the cadastral dataset may fulfil a topographic function.

The cadastral layer is in many GII initiatives considered a framework layer (see Onsrud, 1998b; INSPIRE, 2004; LMIC, 2003, p. 8).

8.2.3 Land Registry

Larsson (1991, pp. 17-18) defines the land registry as:

> "The land register is a public register of deeds and rights concerning real property. Depending on the legal system, there may be a register of deeds or a register of titles. Under the system based on the registration of deeds, it is the deed itself that is registered. A deed is a record of a particular transaction and serves as evidence of this specific agreement, but it is not itself a proof of the legal right of the transacting parties to

enter into and consummate the agreement. Under the alternative system based on the registration of title, this process of tracing the chain of deeds is unnecessary. Title registration is itself a proof of ownership and its correctness is usually guaranteed and insured by the State".

In theory the distinction between registration of title and registration of deeds is clear-cut, but in practice the differences are often not as evident. The Netherlands, for example, has a register of deeds, but in practice this operates with certain characteristics of the title system, because of the close cooperation between the registry and the notary involved in real estate transactions, and the strong internal link between the deed registry and the cadastre (see, for example, Zevenbergen, 2002).

Land registration systems operate throughout the world as the legal basis of recording, with certainty, the ownership and other legal rights in and over land. Such systems provide the machinery for confident property transfer, the operation of a secure mortgage market and protections for the citizen. The effective operation of land and title registration systems are fundamental to successful market economies providing confidence for private ownership and property transfer and, as a consequence, engendering social stability. Information from countries indicate how aspects of registration systems vary. The majority are map based, some backed by a state guarantee, others record the existence and priority of documents of transfer and mortgage (Manthorpe and Walker, 2001).

8.2.4 Land administration in Europe

Land administration in Europe is divers both from the perspective of land registration[14] (ownership guarantees) as for the way the cadastre is organised. Each country in Europe has a unique system of land administration: some countries have a multi-purpose cadastre, some have none, and some have something in between; some have title registration, others a registration of deeds. The responsibilities of the cadastre and the land register are in most countries separate. The cadastre is typically is a national or centrally organised institution, while land registration may reside under the Ministries of Justice and the decentral local courts (examples are Nordic countries and Germany).

The cadastre in many continental European countries stems from the French cadastral model that was instituted by Napolean I (Larsson, 1991, p. 29).

14 It has been argued that harmonisation of the existing land registration systems will promote cross-border real property transactions and facilitates the European mortgage market. A new common way of land registration is the EuroTitle system (see Ploeger and Van Loenen, 2005).

It consists of two parts: a verbal description and a map showing the locations and boundaries of all land units. The French model contains parcel numbers, area, land use and land values for each owner and the land units are based on cadastral surveying (Larsson, 1991, p. 21). Concerning the cadastral maps, Larsson (1991, p. 29) indicates that in Northern and Western European countries "While cadastral maps were originally of the 'island map' type, depicting only the cadastral block or section in question, they now increasingly take the form of 'comprehensive maps' covering [a standardised dataset, linked to a national grid with a common coordinate system]."

However, in Southern and Eastern European countries, the cadastre may not have been fully developed, in the UK it is non-existent. In the UK detailed topographic maps (Ordnance map) of the Ordnance Survey are used to identify real property boundaries, among other means (Larsson, 1991, p. 23).

Many European countries have cadastres in place collecting and providing information about ownerships in real property. The information is typically available in administrative databases and geometric format. The geometry is typically based on surveys performed by licensed surveyors. Many European cadastres have developed from purely taxation cadastres to multi-purpose cadastres (see Larsson, 1991, p. 30). The cadastral layer is among the datasets that are prioritised in INSPIRE (2004, annex II).

8.2.5 Land administration in the United States

Cadastre

In the US a cadastre in the European meaning of the word does not exist. However, two systems of property descriptions are found in the US: property descriptions in metes-and-bounds and property descriptions based on the Public Land Survey System (PLSS).

Metes and bounds

"The original colonies (including their derivatives Maine, Vermont, Tennessee, Kentucky and West Virginia) continued the British system of metes and bounds for the description of parcel boundaries. This system describes property lines based on local markers and bounds drawn by humans. A typical description for an individual parcel under this system might read "From the point on the north bank of Muddy Creek one mile above the junction of Muddy and Indian Creeks, north for 400 yards, then north-west to the large standing rock, west to the large oak tree, south to Muddy Creek, then down the centre of the creek to the starting point" (website Wikipedia).

Particularly in New England, this system was supplemented by drawing up town plats. A plat is a map, drawn to scale, showing the division of land into lots with streets and alleys, usually for the purpose of selling the described lots; this is known as subdivision. After a plat is filed, legal descriptions can refer to lot numbers rather than portions of sections (website Wikipedia).

The metes-and-bounds system was used to describe a town of a rectangular shape, 4 to 6 miles (6 to 10 km) on a side. Within this boundary, a map or plat was maintained that showed all the individual lots or properties (website Wikipedia). A plat subdivides property into individual lots and blocks and is created by private surveying companies (website Minnesota GISLIS).

Public Land Survey System

Most of the states west of Pennsylvania, use the Public Land Survey System as the framework for all parcel boundaries within the state. The system was created by the Land Ordinance of 1785. It has been expanded and slightly modified but continues in use (website Wikipedia.com). The PLSS subdivided all public land in rectangles of equal size. Surveyed boundaries were marked or monumented on the ground. Its corresponding field notes and plans were filed and maintained by the Department of the Interior (Greulich, 1983). Many of the original boundary markers have been lost or obliterated.

"The description of a particular ten acre (40,000 m²) parcel of land under this system would be given as NW SW SE sec. 22 T2S R3E. The elements of such descriptions are interpreted from right to left, so we are describing a plot of land in the township that is the third east of the Range Line (R3E) and the second south of the baseline (T2S). We are also looking at section 22 in that township (refer to the grid above). Next that section is divided into quarters (160 acres each), and we should be in the SE quarter section. That section is divided again in quarters (40 acres) and the description calls for the SW quarter. Last in this description, it is quartered again (into 10 acre plots) and we want the NW quarter" (website Wikipedia).

Legal status of the parcel map: plat

A call for a survey is subordinate to the written intentions of the parties (Kellie, 2001, p. 193). However, "a call in a deed for a plat or a map incorporates the plat or map into the deed in its entirety. What is on the map becomes part of the deed" (Kellie, 2001, p. 200).

One parcel map for the US?

The number of jurisdictions maintaining parcel information in the US is approximately 5,500 (FGDC, 2003) with approximately 140 million privately owned parcels (Stage and Von Meyer, 2003). FGDC has further estimated a $ 1,119,861,000 total cost for the US for the creation of a standardised digital parcel dataset covering the entire surface of the US (FGDC, 2003). The non-existence of a cadastral map in many jurisdictions may explain the high figure. In these instances, one should create a map based on the legal descriptions laid down in the land records. However, large numbers of individuals with varying abilities have written the legal descriptions of land records. Each description was written individually for a particular land transaction, referencing little more than the nearest monuments, property lines, and physical features (website MN GISLIS). Moreover, where maps or plats exist, the accuracy has been of concern to surveyors, particularly when dealing with older documents (Kellie, 2001, p. 194). Therefore, creating a US wide parcel map will result in finding numerous gaps and overlaps, and heterogeneous qualities (see, for example, website Minnesota GIS).

If cadastral maps have been created, they have typically been prepared by tax assessors (Onsrud, 1990). In constructing a tax map, the intent is to identify all taxable land parcels in a jurisdiction along with the approximate size and location of those parcels. Tax assessors' maps were never intended to provide highly accurate, legally defensible descriptions of individual parcels in a jurisdiction (Onsrud, 1990).

The cadastral layer is among the seven framework dataset layers of the US NSDI (website FGDC).

Land registry

"Land records offices in the US are highly decentralized. They are typically maintained at the county or local level. As a result, numerous jurisdictions exist with a wide variety of record keeping systems" (Onsrud, 1989). Among the record keeping systems are registries of deeds, registries of titles, and registries holding Torrens title.

Potential difficulties in understanding each system of land administration and consequently in difficulties for the national mortgage and real estate market, the private sector anticipated an additional system of land administration to the wide variety of public recording and registering systems: title insurance. Title insurance may be defined as: a contract in which an insurer, usually a title insurance company, agrees to pay the insured party a specific amount for any loss caused by defects of title on real estate in which the insured has an interest as purchaser, mortgagee, or otherwise (website Alaska mortgage). The system is similar throughout the US, and the certainty provided generally comparable with the European public sector guarantees.

8.2.6 System of land administration in cases

Denmark

Denmark has a title registration (Manthorpe and Walker, 2001). The State guarantees the system of property transfer and land registration in the sense that the State pays compensation when title is registered incorrectly. Title registration system does not require a map but registration of title for a new real property requires a cadastral procedure and an updated map to be presented to the Land Registry (Manthorpe and Walker, 2001). The Land Registry information is updated by the 85 local courts. The contents of the register are kept in a central database. The Ministry of Justice supervises the central information system (Manthorpe and Walker, 2001).

The National Survey and Cadastre (*Kort & Matrikelstyrelsen: KMS*) maintains the Danish cadastre. KMS is an agency within the Ministry of Environment. The Danish cadastre originally started as a system supporting the collection of land taxes. The parcel map is now gradually expanding from being exclusively a registration of parcel and administrative boundaries to incorporate new registrations such as coastal protection areas, contaminated areas and protected forests – all registrations which impose limitations on the owners use of his property. The parcel map is thus developing into a multi-purpose cadastre.

The main objective of Danish cadastre nowadays is to support an e-client land market, as well as providing a basis for appropriate land management. The cadastre still provides information on entities for taxation (vurderingsejendom). This information is selected from the valuation register of the municipalities (Stoter, 2003, p. 2; see also KMS, 2005).

The total expenditure of KMS in 2001 was around €40 million, of which about one third is covered by income from the market and two thirds by the government. By law KMS is required to finance its market activities by user payments if possible. Because of social considerations, a considerable part of KMS's tasks are nevertheless financed by government appropriations" (SADL, 2003a; Reeberg Nielsen et al., 2002).

The Netherlands

"From a legislative-theoretical angle the Dutch system of land registration has to be qualified as being of the negative type, even after enactment of the new Civil Code (CC) in 1992. […] It is mentioned often that the Netherlands have an improved deeds registration and a mitigated negativeness. Those improvements mainly have to do with the good access to the public registers via the cadastral registration, and with the 'individualisation' of the real estate via the parcel map and the parcel identifier. The negativeness is mitigated to the extent that whoever relies in good faith (bona fide) on the registers, is protected to a large extent" (Zevenbergen, 2003). The property boundaries are surveyed with the authority of the Kadaster and included in the automated parcel map (LKI) which is linked to the administrative parcel database.

The Dutch cadastre originally started as a system supporting the collection of land taxes. Now it is considered a multi-purpose cadastre, including the registration of public and private properties and the public and private restrictions on its use.

In the Netherlands the Agency for Cadastre and Public Registers is empowered to register both the parcels of real estate and the rights upon these derived from private law (like ownership, superficies, condominium, lease, servitude) (Zevenbergen and De Jong, 2002). The cadastre and land registration are part of one organisation (the Kadaster). The Kadaster is required to work on a 100% cost recovery basis. The annual budget is approximately €180 million (Kadaster, 2003b, p. 13).

Northrhine Westphalia

The German system of land administration consists of the land register and cadastre. Only the land register and cadastre in combination are able to give a complete overview about legal and de facto land tenure (DVW, 1993; Hawerk, 2003).

Cadastre

The Cadastre in Germany is defined as the official register of all parcels and buildings in a state, in which all parcels are described with graphical and textual information. The cadastre shows the de facto status of property. All relevant facts, such as designation, location, size and use, plus the boundaries as surveyed by authorised government agencies and licensed surveyors are described (Hawerk, 2003). Further, it contains additional information, for example the results of the official soil assessment. Some parts of the content of the cadastre enjoy the public faith of the land register, like the parcel identifier in the maps and records (Hawerk, 2003).

The cadastre in Germany is a parcel-based system, that is Information is geographically referenced to unique, well-defined units of land (Hawerk, 2003). The former parcel register is operated in a digital system: the Automated Property Register (the *Automatisierten Liegenschaftsbuch* (ALB)), which contains field records and textual records. The geometric description of all boundaries (the parcel maps) are digitised in most parts of Germany into the Automated Property Map (*the Automatisierten Liegenschaftskarte* (ALK)).

In Northrhine Westphalia the cadastral offices are offices of the cities and counties (VermKatG NW par. 21). The cadastre is embedded in the respective local organisation, and therefore closely connected with other registers and tasks of the local authority (Brüggemann, 1999). There are 54 Cadastre offices in 31 *Landkreisen* and 23 *kreisfree* cities.

Land register: the Grundbuch

The land register shows the legal status of all real property. It contains all rights of ownership and other rights on land and buildings (Hawerk, 2003). Until otherwise proved, the correctness of all titles recorded on the register is assumed. Registered titles are in force until the evidence of the reverse. In its documentation and publication role the register functions as the statutory basis for conveyance, in particular to ensure unequivocal status of ownership and other titles, as well as for mortgage loans. The contents of the land register are based on private contracts certified by public notaries (Hawerk, 2003). The land register contains the describing part of the cadastre.

The constitution of the Federal Republic of Germany accords responsibility for legislation around the land register to the Federal Republic. The land registration offices are part of the administration of justice (local courts) in the 16 German states. In Northrhine Westphalia there are 130 local courts (Website Justizministerium NRW). They are responsible for the land registration of the properties of land in their district (Hawerk, 2003).

Massachusetts

In Massachusetts, both land administration functions are separated. The Registry of Deeds records the property ownership information and cities and towns perform the property taxation function.

Cadastre

The property taxation function of 351 cities and towns in Massachusetts involves creating maps depicting property boundaries. Those boundaries are approximate locations only (sometimes very approximate) and are maintained by the tax assessor.

The assessor goes out to the property and collects information like the size of the house, the number of floors, the floor space, number of rooms, status of the bathroom, kitchen, the heating system, and facilities like a swimming pool (the mass appraisal information). He further makes a sketch of the property, which is typically not georeferenced. This sketch is digitised and included in the Mass Appraisal system. The assessor's records refer to the "book" and page number at the property registry that contains the parcel record for that property. The municipality typically assigns the parcel ID. While property boundaries on assessor's maps often serve as a proxy for ownership, any authoritative representation of property ownership must be based on records from the registry of deeds and/or work by a licensed professional surveyor (MassGIS, 2003 and 2004).

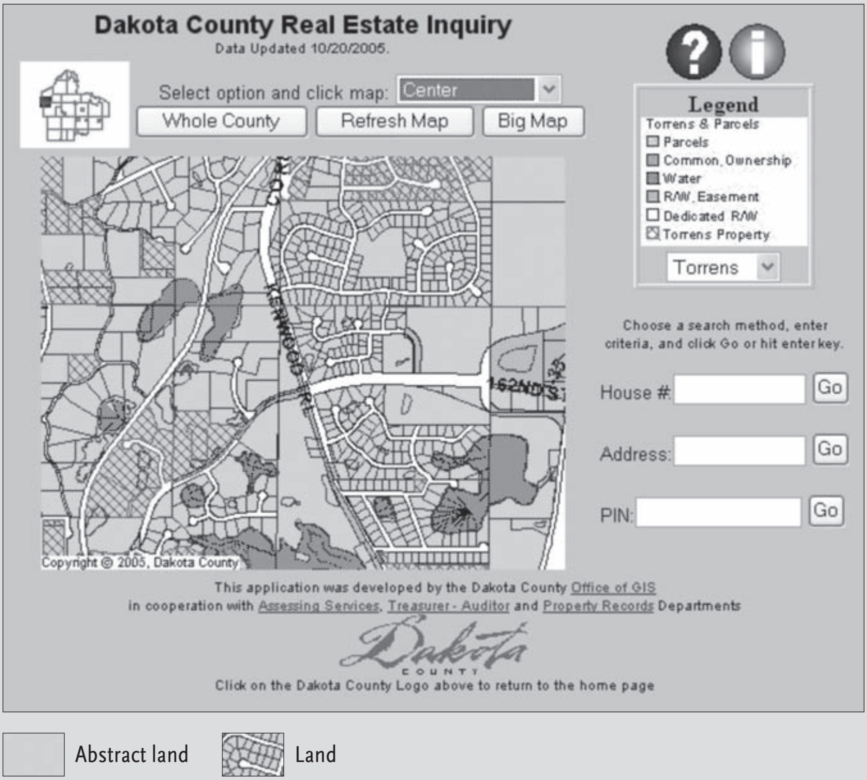
Municipalities get regularly (e.g., weekly) updates from the registry of deeds. They obtain an update for all property transactions, sales, subdivisions, among others. These updates are in majority not electronic, nor GIS-based, although increasingly georeferenced images are provided. The municipality evaluates the deed, copies the information on the deed literally, and relates the address on the deed to a parcel ID. In a case of a new parcel, a new parcel ID will be created.

The Registry of Deeds

In Massachusetts, the legal record of property ownership is found at the 21 deed registration offices (Howe, 2005; see website MA counties for an overview).

There are two separate systems of recording documents related to the ownership of land. These two systems are known as recorded land and registered land. With recorded land, documents are recorded in record books in

Figure 8.1 Parcels with torrens and abstract land in Dakota County (MN)



Source: Dakota County, Minnesota, USA

the sequence the Registry receives them. Within a book, one document is independent of the documents that come before it or after it within the same book. An index should be used to find the relevant documents. The Registry does interpret the documents; it only records the document.

In addition to the recording system, Massachusetts maintains a Land Court registration system. Based on the Torrens system, which has been in existence since 1898 (Greulich, 1983). With registered land the registry of deeds (operating as an office of the Massachusetts Land Court (M.G.L. Chapter 185: Section 10)) issues a property owner a certificate of title. The certificate of title is a decree in which the Land Court declares that a particular person is the owner of a particular parcel of property and any document that effects the ownership of that parcel is annotated on the back of the certificate of title. The Commonwealth of Massachusetts guarantees title to registered land; the state reimburses the property owner for any losses (see MGL chapter 185; website Middlesex County). Most property, however, is known as recorded land (see Greulich, 1983).

Scanned copies of some registry records are available on-line, but often people who are specialists in title research have to go physically to the registry to perform the research. Parcel information is stored and researched on the basis of individual properties (Onsrud, 1989). In the deed the parcel is de-

Table 8.1 Key facts about the organisational setting of the cadastre and land registry in cases researched

	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Type of land registration	Title	Deed +	Title	Deed/title	Deed/title
Primary purpose of cadastre	Multipurpose	Multipurpose	Multipurpose	Tax	Tax
Number of organisations responsible for 'legal' information in jurisdiction	85	1	130	21	7
Number of organisations responsible for parcel dataset of jurisdiction	1	1	54	351	7

scribed, sometimes supported by a map. Therefore, there is no parcel (legal) map except as part of the record for individual properties.

Metropolitan area of Minneapolis and St. Paul

Also in Minnesota, there are two separate systems of recording documents related to the ownership of land. These two systems are known as abstract land and land with Torrens title (see Figure 8.1). Land in Minnesota, which has been registered pursuant to an Order of Registration issued by the District Court is commonly called 'Torrens Land'. The owner of registered land is said to have "Torrens Title." The Certificate of Title is conclusive as to the state of title (website Washington County; see also Minnesota Statutes chapter 508 esp. 508.25).

Land, which has not been registered, is "Abstract Land". The abstract system is a system of recording evidence of real estate title. "The history of real estate transactions is indexed by legal description and name, this includes transfers of ownership and any rights (i.e. mortgages, contracts, liens) that persons other than the owner may have in the land. Prior to the enactment of the Torrens Act in 1901, all land was Abstract land" (website Washington county; see also MS 2004 chapter 507).

If a property is abstract, documents are recorded with the county recorder. If a property is under the Torrens system, documents are filed with the county registrar of titles.

Property boundary basemaps and ownership records for both Abstract and Torrens title are a responsibility of the counties and maintained at the county level, usually by the recorder's, assessor's or land surveyor's offices (website LMICa).

Minnesota's survey plat maps serve as the fundamental legal records for real estate in the state; all property titles and descriptions stem from them. They also serve as an essential resource for surveyors (Minnesota Statutes, Chapter 505; website LMIC; website Dakota County).

A Registered Land Survey is a survey performed for identifying registered (Torrens) lands in accordance with the requirements of Minnesota Statutes (Chapter 508).

Although Torrens Land theoretically provides more security, mortgage companies still require insurance for both Abstract and Torrens land in order to be eligible for a mortgage. Table 8.1 summarises the key facts about the cadastre and land registry in cases.

8.3 Technical parcel data characteristics

This section builds on the theoretical framework provided in chapter 4. Technical data characteristics may be split in internal and external characteristics. The internal data characteristics decide the extent to which its primary and secondary users can use it. In addition to the internal data characteristics, the external data characteristics may decide then the extent to which other users are able to use the dataset. This section provides the case study findings for the internal and external data characteristics of the researched parcel datasets.

8.3.1 Internal technical data characteristics

Chapter 4 provides the GII and user requirements for the internal technical characteristics of a dataset. Content, positional accuracy, currency and update frequency, structure of the data, and consistency in the dataset's elements are among the dataset's internal technical characteristics. Here, the datasets found in the case studies are evaluated based on these elements and at the end of this paragraph summarised.

Content

Denmark

The cadastre covers about 2,2 million properties in Denmark (Manthorpe and Walker, 2001). All land parcels and roads in the parcel map have a parcel identifier. Apart from parcels, the parcel map also contains other information such as other boundaries (centre line in stream wider than 3 metre in case the stream is a boundary, road boundary, railway boundary, edge of lake, coastline, parish boundary) and areas of public restrictions which restrict owners to use the land freely (protected forest, dune protection zone, coast protection zone, polluted land parcel) (website KMS). In addition, it includes topographical information such as road names, forest names, stream names, lake names and coast names. Roads form a full planar partition with the parcels (no overlap).

The registration of parcels and properties is an administrative registration and maintains information on parcels such as parcel identifier, area, area of road, area of protected forest, area of coast protection zone, area of dune protection zone, number of separate land units which a parcel consist of, share in common parcel, registration as protected forest, registration as coastal and zones, polluted land parcel, and land use (website KMS). See figure 8.2 for an example of the Danish parcel map.

Netherlands

The Cadastre contains approximately 7 million parcels (Manthorpe and Walker, 2001, p. 145). The Landmeetkundig Kartografisch Informatiesysteem (LKI) consists of the geometric information of the cadastral objects and the changes of

Figure 8.2 Example of Danish parcel dataset

Source: National Survey and Cadastre, Denmark

the boundaries and buildings. It includes cadastral parcels, parcel numbers, main buildings and relevant other buildings, structural works and other topographic detail if necessary for orientation purposes, name of cadastral sections, administrative boundaries, important boundaries of land use, housenumbers, streetnames, and names of waterways (see Kadaster, 1994 (appendix D); Kadaster, 1996, p. 52).

Further, the administrative dataset (*geAutomatiseerde Kadastrale Registratie* (AKR)) includes the following information: name, address, profession, and marital status of the owner(s); property rights of the owner, legal claims on the real property (servitudes), cadastral reference of the parcel, size of the parcel, reference to mortgages on the property; land use type, address of the buildings, or local reference of parcel without buildings, centre-point of the parcel in national coordinate system; properties managed by government entities, sales information, taxation number of owner, among other information related to, for example, land consolidation (Kadaster, 1994).

Figure 8.3 shows an example of the Dutch parcel map.

Northrhine Westphalia

Northrhine Westphalia has approximately 9,000,000 parcels. ALK contains parcel boundaries and numbers, boundaries of districts, survey control points, outlines of houses and buildings, house numbers, street names, results from official soil assessment, type of land use and topographic details like kerbs, and cycle tracks (Hawerk, 1995, p. 19; see also OBAK, 2002; OSKA, 2003).

Stored details for each parcel in ALB are (Hawerk, 2003, p. 6): name, date of birth, address, shares of the landowner, location of the parcel, like streetname, house number, centre-coordinates, district and parcel-number, area of

Figure 8.3 Example of Dutch parcel dataset

Source: Kadaster

the parcel, type of land use, results from official soil assessment, internal information about year of creation of the parcel, year of maintenance, number of parcel map, number of survey plans, number of folio and property in the land register, additional details about the parcel, like parcel is part of a consolidation project, polluted soil, historical monuments, parcel is part of a nature reserve or a water reserve.

Massachusetts

Massachusetts has approximately 2,300,000 parcels (MacGaffey, 2005) of which 2,200,000 are privately owned (Stage and Von Meyer, 2003). Within Massachusetts the content of the parcel dataset varies. MassGIS has developed a standard for digital parcel files and has also initiated a grant program for cities and towns to encourage development of assessor's digital parcel files that comply with the standard. Ultimately this should result in a complete information layer of land ownership adhering to this standard (see MassGIS, 2003). The starting point of the project was the digitisation of the assessor's map.

The standard was issued in three levels. Level I compliance requires digitising assessor's maps in accordance with the boundary compilation requirements, assigning an identifier to each parcel polygon, and then joining the resulting map information to information extracted from the assessor's database.

The attributes of the parcels must include a minimum set of 19 attributes extracted from the assessor's database. In addition, the attribute field PROP_ID must be added to this copy of the assessing information. Additional attributes are required at Level II (interest in the land (encumbrances) and polygon type (non-legal)) and there is a requirement for creating a parcel ID that is unique statewide. In addition, every property represented on the assessor's maps must be linked to a record in the assessor's property database. Conversely, every record in the assessor's database must be linked to a property represented on the assessor's maps. Level II has an option for uniquely identifying buildings and associating them with addresses. At Level II there is also a requirement for using the official legislated town boundary. Level III covers making the link between the assessor's database and the GIS more direct and developing a master address file.

In June 2005, approximately 31 cities and towns (9%) adhered to the level II standard (MassGIS, 2004), while 94 communities (27%) did not have parcel information in digital format. The majority of local government has some kind of digital information available. This information may adhere to the MassGIS level I standard (5% of the local governments) or may not adhere to any standard (remaining 60% of local governments). 14% of the 2,3 million parcels is in level II standard, and 16% of Massachusetts' parcels adheres to the level I standard. 52% is not conform any standard, and 4% in development to become digital. Finally, 14% of the parcels is not available in digital format (MacGaffey, 2005).

Table 8.2 Contents of the parcel datasets

Contents of the administrative register	Denmark	Netherlands	Northrhine Westphalia	Metro (integrated parcel dataset)	Massachusetts (level 1 standard)
Contents of the parcel map					
parcel ID	Y	Y	Y	Y	Y
buildings (main)	–	Y	Y	–	–
other topography (relevant/limited)	Y	Y	–	–	–
other topography (all)	–	–	Y	–	–
house numbers (limited)	–	Y	–	Y	–
house numbers (all)	–	–	Y	–	–
names of streets	Y	Y	Y	Y	–
names of waterways	Y	Y	Y	–	–
names of other topography (forest, coast)	Y	–	–	–	–
type of land use	–	–	Y	–	–
results from soil assessment	Y	–	Y	–	–
areas of public restriction	Y	–	–	–	–
survey control points	Y	–	Y	–	–
coordinates of point in parcel polygon	–	–	–	–	Y (level 2)
Administrative register					
parcel ID	Y	Y	Y	Y	Y
object address	–	Y	Y	Y	Y
parcel coordinates	–	Y	Y	–	–
house number coordinates	–	Y	–	–	–
size of parcel	Y	Y	Y	Y	Y
historic info: year of parcel creation etc.	Y	–	Y	–	–
registered rights	–	Y	–	–	–

***Metropolitan area of Minneapolis and St. Paul*[15]**

The parcel dataset available through MetroGIS has a standard set of 25 attributes needed mostly by the MetroGIS community. Attributes include owner and taxpayers name and address, parcel ID, street name, city name, zip code, school district number, watershed district name, market values of the property, building number, number of residential units, and date of last sale. In the beginning of 2005, the attributes were expanded with another 30 attributes, to a total of 55 attributes (MetroGIS, 2005). The extension includes additional building information (year built, square footage, type of heating/cooling),

15 This section is extracted from: website MetroGIS metadata and (LMIC, 2003 and 2004).

Table 8.2 continued

Contents of the administrative register	Denmark	Netherlands	Northrhine Westphalia	Metro (integrated parcel dataset)	Massachusetts (level 1 standard)
Deed information (time, page number etc.)					
* reference to deed in registry	Y	Y	Y	–	Y
Mortgage information					
* amount of mortgage	–	Y	–	–	–
* time notarial passed	–	Y	–	–	–
* time deed registered	–	Y	–	–	–
type of land use	–	Y	Y	–	Y
results from soil assessment	–	Y	Y	–	–
maintenance parcel by public entity	–	Y	–	–	–
existence of construction below the surface	–	Y	–	–	–
owner information (name, address, etc.)	Y	Y	Y	Y	Y
house numbers limited	–	–	–	–	Y
Taxation information					
* assessed value for land	–	–	–	Y	–
* assessed value for structure	–	–	–	Y	–
* assessed value for parcel	–	–	–	Y	Y
* year of assessment	–	–	–	Y	Y
* last sale date	–	Y	–	Y	Y
* last sale price	–	Y	–	Y	Y
* number of dwelling or residential units	–	–	–	Y	Y
* building area for commercial properties	–	–	–	–	Y
* taxpayer's information	–	–	–	Y	–
* structure information	–	–	–	Y	Y (non-standard)

among other additions. The dataset consists of approximately 920,000 parcels.

Content of parcel datasets summarised

Table 8.2 provides an overview of the content of the parcels dataset. The European datasets are clearly oriented towards a multi-purpose cadastre providing a comprehensive overview of the legal status of the property, including the public law restrictions applying to the properties. The US datasets are more oriented to taxation purposes with relevant property taxation information included such as the type of structure, its year built, its heating system, and other information relevant for the value of real property. The US dataset is of value for those working in the real-estate sector. The European datasets may serve much broader communities of users.

Table 8.3 Content of the parcel datasets (Table 8.2 summarised)

	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Content (relative)	Core-comprehensive	Core-comprehensive	Comprehensive	Poor-core	Core
Number of parcels	2,200,000	7,000,000	9,000,000	2,300,000	920,000

Positional accuracy

Denmark

The parcel map is available in the scales of 1:1,000 and 1:2,000 for urban areas and 1:4,000 in rural areas (Manthorpe and Walker, 2001, p. 130). The accuracy in relation to the national reference grid varies from 10 centimetres to several metres. This is because of the 'digitalisation' process of the unique analogue parcel maps. The accuracy of the individual paper maps is at the centimetre level.

Netherlands

The scale of the parcel map is 1:1,000 and 1:2,000 (Manthorpe and Walker, 2001, p. 131). The absolute positional accuracy is approximately 28 cm (√2*2dm) for urban areas and 56 cm (√2*4dm) for rural areas (Kadaster, 1996). Buildings and other physical objects are used as a reference for the parcel boundaries in the map. Therefore the relative accuracy is relatively high. However, the parcel map shows only the relative position of parcels and does not provide measures of distances (website Kadaster).

Northrhine Westphalia

Generally the scale of ALK is 1:1,000. However, because of historical reasons many other scales exist (1:500, 1:2,500) (website ALK lexikon; Manthorpe and Walker, 2001, p. 130). ALK has a positional horizontal accuracy of generally 20 - 30 cm.

Massachusetts

The scale of the datasets varies, but is generally in the range of 1:1,000-1,200-2,400. The positional accuracy varies from dataset to dataset. The City of Newton's information has an accuracy of +/– 77 - 154 cm (2,5 - 5 feet), the City of Boston's information on average 154 cm (5 feet). In Boston, the quality of the parcel information is mixed. The city's assessing department created the parcel layer from digitised 1952 half section sketches. Mostly the information had no georeference, but only 'metes and bounds' and descriptions like 20 feet from 'physical feature'. Since the registries of deeds provide now often georeferenced parcel information, the digital parcel dataset in Boston is frequently adjusted to the new, more accurate, information.

The MassGIS minimum Horizontal Accuracy Requirement for the parcel standard boundary compilation requires that "vector features from a road centreline GIS or CAD dataset which meets National Map Accuracy Standards at 1" = 400', or better, shall lie completely within the rights of way shown on the parcel map." (MassGIS, 2004, p. 14). This implies a horizontal positional accuracy of +/– 410 cm (13.33 feet) (see website Utexas; website USGSa).

Metropolitan area of Minneapolis and St. Paul
The parcel information is of the scales 1:1,200 (urban) to 1:2,400 (rural). The datasets delivered to MetroGIS have a positional accuracy that varies from 1000 cm (30-40 feet) to less than 31 cm (one foot) (LMIC 2003 & 2004). The majority of the parcel boundaries is within 92 cm (3 feet) horizontal positional accuracy.

Currency and update frequency
Denmark
The parcel information is updated on a daily basis. Most municipalities get an update twice a year of the cadastral database. 5 to 10 municipalities in Denmark obtain an update of the dataset for the parts that have been changed in their Kommune. This happens about 120 times per year.

Netherlands
The cadastral information is updated on a daily basis. The parcel map has a currency of approximately one year.

Northrhine Westphalia
ALK' s currency is generally two years or more up-to-date (< 2 years). The ALK is daily updated (e-mail correspondence; website Geocatalog1). The Micus report (2001b, p. 9), however, mentions the currency of the information as a barrier. Because of limited budgets and personnel, some counties are not able to create the ALK on time. As a result the quality of ALK may be different in different ALK datasets. Micus (2003, pp. 8, 43) found that it might take years before new buildings are included in the ALK.

Massachusetts
The assessors sketch is the basis for the taxation, and is current.

Metropolitan area of Minneapolis and St. Paul
The integrated dataset is quarterly updated (every three months). The update frequency from the counties varies from daily to monthly (LMIC 2004; website DataFinder).

Data structure
Denmark
Both the register and the maps are in vector format. KMS will relief the present systems by a new overall cadastral system based on an object oriented data model middle 2006.

Netherlands
The original spaghetti structure of the parcel dataset has been upgraded to-

wards object-oriented information (polygons/surfaces with unique IDs) for parcels. The buildings have a spaghetti information structure.

Northrhine Westphalia
The ALK is available in analogue and digital format. When the information is in digital format, it is in vector format and object oriented. Also the multiple meaning of information elements is kept, for example, when a parcel boundary is also an administrative boundary (Köln, 2004).

Massachusetts
The datasets vary from analogue non-geo-referenced sketches of tax property to digital vector and object-oriented datasets georeferenced GIS information with comprehensive metadata.

Metropolitan area of Minneapolis and St. Paul
The dataset is in vector format and object-oriented.

Consistency in dataset(s)
Denmark
The parcel map has full topology and the maps have different linking facilities, for example to the property-related information collections (Daugbjerg et al., 2001). The content is consistent throughout the country.

Netherlands
The parcel map has full topology for the parcel information. The content is consistent throughout the country.

Northrhine Westphalia
There is no consistent digital parcel dataset for Northrhine Westphalia. This is explained by the 87% coverage of the Statewide digital dataset. Over the past years significant progress has been made in integrating the local datasets into one state dataset. The content is consistent throughout Northrhine Westphalia. The logical consistency is conforming state guidelines (OBAK, 2003) with optionally local supplements. This logical data structure of ALK describes the data geometry on the line and point levels. The appointment of object keys (described in the OSKA, 2002), that are applicable to all cadastral agencies in Germany, established the semantic elements (meaning).

Massachusetts
The datasets vary significant in quality and it is expected that a merge of the datasets would result in identifying gaps, overlaps, inconsistent attributes and more differences. However, efforts to create one parcel dataset for Massachusetts remain so far uninitiated.

Metropolitan area of Minneapolis and St. Paul

Although all counties agreed on the content of the regional parcel dataset, the integrated parcel dataset is not a fully harmonised product with respect to the content delivered by the counties. Of the 55 agreed attributes only 11 are populated for all counties (MetroGIS, 2005a; website DataFinder Parcel). Parcel owner and taxpayer information, for example, exists for many, but not all counties. However, "the attributes are normalised across the seven county Metropolitan Area and the Metropolitan Council checked each shape file to insure it had all desired attribute fields, field names, types and lengths. No attempt was made to edgematch or rubbersheet the seven counties, thus overlaps and gaps may exist between counties" (website DataFinder).

The dataset contains one record for each real estate/tax parcel polygon. "In many places a one-to-one relationship does not exist between these parcel polygons and the actual buildings or occupancy units that lie within them. There may be many buildings on one parcel and there may be many occupancy units (e.g. apartments, stores or offices) within each building (website Datafinder). "Not all tax parcels are represented by a unique polygon. For example, a county might have one polygon representing a condominium complex. Some counties have provided an additional parcel points shape file that will include points to represent such tax parcels (e.g. a point for each individual condominium)" (website Datafinder).

Internal technical data characteristics summarised

The internal quality is composed of the content, the positional accuracy, the currency and update frequency, the structure of the information, and the consistency within the dataset. Tabel 8.4 summarises the internal data infrastructure. The content of the datasets varies from a taxation focus in the US cases to a multi-purpose approach in the European cases. The dataset of Northrhine Westphalia has the most comprehensive content, including next to ownership information also full topography. Denmark and the Netherlands are less comprehensive although the Danish dataset contains the results of soil assessment and areas of public restriction. The Dutch parcel dataset includes buildings.

The positional accuracy in Northrhine Westphalia is very accurate (20-30 cm), the Netherlands' accuracy is within 60 cm, and in Denmark it varies from 10 cm to several metres. The source of the digital dataset in Denmark (the paper sheets), however, has a consistent accuracy at the centimetre level. Parcel information in the US cases generally are less accurate. In Metro it varies between 1,000 cm to less than 30 cm and in Massachusetts it is in the researched datasets on average 77-156 cm. The difference in positional accuracy in the European cases and the US' cases remains unexplained.

Currency and update frequency do not vary much among the cases and is in the range of 1-2 years with some exceptions. Further, all cases except for

Table 8.4 Internal data characteristics parcel datasets

	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Content	Core-comprehensive	Core-comprehensive	Comprehensive	Poor- core	Core
Horizontal positional accuracy (in cm)	10-100	28-56	20-30	77-154-410	30-92-1000
Currency (years)	1-2	1	1	–	0-2
Data structure	Spaghetti (object)	Spaghetti/object	None-object	None-object	Spaghetti/object
Quality consistency throughout the (integrated) dataset	High	High	Reasonable	None	Reasonable

Massachusetts have full topology in the dataset(s). The content in Denmark and the Netherlands is fully harmonised and these datasets show no overlaps or gaps. In the Northrhine Westphalian and Metro dataset some differences in content may be found in the originating datasets, and gaps or overlaps may be found in the integrated dataset. In Massachusetts these overlaps or gaps may also be found in the datasets that are digitally available.

8.3.2 External technical data characteristics

Chapter 4 provides the GII and user requirements for the external technical characteristics of a dataset. Scale or resolution, the area a dataset covers, the level of interoperability, documentation of the metadata and sustainability of the technical data characteristics are part of a dataset's external technical characteristics. This section evaluates the datasets found in the case studies based on the technical and non-technical characteristics. At the end of this section a summary follows.

Coverage

Denmark

The single parcel dataset covers Denmark completely.

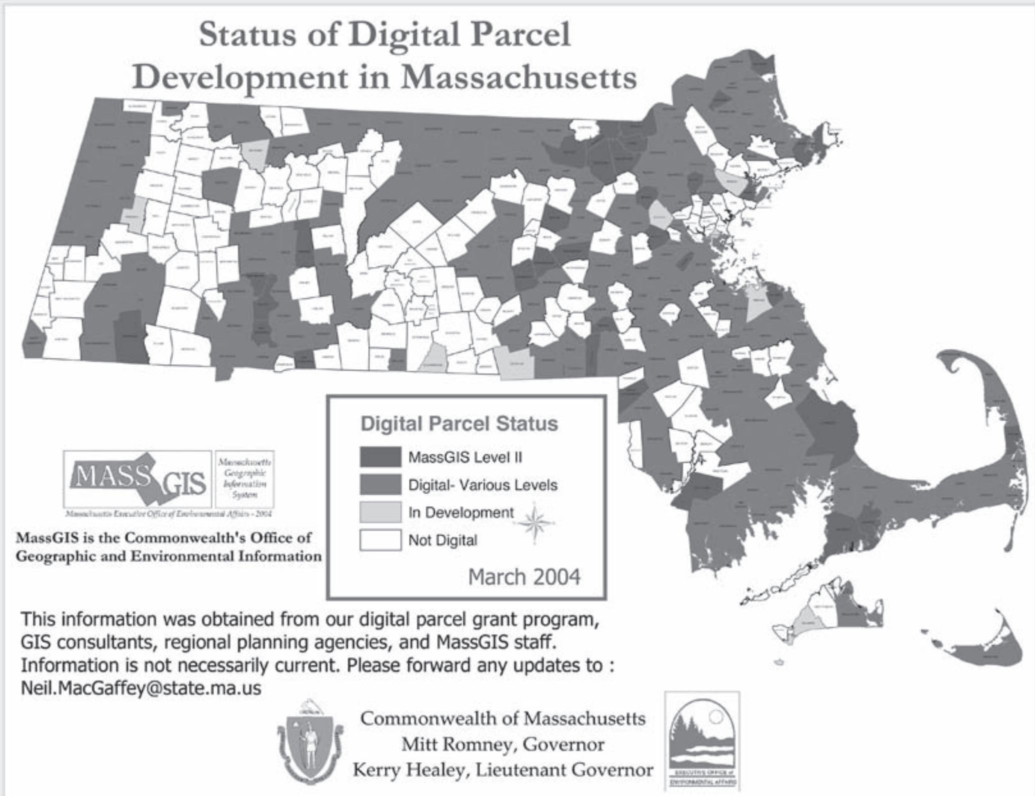
Netherlands

The single parcel dataset covers the entire Netherlands.

Northrhine Westphalia

Together, the datasets of the 54 Cadastres cover Northrhine Westphalia entirely. Some parts of these local datasets, however, are only available in paper format. In addition, the Landesvermessungsamt NRW and the local authorities are working towards a single parcel layer for Northrhine Westphalia. In 2005, this harmonised ALK dataset had approximately 87% digital coverage (website Stand ALK).

Figure 8.4 Status of digital parcel development in Massachusetts



Source: MassGIS, 2004

Massachusetts

Currently, every community in Massachusetts has a local tax map. However, of the 351 cities and towns in Massachusetts only about two thirds of them have digital versions of their assessor's maps (see Figure 8.4 for a general overview). The communities other than the large cities (Boston, Springfield, Worcester) that do have digital assessor's maps, have a geographic area that is typically less than 65 square kilometres.

Metropolitan area of Minneapolis and St. Paul

In the MetroGIS area, all counties have a 100% digital parcel dataset. MetroGIS has integrated the county parcel datasets for the Metropolitan area. The dataset is a compilation of tax parcel polygon layers from the seven Minnesota metropolitan area counties. The integrated dataset covers the seven county Metropolitan area entirely. This chapter discusses the integrated dataset. Where applicable reference is made to the underlying county datasets.

Coverage parcel information summarised

Table 8.5 shows an overview of the coverage of the parcel information in the cases.

Table 8.5 Coverage of the digital parcel datasets

	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Coverage area	DK	NL	NRW	MA	Metro
Number of datasets for jurisdiction coverage	1	1	54(1*)	351	1/7
Digital coverage (in vector format)	100%	100%	87%	66%	100%

* One if the integration process is completed.

Interoperability

Denmark

The parcel maps, are designed on the basis of the national reference system (34/45 ed50). Both the register and the maps are digital. The parcel information is available in the national DSFL format, and proprietary formats. Since 1997 the map series has been digital based on *Specifications on Digital Cadastral Maps* (Produktbeskrivelse Digitalt Matrikelkort M3-standard (February 1996)).

The parcel map was an island map with different quality of connection to the national grid. KMS digitised the maps and created one map. A production strategy aiming at relating each island map to the national grid was considered too expensive. Instead the maps with all unique local references systems are merged or combined into one map. Changes in legal boundaries are used to improve the dataset overtime. Therefore, the digital parcel information may not fully compare to a topographic dataset.

Netherlands

The parcel information is referenced to the national coordinate system *Rijksdriehoeksmeting*. The exchange format is the national NEN1878 format. The Kadaster also provides the information in de facto industry standards.

The buildings in the parcel map are obtained from the large-scale base map (GBKN). Although legal boundaries not always align with the topography, the main buildings align very well. Other building may not align with the parcel information because of the smaller positional accuracy of the measurements of the other buildings.

Northrhine Westphalia

The ALK uses the national reference system (Gauss-Krueger projection, Bessel ellipsoid and the Potsdam Datum). The standard exchange format is the *Einheitliche Datenbankschnittstelle* (EDBS). The structure is published. The information is also available in proprietary vector formats.

Despite the use of a common standard, it has been reported that the use of heterogeneous software systems within cities and counties is a barrier for the access and use of the ALK (Micus 2001a, p. 9).

The parcel information aligns with the topography in ALK (see Figure 8.5).

Massachusetts

The datasets vary from analogue non-geo-referenced sketches of tax property to digital vector and object-oriented datasets georeferenced GIS informa-

Figure 8.5 Example of ALK (Asperden in the municipality of Goch NRW)

Source: Landesvermessungsamt NRW, Bonn

tion with comprehensive metadata. The Parcel standard recommends ESRI shapefiles as the exchange format of the parcel dataset (MassGIS, 2003, p. 24), but also other de facto exchange formats may be found. The MassGIS parcel standard can be considered to be the state parcel information model.

Since the 351 datasets vary considerably with respect to format (digital/analogue) and other qualities, it is difficult to provide a general statement on the alignment of the parcel datasets with other datasets.

Figures 8.6 through 8.9 show some examples are provided of the variety of technical characteristics in Massachusetts parcel datasets. The examples show an area on the border of the cities of Newton and Boston. Figures 8.6 and 8.7 show that, in the City of Newton, the parcel dataset aligns well with the city's topographic dataset and the aerial photography. In the City of Boston the alignment of the parcel dataset with the topography is only approximate (see Figure 8.8 and 8.9).

Combining the datasets of Newton and Boston, for example, for 11 Playstead Road (the highlighted parcel in Figure 8.6 and Figure 8.8), however, is unlikely to result in one fluent parcel boundary.

Metropolitan area of Minneapolis and St. Paul

The information of the seven counties were assembled into a common coordinate system (UTM). Each county provided parcel polygons and attributes in shape file format to the Metropolitan Council. The individual datasets are also available in other de facto proprietary standard exchange formats (see website LMICc).

The FGDC's cadastre standard model applies to the primary producers with the exception of occasional items that the counties recognize are in all of their best interests, and they voluntarily modify their practices.

Figure 8.6 Municipality boundary of Newton (Middlesex County) with Brighton (Suffolk County)*

Source: City of Newton, Massachusetts, USA

* Playstead Rd. Registered in the Middlesex South Registry of Deeds (deed book 31641/566) and Suffolk Registry of Deeds (deed book 11441/102) (website Masslandrecords) City of Newton Property ID: 71037 0004.

Figure 8.7 Fine alignment for the City of Newton's parcel information with aerial photographs and the topographic dataset (website MA City of Newton)

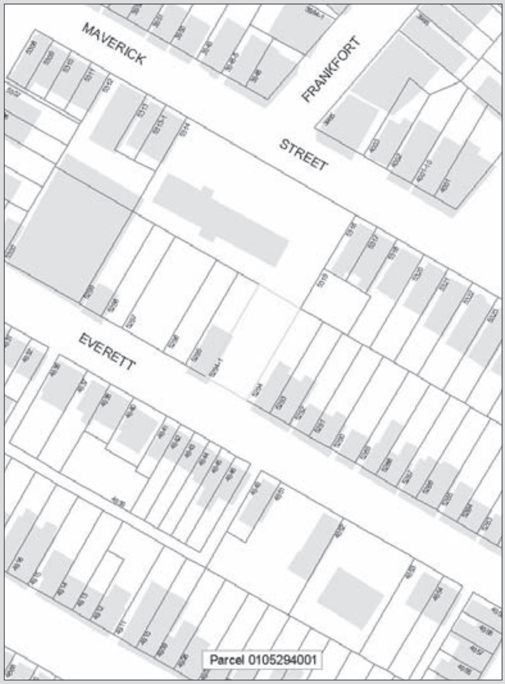
Source: City of Newton, Massachusetts, USA

The administrative boundaries are accurate and align with the parcel dataset. The parcel dataset does, however, not necessarily align with topographic information (see Figure 8.10).

Figure 8.8 Approximate alignment in the layers of the City of Boston

Source: City of Boston Assessing Department Boston, Massachusetts, USA

Figure 8.9 Information from Assessing department City of Boston



Source: City of Boston Assessing Department Boston, Massachusetts, USA

(parcel ID = 2203719000) (website MA City of Boston)

Interoperability of parcel datasets summarised

Table 8.6 provides an overview of the coverage of the interoperability of parcel datasets.

Documentation of metadata

Denmark

The Danish parcel dataset has comprehensive generic metadata documented. In the Danish clearinghouse, the following metadata is specified: purpose, intended application scale, usage, information type, information language, reference documents, sample of the information, source, horizontal accuracy, temporal accuracy, spatial reference system, geographic area, objects and attributes, restrictions on use, copyright owners, information exchange format, on-line access, responsible organisation, and contact information (see website DK clearinghouse). The price of the information is published on the KMS website; the clearinghouse information refers to this site.

It is expected that in the near future Geodata-info.dk is going to adhere to the ISO 19115 standard. The clearinghouse allows for XML downloads of the metadata (since 2002).

Figure 8.10 Example of poor alignment of building footprints and with parcel information, and road centreline information in Ramsey County

Source: Ramsey County, Minnesota, USA

Netherlands

The Dutch' parcel dataset has limited metadata documented. In the national clearinghouse (website NL clearinghouse) the following metadata has been documented: dataset title, dataset language, abstract describing the dataset, dataset responsible party, geographic location of the dataset, reference sys-

Table 8.6 Overview of the interoperability of the parcel datasets

	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Coordinate system	National	National	National	Local/state	State
Transfer format	National/ De facto proprietary	National (open)/ De facto proprietary	National (open)/ De facto proprietary/none	De facto proprietary/ None	De facto proprietary
Data model	National	National	State	State/none	MetroGIS standard
Interoperable horizontally (alignment with other datasets)	N	Y	Y/N	N/Y	N

tem, limited information about reuse, and order information and limited information about the information quality.

The Kadaster website mentions the following metadata: dataset title, dataset abstract, information exchange format, prices, and detailed order information (see website Kadaster1).

Northrhine Westphalia

Metadata documentation varies heavily throughout Northrhine Westphalia and in many instances no metadata is documented. The City of Bochum, for example, has documented metadata about scale, language, content, information of metadata creation, quality aspects of the information (positional accuracy, currency, logical consistency, reference data, among others), prices and use restrictions, and contact information (see website ATKIS).

Currently a GDI-NRW working group on metadata defines a common concept for metadata collection in the cadastre. This concept will take into account the metadata profile currently developed at the AdV-level.

Massachusetts

The documentation of metadata varies from none to comprehensive. MassGIS requires that metadata complying with the Federal Geographic Data Committee's metadata standard be required from any organisation that delivers or creates digital GIS information. At Level II of the MassGIS parcel standard there is also a requirement for using the official legislated town boundary, and for creating metadata.

Metropolitan area of Minneapolis and St. Paul

The integrated parcel dataset adheres to the Minnesota Geographic Metadata Guidelines (MGMG) (website MN MGMG). Five of the individual county datasets adhere to the MGMG standard, the others (Anoka and Hennepin) have limited metadata (LMIC 2003 and 2004). The counties are not obliged to provide the metadata.

The metadata provide sufficient information about use restrictions. Prices for others than MetroGIS stakeholders, however, are indirectly included in the metadata; reference is being made to the counties.

Table 8.7 Metadata documentation in the parcel datasets

Metadata documentation	Parcel dataset	Denmark	Netherlands	Northrhine Westphalia[1]	Massa-chusetts[2]	MetroGIS (Minnesota)
Core	dataset title	Y	Y			Y
	dataset reference date	Y	–			Y
	dataset language	Y	Y			–
	dataset topic category	–	–			–
	abstract describing dataset	Y	Y			Y
	metadata point of contact	–	–			Y
	metadata date stamp	Y	Y			Y
Conditional core metadata	dataset character set	Y	–			Y
	geographic location of dataset	Y	Y			Y
	metadata language	–	–			–
	metadata character set	Y	Y			Y
Optional core metadata	dataset responsible party	Y	Y			Y
	spatial resolution of dataset (scale)	Y	–			–
	distribution format	Y	–			Y
	additional extent information for the dataset	–	–			–
	spatial representation type	Y	–			Y
	reference system	Y	Y			Y
	lineage	–	–			–
	on-line resource	Y	Y			Y
	metadata file identifier	–	–			–
	metadata standard name and version	–	–			Y
Comprehensive metadata	detailed information about the technical quality of the dataset	Y	–			Yb
	the use and access restrictions imposed	Y	–			Yb
	standard order process information (contact information)	Y	–			Y
Standard adherence?		Y	–			Y

Yb = in additional documents included.

1 Metadata varies between the 54 datasets from none to comprehensive

2 Metadata varies between the 351 datasets from none to comprehensive

Metadata documentation of parcel datasets summarised

Table 8.7 and Table 8.8 provide an overview of metadata documentation in the parcel datasets.

Table 8.8 Metadata documentation in the parcel datasets

	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Metadata documentation	Comprehensive	Poor	None-comprehensive	None-comprehensive	Comprehensive
Metadata standard	State standard	None	None	None/state standard	State standard
Metadata language	Danish/English	Dutch	German	English	English

Sustainability of qualities

Denmark

The collection, maintenance and dissemination of parcel information has its basis in legislation (e.g., *Tinglysningsloven*), The Cadastre Act established the KMS as the authority for cadastral mapping. The parcel map is a legal overview map, which shows the registered boundaries of land parcels and roads.

Netherlands

The Dutch Kadaster is responsible for the creation and provision of the parcel map. Legislation is the basis for parcel information collection, maintenance and dissemination (Kadaster, 1989, chapter 3 and 4).

Northrhine Westphalia

The information collection and creation of ALK is anchored in legislation, guaranteeing to a great extent the existence, availability and quality of the dataset (see Katastermodernisierungsgesetz, 2005; Vermessungs- und Katastergesetz (VermKatG NW (par. 9) see also: website LVA). The dataset has a seal of authority (Brox et al., 2002).

Massachusetts

There is not one entity responsible for thé parcel map of Massachusetts. The local communities are responsible for the assessor's map. They are, however, under no obligation to integrate the individual sketches into one digital georeferenced dataset with multi-purpose cadastral functionalities. Registries of Deeds are only required to document the deeds and to index and publish them. Although the state guarantees property boundaries of registered land, the registries are not required to create one property map their jurisdiction. In addition, because the registration with the Land Court is voluntary "only about 20% of Massachusetts real estate in the form of scattered land parcels are registered with the Land Court" (Greulich, 1983). MassGIS has prioritised the creation of digital parcel maps in Massachusetts as one of its top priorities, but lacks (political) powers to enforce this upon local communities. Through the provision of funds available for digital parcel projects, they accomplished some improvement in the level of available digital parcel information adhering to the MassGIS standard.

Although there is no formal rule deciding for the quality control of the complete property map of a city, individual property maps need to adhere to a minimum quality standard. Every three years a community's assessments must be reviewed by the Commissioner of Revenue and certified as meeting legal standards. Part of the certification review consists of a review of the quality of information and adequacy of tax maps, amongst other issues (MDR, 2003; G.M.L. c.58 s. 1 & s. 1A). Through the certification review, the State Department of Revenue establishes minimum standards for assessor's maps. If the mapping is not sufficient for proper taxation, they can force the city to redo the mapping of the parcel information.

Metropolitan area of Minneapolis and St. Paul

Although MetroGIS is the custodian of the integrated parcel dataset, it has no legal standing and relies entirely on the willingness of the participating counties to provide the county information with the agreed content and in the required format. County government is responsible for the datasets underlying the integrated dataset and as a result the quality of the county datasets decide for the quality of the integrated dataset.

The creation and maintenance of parcel datasets is a task of county government. In Minnesota, state law requires each county to be responsible for verifying and approving all subdivision plats as a part of the official filing process (MS chapter 389 see specifically 389.011 subd 1; website MN GISLIS).

In any county of having more than 200,000 inhabitants, the county surveyor shall, at the request of the examiner of titles for such county, make a survey of the plat described in any application for registration (MS 2004, chapter 508.14).

A Registered Land Survey (RLS) is a survey performed for the identification of registered Torrens lands, according to Minnesota Statutes 508.47. A registered surveyor must certify the RLS to be a correct representation of the parcel. The RLS is filed in the office of the Registrar of Titles. Before this, the county surveyor must approve it. The RLS must correctly show the legal description of the land and the outside measurements of the parcel (Van Oosterom et al., 2005).

The boundaries shown on the integrated parcel dataset are approximate – they are not substitutes for certified property surveys, legal property descriptions or detailed plat maps (website LMICc).

External technical data characteristics summarised

The external qualities are composed of the scale, coverage of the dataset, the content, its interoperability characteristics, the metadata documentation, and the sustainability of the technical characteristics of the dataset.

In broadest sense of the term parcel information, the parcel information exists and covers the researched jurisdictions entirely (see Table 8.9). However, only the Netherlands, Denmark and Metro have full digital parcel information coverage. In Northrhine Westphalia only a small percentage is in analogue format while in Massachusetts a significant percentage of 33% of the entire area is not covered with digital parcel information. The scale in the

Table 8.9 The external technical data characteristics of the parcel datasets summarised

	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Coverage area	DK	NL	NRW	MA	Metro
Digital coverage (vector format)	100%	100%	87%	66%	100%
Number of datasets for jurisdiction coverage	1	1	54(1)*	351	1(7)**
Standard adherence	De facto/ jurisdiction wide (proprietary)	De facto/ jurisdiction wide (open and proprietary)	De facto/jurisdiction wide (open and proprietary)/ N/A	De facto/ jurisdiction wide (proprietary)/ N/A	De facto/ jurisdiction wide (proprietary)
Data model	De facto/ jurisdiction wide harmonised	De facto/ jurisdiction wide harmonised	De facto/jurisdiction wide harmonised/ none	De facto/ jurisdiction wide harmonised/ none	De facto/ jurisdiction wide harmonised
Metadata documentation	Comprehensive	Poor	None-comprehensive	None-comprehensive	Comprehensive
Quality assurance	Seal of authority backed by legislation	Seal of authority backed by legislation	Seal of authority backed by legislation	Project based	'Seal of authority backed by legislation'

N/A = not available.
* One if the integration proces is completed.
** 7 for non MetroGIS stakeholders.

researched dataset compares well with each other with generally a scale of 1:1,000/1,200.

In Denmark, the Netherlands, and Northrhine Westphalia parcel information mapping is conform a national parcel information standard. In Metro generally the national parcel information is adhered to although individual counties have modified it to meet their specific needs. In Massachusetts, the MassGIS parcel information standard is being adhered to by a significant, but relative to the other cases, small amount of local governments (10-45%). Accordingly, the datasets in Massachusetts vary so much in their characteristics that a Massachusetts-wide parcel information coverage with some kind of harmonised characteristics is not expected to be achieved shortly.

Denmark and the Metro dataset have comprehensive metadata documentation. The Netherlands has less comprehensive documentation, and documentation in the datasets in Northrhine Westphalia and Massachusetts varies from dataset to dataset.

Quality of the dataset is likely to be most sustainable in the legislated cadastral datasets (Denmark, the Netherlands, Northrhine Westphalia, and Metro). In Massachusetts, the quality guarantees relies on the existing awareness for parcel information collection within the decision-making levels. According to several interviewees the richer communities in Massachusetts have better quality parcel information than the less fortunate communities.

8.4 Non-technical data characteristics

This section builds on the theoretical framework provided in chapter 5: the non-technical data characteristics. Here the following non-technical data characteristics of the researched parcel datasets are provided: the legal accessibility, the financial accessibility and the physical accessibility of a parcel dataset.

8.4.1 Legal access

Legal accessibility consists of legal means to enhance access and legal means to restrict access.

Enforceable access
Denmark
Parcel information can be requested through the Cadaster Act. Parcel information is open to the public. For access to the web cadastre a subscription and the payment of a fee are required. Access to the entire dataset cannot be enforced through a Cadastre Act request.

Netherlands
Access can be enforced through a Kadaster act request. This, however, only applies to requests for limited numbers of parcels. Requests for the entire dataset are likely to be denied because of privacy legislation, among other reasons.

Northrhine Westphalia
The ALK is subject to the Cadastre Act (Katastermodernisierungsgesetz 2005). Access to the entire ALK may be enforced through a request to the Cadastre Act. Access to the administrative information (ALB) is not open to the public because of privacy restrictions. A legitimated interest must be shown in order to access the information.

Massachusetts
The Massachusetts' public records act (M.G.L. C. 4, S. 7, Cl. 26 and C. 66, S. 10) applies to public (digital) parcel information and the information can be requested through this act.

The assessors must provide a copy of the requested information in an electronic form if a computerised form of the information exists, the computerised form does not (i) contain exempted information or (ii) require significant programming to screen exempted information, and the computerised form can be copied either in-house or by a service bureau that is contractually required or willing to make a copy (DoR, 1988). One does not have to explain the intended use of the dataset, nor is identification required.

Metropolitan area of Minneapolis and St. Paul

The parcel datasets of the individual counties are subject to the public records act (Minnesota Government Data Practices Act (MGDPA)). Since all of the state's data practices laws apply to the assembly as well as to the components, the MGDPA also applies to the integrated parcel dataset. The parcel datasets have been classified as data with a commercial value. Parcel information is further likely to be classified as information on individuals, which makes it subject to state privacy legislation (Minnesota Rules). Access to public information with a commercial value is not restricted (Engler, 2004). If one is willing to pay for the information, it should be provided.

Intellectual property rights

Denmark

KMS claims copyright and database right in the parcel information.

Netherlands

The Kadaster claims copyright and database right in the dataset.

Northrhine Westphalia

All local governments in Northrhine Westphalia claim copyright and database right in their information (see, for example, website LVA1).

Massachusetts

Generally, local governments do not claim copyright in their parcel information. Notable exceptions are the Towns of Dedham, Barnstable and Yarmouth.

Metropolitan area of Minneapolis and St. Paul

State and local governments may assert ownership through a copyright (see MGDPA, Chapter 13.03, subdivision 5). Intellectual property rights and responsibilities remain with the primary producers of the parcel datasets, which decide access rules within the context of the MetroGIS process for each regional information solution (Johnson and Albeit, 2002). The seven counties claim copyright in their datasets[16].

Use restrictions

Denmark

KMS only provides use rights in its information. Generally, the dataset can only be used for internal purposes of the organisation that acquired a use right. The parcel information cannot be resold without written permission. If the

16 Based on the responses to the LMIC statewide parcel inventories (LMIC, 2004 and 2003), the license agreement and/or the websites of the counties.

parcel map is disseminated the intellectual property rights of KMS should be mentioned and the limitations in the use. The use right cannot be transferred to others. If one has acquired extended use rights, the dataset may be resold to others, but against the payment of royalties based on the resell.

The standard contract for municipalities rules that municipalities can only use parcel information for the purposes necessary for the accomplishment of their public task. This includes planning and maintenance activities, and tasks concerning the sewer system. It is specifically mentioned that the information cannot be used for other utility purposes like electricity supply or water supply. This is written in the contracts with the municipalities (275 contracts). Municipalities may sell or distribute the parcel information to individuals, natural persons, only for the personal use of the information.

Netherlands

Organisations that acquired the parcel dataset can only use it for their internal organisation purposes. They are not allowed to resell the dataset without prior permission from the *Kadaster* (Kadaster, 2004a).

Northrhine Westphalia

In Northrhine Westphalia users of public geographic information are granted a "limited use right" as described in the copyright act (*Urheberrechtsgesetz*) and further in the Cadastre Act (VermKatG NW: §3 Abs. 1).

Information (Ergebnisse) from local government can only with permission of the concerned organisation be multiplied, made public, or provided to third parties. Copies and processing the information for internal use are permitted. This also applies to digital information (see Katastermodernisierungsact 2005: §5(2)).

The *Landesvermessungsamt* further requires that the text "Copyright-Vermerk © Geobasisdaten und/oder Topographische Karten: Landesvermessung NRW, Bonn" is added to the dataset for use in presentations and copies of the provided dataset (website LVA1).

Massachusetts

The provisions in the Massachusetts statutes provided, parcel information is available without any restrictions in the use. One respondent, however, stated "the general restriction is you can't resell the information to third parties". The standard Memorandum of Understanding of the Town of Brookline and other public Agencies concerning the exchange of digital GIS information and GIS information products confirms this: "The Public Agency may use these data for its own internal purposes and studies …[The data] is not to be distributed or resold to [others] without the prior consent of the Town". The Town further requires to be credited as data source and requires the inclusion of a liability waiver in further uses of the information (see Town of Brookline, 1998).

Metropolitan area of Minneapolis and St. Paul

Access to the integrated parcel information set is restricted by licensing requirements imposed by the counties that supplied the source information. The license provisions of Anoka, Carver, Dakota, Ramsey, Scott and Washington County are harmonised in one standard license for MetroGIS' stakeholders (Metropolitan Council, 2002). Access to Hennepin County is subject to other provisions. Under both licensing requirements, the regional parcel dataset is available through MetroGIS at no cost to certain Governmental Units and Academic Institutions. MetroGIS' stakeholders may use the licensed parcel dataset for their own internal business or organisational purposes. The license(s) prohibits users to redistribute the parcel dataset or subsets thereof to any private entity.

Privacy

Denmark

Although the European Directive on the protection of individuals with regard to the processing of personal information and on the free movement of such information (EU, 1995) is implemented in Danish legislation, interviewees indicated that parcel information is not subject to this privacy legislation.

Netherlands

The European Directive on the protection of individuals with regard to the processing of personal information and on the free movement of such information (EU, 1995) has been implemented in national legislation (Wet bescherming persoonsgegevens) and applies to the parcel information . Requests for data queries that are considered to be privacy-sensitive are not granted. For example, requests for all parcels with the land use code houseboat or (house) trailer will be denied. Also access to mortgage information is not actively provided. The use conditions rule that information cannot be used for direct marketing purposes.

Northrhine Westphalia

The new Katastermodernisierungsgesetz (2005) arranges that the geographic framework information, including the parcel dataset, can be provided for any use if the ownership information (e.g., name and birth date) is taken out. Apparently this privacy constraint only applies to ownership information and not to land use (living) information given the sales of such a product by the Northrhine Westphalia Landesvermessungsamt.

Previously, "ALK [was] accessible to the general public in accordance to the rights of protection of individual interests (privacy). Person-related information can be provided to users with a special interest, e.g., in buying a parcel. Not person related information is accessible to all without any restrictions" (Hawerk, 1995, p. 18).

Massachusetts
Privacy is no issue for assessing information, as it is not for other geographic information. Many Massachusetts cities and towns have on-line parcel and other GIS datasets, and often these communities allow for searches on name (e.g., the Town of Groton (website MA Town of Groton), Boston Atlas (website Boston Atlas)), providing overviews of properties including the assessed value of the property, its location (address) and its characteristics. Sometimes the tax amount due and payments are published (see, for example, website MA City of BostonB). Moreover, in Massachusetts mortgage information is available on the internet from the Registries of Deeds (see, for example, website Suffolk).

Metropolitan area of Minneapolis and St. Paul
Minnesotan legislation arranges for restrictions in the use of private information on individuals (MGDPA 13.02 Subd. 5; 13.02, 13.04, 13.05, and 13.43; MR 1205). It defines data on individuals as "All data, in whatever form it is maintained, is "data on individuals" if it can in any way identify any particular individual" (MR 1205.0200 subp. 4). This includes data that "identifies an individual in itself, or if it can be used in connection with other data elements to uniquely identify an individual. Such data shall include, but is not limited to, street addresses, job titles, and so forth where the particular data could only describe or identify one individual" (MR 1205.0400 subp. 4). Code numbers can also be classified as data on individuals if they are used to represent particular individuals, constitute "data on individuals" if a list or index of any type is available by which the code number can be cross-referenced to a name or other unique personal identifier so that any individual's identity is revealed (MR 1205.0400 subp. 4). Given the definitions in the legislation, most geographic information would qualify as information on individuals. This, however, does not imply anything about the information being classified as being public or private.

The interviewees indicated that the privacy laws do not limit the use of the parcel information. However, in one instance a county initially provided a full search (including on names) for property information on the Internet. This resulted in many negative reactions from the public that they decided to not provide the service on Internet to search on names. Several interviewees indicated that it is now commonly understood to only provide access to the parcel information on websites through object information. Scott County, however, allows for searches on names (website MN Scott County1). The privacy legislation in Minnesota does not limit the use of parcel information.

Liability
Denmark
–

Netherlands
The *Kadaster* is subject to liability for its torts and those of its officers, employees and agents acting within the scope of their employment or duties (see Kadasterwet art. 117).

The *Kadaster* waives all liability claims for direct, or indirect damage caused by use of its information (article 9.8 Kadaster, 2004a). The *Kadaster* does not accept claims for damage with a customer higher than the fee that has been paid by that customer.

Northrhine Westphalia
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Massachusetts
Many municipalities use disclaimers for the use of their information. Notable exceptions are the freely downloadable datasets from the Boston Atlas and the City of Fitchburg, which both do not use any disclaimers.

Metropolitan area of Minneapolis and St. Paul
Every county is subject to liability for its torts and those of its officers, employees and agents acting within the scope of their employment or duties whether arising out of a governmental or proprietary function (MGDPA 466.02). The responsible authority shall establish procedures to assure that all information on individuals is accurate, complete, and current for the purposes for which it was collected; and establish appropriate security safeguards for all records containing information on individuals (MGDPA 13.05 Subd. 5).

Unlike geographic information from municipalities in Minnesota (see MGDPA 466.03 subd 21 a&b), the liability of Counties is not exempted from liability claims for certain uses of the parcel dataset if a disclaimer of the accuracy of the information is provided.

The integrated parcel dataset license agreement and each of the counties attempt to limit their liability through the inclusion of a liability statement (see, for example, MGCGI, 2003, p. 47).

Legal access findings summarised
Table 8.10 provides an overview of the legal accessibility of the parcel datasets. In all cases legislation arranges for access to the parcel information. In the European cases access to the parcel information can be enforced through a cadastre act request. In the US cases the state public records act applies to the public parcel datasets. In the European cases this only applies to access for limited numbers of parcels. In the US cases access to a complete parcel dataset can be enforced through legislation. In Northrhine Westphalia access is limited to those with an interest in the information (owner, potential buyer).

Table 8.10 Legal access to the parcel datasets

	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Access legally enforceable?	Yes, for insignificant parts of the dataset	Yes, for insignificant parts of the dataset	Yes, for insignificant parts of the dataset	For complete parcel dataset	For complete parcel dataset
Use restrictions?	Use restricted to internal purposes	Use restricted to internal purposes	Use restricted to internal purposes	None	Use restricted to internal purposes
Privacy legislation limiting use	No	Yes	Yes	No	No

Only Massachusetts (as expected) applies open access policies to the public information. In the other cases (Denmark, the Netherlands, Northrhine Westphalia, and Metro) intellectual property rights and use restrictions are imposed by the public entity. In Massachusetts the public information is provided without copyright claims and additional use restrictions, although some exceptions may be found.

Privacy legislation only limits the use in Netherlands and Northrhine Westphalia. In the other cases, privacy legislation does not impede the use[17].

8.4.2 Financial access

Denmark

Users of the parcel information have several options for access to the parcel data: the full dataset for Denmark with extended use rights is available for DKK 17,878,728 (incl. VAT) (€2,399,829; 2004). This is approximately DKK 7.50 (€1.00) per parcel. The entire dataset with limited use rights is available for DKK 3,438,217 (incl. VAT) (€461,506). Yearly updates from the register for the complete country cost DKK 687,643 (incl. VAT) (€92,301) (website KMS).

In 2003, "the Ministry of Treasury, The Ministry of Environment, The Ministry of Custom and Tax, The County Association and The Municipality Association have entered into an agreement on the use and financing of digital addresses, parcel maps, the cadastral register, the property databases and the taxation/valuation databases. The agreement includes access to the updates of the parcel maps free for those authorities that have acquired a right to use the parcel maps. The rest of the mentioned information is freely available for the authorities. The different users have to pay the distribution costs" (SADL 2003a). In return, the municipalities have to maintain the address register.

On request, KMS should indicate the calculation basis for the published charge (EU, 2003 article 7).

Netherlands

Legislation arranges for the prices of the information (Cadastre act Art. 108 & 109 and Kadaster 2004b). The entire geometric parcel dataset (LKI) is avail-

17 Information based on interviews.

able for €3,500,000 (personal communication). The administrative dataset (AKR) costs €8,500,000 (personal communication). Licensees pay €0.56 per parcel requested (Kadaster, 2004b). A license for monthly updates costs €142 per 1,000 parcels (Kadaster, 2004b). This would for the entire dataset result in a price of €994,000 per year for updates. There are no special fees for special user groups. Special fees apply to subsets of the (administrative) parcel dataset. For example, mortgage information at the zip code level (6ppc) costs €0,06 per parcel or €23,580 per year (Kadaster 2004b).

On request, the *Kadaster* should indicate the calculation basis for the published charge (EU, 2003 article 7).

Northrhine Westphalia[18]

The *Katastermodernisierungsgesetz* (2005 par. 4) rules that access of the ALK within government is without cost. The free access provision doe not apply access for commercial purposes. For commercial purposes the *Gebührenordnung* (VermGebO (2002 and 2004)) still rules for the fee for information of the Cadastre (VermKatG NW par. 13 (5)). Hawerk (1995, p. 18) states that the provision of ALK is 'more or less based on cost recovery' (see also Micus, 2003, p. 74). There is a standard fee of €75 for vector information (VermGebO: 2.3.6). Further, the fee for the information depends on the category of the layers, the information density, the size of the area requested and the format requested (analogue, vector, raster). Further, there are different fees for different uses. The fee schema provides the fees for the EDBS format. Fees for other formats are in percentages of the EDBS fee. Moreover, legislation rules that no fee is assessed for municipalities belonging to the same county (*Kreis*) (if the fee cannot be charged to third parties) for direct access to information (VermGebO NRW: 40; the VermGebO NRW (2002: 2.3.5 & 2004 article II (25))). Finally, universities may obtain free access to the dataset for academic uses.

The fee schedule in the fee ordinance is related to the number of hectares requested starting with a fee for 1-500 ha (see VermGebO 2002: 2.3.2.1.1). The fee per ha varies from €4 - €15 per ha for requests not exceeding 500 ha (VermGebO 2002 art. 2.3.2.1.1). The standard ALK costs for more than 200,000 ha €1 per ha (VermGebO 2004 art. II (12)). ALK information with full coverage of Northrhine Westphalia would cost approximately €3,400,000. Yearly updates cost 15% of the initial fee (VermGebO 2002 art. 2.3.5.2). This would approximately be €510,000.

In certain parts of Northrhine Westphalia local government cooperates through *Rahmenverträge* with utilities. The utilities finance the creation and maintenance of ALK, and can use the information freely (Micus, 2003, p. 42).

18 After the case study research was completed, the Katastermodernisierungsgesetz (2005) has been enacted, which arranges for free access and use of the geographic framework information for non-commercial purposes.

On request, the counties sh ould indicate the calculation basis for the published charge (EU, 2003 article 7).

Massachusetts

According to the Massachusetts statutes (M.G.L. C. 4, S. 7, Cl. 26 and C. 66, S. 10) the public can obtain (digital) parcel information at the cost of reproduction. For specific complex requests an hourly fee may be charged ($50 per hour) for the time taken to create the files (950 CMR 32.05 (1c) & 950 CMR 32.05 (1e)). Generally, this is being adhered to by the Massachusetts' administrations. Most governments charge something for their information in the range of $50-100 per CD with full coverage of their jurisdiction. For the City of Boston this would be one tenth of a dollar cent per parcel for the parcel dataset. For the Town of Brookline one would need to pay almost 7 times this amount per parcel. Both the City of Fitchburg (website MA City of Fitchburg) and the Boston Atlas (website Boston Atlas) provide free access to their information They are, however, the exception. Academic institutions may obtain the information for free. Also other government entities may acquire the information for free.

Metropolitan area of Minneapolis and St. Paul

Financial access in Minnesota is directly linked with the classification of the information requested. Financial access to public information is typically based on the marginal cost of dissemination (MR part 1205.0300 subpart 4; (website MN Admin; MDA and IPAD, 2000, p. 29).

When a request involves copies of public information that has commercial value and is a substantial and discrete portion of or an entire database, among others, developed with a significant expenditure of public funds by the agency, the responsible authority may charge a reasonable fee for the information in addition to the costs of making, certifying, and compiling the copies (MS 13.03 (3d)). This allows government to recover the cost of developing a system to maintain and manage electronic information (website MN Admin; MGCGI, 2003, p. 3). The responsible authority, upon request, shall provide sufficient documentation to explain and justify the fee being charged (13.03 subd 3 (d)).

The integrated parcel dataset is available without cost for MetroGIS' stakeholders. Individuals and organisations that do not qualify as governmental or academic institutions (e.g., private sector) must acquire the dataset directly from each county and have to pay a fee. The counties agreed upon a standardised fee schedule for the same information that comprises the integrated parcel dataset distributed to MetroGIS' core stakeholders via DataFinder ($0,05 per parcel).

Because of the classification of public information with a commercial value, the fee includes the cost of developing the dataset. In 2001, private interests

Table 8.11 Financial access to the parcel datasets

	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Price entire dataset	CR € 2,400,000	CR € 3,500,000	CR € 3,400,000	OA $50-100 per CD	Partial CR $48,000
Price per parcel	€ 1	€ 0.56	1/ha*+€ 75 per request	< $0.01	$0.05
Price of yearly updates	€ 92,000	€ 994,000	€ 510,000	–	–
Price complete with limited use rights	€ 460,000	–	–	–	–
Specific user groups policy	Free for government	Government may be charged less than € 0.56 per parcel	Generally free for government	–	Free for MetroGIS stakeholders

CR = full cost recovery.
OA = ≤ marginal cost of dissemination.
* For requests including more than 200,000 ha.

would have to pay over $450,000 for the integrated parcel dataset. This would be $0.50 per parcel. Today, the fee would be about $48,000 ($0.05 per parcel). In 2004, it was proposed to drop the price to $0.01 per parcel, which would be $10,000 for the entire dataset (see also CDPWG, 2003; website MetroGIS1; and LMIC, 2003). Regardless the outcome of the pricing debate Scott and Hennepin County already provide their dataset for $0.01 per parcel (for 50,000 or more parcels: see website MN Scott County, website MN Hennepin County). Already outside the Metropolitan area one county now allows for free downloads of most of its geographic information (see website MN Clay County).

The County Data Producers Working Group (CDPWG) has also agreed in principle to pursue formal policy changes concerning unlicensed access to the Regional Parcel Dataset for browsing parcel information that is a component of the Emergency Management Application that is currently being tested (MetroGIS, 2004c, p. 21). Further a policy for 3+ year-old parcel information was enacted but did not include a public domain access component to 3+ year-old information as originally proposed.

Financial access findings summarised

Table 8.11 presents the overview of the financial accessibility of the parcel datasets. In principle, only Massachusetts (as expected) applies open access policies to the public information Public information can be acquired against the marginal cost of dissemination, generally $50 per CD. In all other cases a (partial) cost recovery pricing is adhered to. The total cost of the datasets in the European cases varies from €2,400,000 in Denmark to €3,400,000 in Northrhine Westphalia and €3,500,000 in the Netherlands. The Metro dataset may be acquired for a $48,000. Prices per parcel vary from $0.05 per parcel in Metro, €0.56 per parcel in the Netherlands to €1 per parcel in Denmark. In Northrhine Westphalia the fee ordinance does not provide information per digital parcel.

8.4.3 Physical access

Denmark

The parcel dataset is published in the national clearinghouse (www.geodata-info.dk). Use restrictions are included in the provided metadata. For prices the site refers to the KMS site where prices are published (website KMS). The parcel dataset is available from one central point: KMS. In order to obtain a limited or extended use right a contract must be signed.

The parcel information can be delivered on a CD-ROM or a diskette, with a list of the DSFL code. Basic parcel information including the parcel map has been available on the internet (web cadastre). The Map Service (*Kortforsyningen*) through which web access to the parcel maps (vector-based) is provided, is based on the OGC Web Map Service standard (see website KMS1). From May 2002 the service has been open for the private consumers market. Using the system requires subscription (Daugbjerg et al., 2001).

Also many municipalities provide on-line access to the parcel map. See, for example, the website of Aalborg Kommune (website DK Aalborg). Municipalities' websites that show the parcel map of their jurisdiction typically only show the map and do not provide additional administrative information. Sometimes geometric parameters such as surface, and object ID are shown, but information about ownership, and other rights are lacking.

Netherlands

The national clearinghouse includes outdated information about the parcel dataset. Use restrictions are incorrect (metadata states no use restrictions) and prices are in guilders. The parcel dataset is available from one central point: the *Kadaster*. For requests concerning the service area of a local office, one has to contact the local office. For nationwide and interservice area requests, one has to contact the central *Kadaster* office in Apeldoorn. For an information request of some significance the *Kadaster* accountmanager will visit the customer and assess the needs. In order to obtain a copy of the dataset a contract must be signed.

Data is available on a CD-ROM, DVD. In the future there may be a ftp server for information transmission. *Kadata* internet also offers a variety of information This information is downloadable. Only registered users have access to the site. The municipality of Enschede provides free views of *Kadaster* information (name owner, sales price) through the internet (see website Enschede).

The *Kadaster* promotes its products through the publication of the average price of houses specified per type. They provide other extracts from their information for publication in financial magazines, through presentations, website advertisements on popular (real property) websites, and promotion stands at exhibitions of several conferences.

Northrhine Westphalia

The Northrhine Westphalian clearinghouse (website Geocatalog) does not include the integrated ALK of the *Landesvermessungsamt*. Further, only ALK information from four individual *Katasters* was found here (01 December 2004).

Price and use restrictions are not included in both the metadata of the *Geodatenzentrum* and geocatalog.de. The *Landesvermessungsamt* has published its restrictions on its website (website LVA1) and so have some individual counties.

The independent 54 counties need to be contacted to obtain information concerning the information of one specific jurisdiction. The *Geodatenzentrum*, which is placed within the *Landesvermessungsamt* will be formally embedded in the new legislation and will take care of cross-county information requests (Katastermodernisierungsgesetz, 2005, paragraph 15).

Data cannot be downloaded, and administrative procedures need to be fulfilled to acquire the information. Information is available on CD, e-mail or on paper. The city of Aachen is among the few that provides free views of ALK information through the internet (see website Aachen). Information is delivered after a contract has been signed.

Massachusetts

The central point for access to geographic information in Massachusetts is the MassGIS' website (website MassGIS1). Some of the viewers from local governments are indirectly accessible through this service (links to the city or town's sites are provided). Another point of access is Vision Appraisal Technology. Its' website provides access to the Assessing information of its customers in New England, including Massachusetts (see website Vision Appraisal). Five of the listed 43 local governments have on-line maps available. The parcel information of the 351 local governments is not available from one access point. One has to contact each of the 351 local governments.

Similar to the varied adherence to the MassGIS parcel standard, also the metadata documentation varies heavily. Some of the excellent ones include prices and use restrictions and are available on their website (see, for example, the Town of Brookline, MA).

Digital information, if existing, is available on CDs, small requests may be acquired through e-mail. Parcel information from both the City of Fitchburg and the Boston Atlas can be downloaded (free login-id and password are required for Boston Atlas). Many governments have an on-line viewer available on their website.

Metropolitan area of Minneapolis and St. Paul

Minnesota has the general policy that every government agency shall keep records containing government information in such an arrangement and condition as to make them easily accessible for convenient use (MGDPA 13.03

subdivision 1; see also website MN IPAD). The integrated parcel dataset is published in and can be accessed through the regional clearinghouse: DataFinder.

The integrated parcel dataset is only available for MetroGIS participants. Therefore, only public, academic or non-profit organisations can acquire the integrated dataset and use the download service (website MN DataFinder). Individuals and organisations that are not stakeholders of MetroGIS (e.g., private sector) cannot acquire their information through DataFinder, but must acquire the dataset directly from each county. MetroGIS provides on its site an overview of contact information for these county datasets (see website MM MetroGIS1). In order to obtain a copy of these datasets a contract must be signed.

For other users than MetroGIS participants, most of the counties provide their datasets on CD, FTP or e-mail among other means (see LMIC, 2003 and 2004).

Data for single properties are freely available from the individual county websites. Some provide access through name (Scott), others through map (Dakota, Ramsey, Washington, Hennepin, Scott), but most through address, or parcel ID (Anoka, Dakota, Ramsey, Washington, Hennepin, Carver) (website MN DataFinder)[19].

Physical access findings summarised

Table 8.12 shows an overview of the physical accessibility of the parcel datasets.

Transparency

In Denmark and Metro the parcel dataset is published in the clearinghouse of the jurisdiction involved and the comprehensive metadata of the Danish and Metro dataset (indirectly) include information on prices and use restrictions. The Dutch dataset has been found in the national clearinghouse but the information published is outdated. In Northrhine Westphalia, only few datasets are included in a clearinghouse. In Massachusetts the clearinghouse for public information (website MassGIS) does not provide parcel information in a searchable way.

Access means

Only Massachusetts applies open access policies to the public information. The other cases (Denmark, the Netherlands, Northrhine Westphalia, and Metro) require for requests for an entire dataset the identification of the requester and a specification of the purpose of the use. In these restrictive cases also a contract must be signed before accessing the information

19 See for County websites with parcel information the references under Online references.

Table 8.12 Physical access components of parcel datasets

	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Publication dataset	Metadata published in clearinghouse	Limited metadata published on provider's website	Limited metadata published on provider's website	Limited metadata published on provider's website	Data, services directly available from clearinghouse*
Time between request and access	Adequate-immediate	Adequate-immediate	Adequate-immediate	Adequate (immediate)	Adequate (immediate*)
Acquisition procedure	Contract	Contract	Contract	FOIA request	Contract
Number of points to contact for maximum coverage of jurisdiction	1	1	54 (1**)	351	1 (7***)
Online viewing (free)	Y	N	N	Y	Y

* Only for MetroGIS stakeholders.
** One if integration process is completed.
*** Seven for non MetroGIS stakeholders.
FOIA: Freedom of Information Act

Time between request and access
In Denmark, the Netherlands and Metro subscribers to the information can immediately download the parcel information However, in Metro non-stakeholders of MetroGIS cannot use this download service. In Northrhine Westphalia and Massachusetts such a service is generally not provided. Northrhine Westphalia and Metro also provide their information through ftp. All cases provide their information on a CD-ROM, which is generally provided within reasonable time after a request has been made.

One access point
The parcel datasets of Denmark, the Netherlands, and Metro (for Metro stakeholders) are available from one access point. In Northrhine Westphalia, the Landesvermessungsamt is working towards such a situation, but currently 54 entities need to be contacted for full coverage of Northrhine Westphalia. In Massachusetts 351 towns or cities need to be contacted.

8.4.4 Policy consistency

Denmark
Provided that the dataset is available from KMS, and that KMS controls its distribution points (municipalities) the access policy is consistent throughout Denmark. It is unclear to what extent these policies are in line with the general national public information policies.

Netherlands
The policies for parcel information are consistent throughout the Netherlands. The *Kadaster* is responsible for the distribution of the parcel information and is bound to legislation deciding on prices and use.

The policies are not consistent with national policy lines. These exempt public information with a specific access regime (e.g., parcel information) from the general access policies, which are more open than those for parcel information

Northrhine Westphalia
Legislation sets the rules for the access policy of parcel information (Katastermodernisierungsgesetz, 2005; VermGebO (2002 and 2004)). The policies are consistent for Northrhine Westphalia.

Although the *Gebührenordnung* provides the legal framework for the price setting of the ALK, it is generally regarded as complex and difficult to understand, and inflexible to be of use for internet applications. Especially for request for areas smaller than 200,000 ha the criterion 'information density' seems to be ambiguous and is likely to be applied differently in each county.

Massachusetts
In general terms the access policy is consistent within government and with other public information policies: few use restrictions, no copyright and a fee representing the marginal cost of dissemination. In specific instances one may find differences in use restrictions, liability waivers and prices per parcel.

Although the datasets are subject to the Massachusetts General Laws, local communities do not always have identical policies in place.

Metropolitan area of Minneapolis and St. Paul
The access policy that applies to a specific dataset depends on the classification of the dataset as public, private, information on individuals or not, and information with a commercial value or not. In principle, it is the government entity itself that categorizes a dataset. Therefore, the decision whether or not public information has commercial value is left to the individual organisations and is potentially inconsistent throughout Minnesota. This may lead to a situation where in one organisation information can freely be used, while another organisation charges users for similar information

However, within the Metropolitan area all counties have restrictive policies in place. Use restrictions are consistently restrictive, and pricing of the county parcel datasets varies from $0,01 to $0,05 per parcel.

Because of the classification of parcel information as public information with a commercial value the access policies are more restrictive than those of other public datasets.

Policy consistency findings
All researched entities have a formal access policy in place. Although the research has found in some cases differences in interpretation of the general legal framework for parcel information, these were not such that the policies

Table 8.13 Non-technical characteristics of the parcel datasets

	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Access legally enforceable?	Yes, for insignificant parts of the dataset	Yes, for insignificant parts of the dataset	Yes, for insignificant parts of the dataset	For complete parcel dataset	For complete parcel dataset
Use restrictions?	Use restricted to internal purposes	Use restricted to internal purposes	Use restricted to internal purposes	None	Use restricted to internal purposes
Financial access	Cost recovery	Cost recovery	Cost recovery	Open acces	Partial Cost recovery
Policy consistency	Uniform	Uniform	Harmonisation	Harmonisation	Harmonisation
Publication dataset	Metadata published in clearinghouse	Limited metadata published on provider's website	Limited metadata published on provider's website	Limited metadata published on provider's website	Data, services directly available from clearinghouse*
Acquisition procedure	Contract	Contract	Contract	FOIA request	Contract
Time between request and access	Adequate-immediate	Adequate – immediate	Adequate – immediate	Adequate (immediate)	Adequate (immediate*)
Number of points to contact for maximum coverage of jurisdiction	1	1	54 (1**)	351	7 (1***)

* Only for MetroGIS stakeholders.
** One if integration process is completed.
*** One for MetroGIS stakeholders.
FOIA: Freedom of Information Act

within a jurisdiction were considered non-consistent. However, in the restrictive cases, the policies for parcel information were generally more restrictive than those for other public information.

8.4.5 Adherence to non-technical user requirements for parcel information

In chapter 5 the non-technical GII requirements are described. A dataset should have as few use restrictions as possible, consistent access policies throughout government, with prices that do not impede the use of the information Users require transparency of available information and access should be provided through electronic means. Further, an ideal situation would provide for as few contact points, preferably one, per framework dataset, even if the dataset were integrated from several other datasets. Table 8.13 summarizes the non-technical case study findings for parcel information

For the legal access and financial access characteristics, the open access policies for parcel datasets in Massachusetts should be considered as excellent, where in the other cases the restrictive policies (both legally and financially) would be qualified as poor.

The centrally organised datasets of Denmark and the Netherlands have the better physical access characteristics. Both datasets are available through one contact point and direct access to the databases is available after a contract has been signed (viewing and downloading).

For the decentrally organised parcel datasets respectively 7, 54 and 351 organisations need to be contacted in order to obtain maximum coverage of the case-jurisdiction. The Metropolitan region has one contact point for MetroGIS stakeholders and information can be downloaded from this point. Non-stakeholders need to contact the seven counties that collected the original information However, these counties can be requested the information that was provided to MetroGIS for inclusion in the integrated parcel dataset.

Northrhine Westphalia is working to a similar situation of an integrated dataset. However, until complete coverage has been reached, the 54 individual cadastral offices need to be contacted for the parcel information In some instances the information is available through download services (ftp), in other the information is still in paper format.

The situation in Massachusetts is less promising. 351 Entities need to be contacted to obtain a possible dataset that covers Massachusetts entirely. These datasets are not included in the state clearinghouse, metadata varies heavily, and information is generally not directly accessible.

8.5 Assessing the fitness-for-use value

Together, sections 8.2 and 8.3 provide the assessment that has been made for the parcel datasets. Table 8.14 presents an overview of the findings.

The technical data characteristics, both internal and external, are assessed to be in an advanced stage of development in the Danish and Dutch' parcel dataset. These are the datasets that will be sufficient for use as a framework layer in a GII. Also the Metro dataset meets the external technical data requirements of a GII. However, the content is less comprehensive than the Danish and Dutch datasets and is not as consistent with respect to positional accuracy and content. The most comprehensive content is in the parcel dataset of Northrhine Westphalia, including both parcel information and full topographic detail. This dataset, however, is not covering the entire jurisdiction of Northrhine Westphalia and some parts are still in analogue format. This inconsistency has resulted in poor scores in the technical data characteristics. Potentially, however, with full digital coverage the Northrhine Westphalian situation would be comparable to the situation in Denmark and the Netherlands. Finally, Massachusetts has the least favourable position concerning the parcel information. Massachusetts has been assessed in all technical categories to be insufficient from a GII perspective. This is explained by the wide variety of technical characteristics of the 351 datasets of which significant percentages are not in digital format and/or not adhering to a standard data model.

For the non-technical data characteristics the open access policies of Mas-

Table 8.14 Overall assessment of the technical and non-technical parcel information characteristics

		Denmark	Netherlands	Northrhine Westphalia	Massa-chusetts	MetroGIS (Minnesota)
Technical parcel information characteristics						
Internal characteristics	Content	+	+	++	–	o
	Horizontal positional accuracy	+	++	++	–	–
	Attribute accuracy					
	Currency	++	++	++	–	++
	Data structure	o	+	– –	– –	+
	Quality consistency throughout the (integrated) dataset	+	+	– –	– –	–
	Average internal data characteristics score	+	+	o	–	o
External characteristics	Digital coverage (vector format)	++	++	+	–	++
	Number of datasets for jurisdiction coverage	++	++	–	– –	+
	Standard adherence	+	+	–	–	+
	Data model	+	+	–	–	+
	Metadata documentation	++	–	– –	– –	++
	Quality assurance	++	++	++	–	+
	Average external data characteristics score	+	+	–	–	+
Non-technical parcel information characteristics						
Access policy	Legal access	–	–	–	++	–
	Financial access*	– (++)	–	– (++)	++	– (++)
	Average access policy score*	– (+)	– (+)	– (+)	++	– (+)
Physical access	Publication of the dataset	++	–	– –	– –	++
	Number of points to contact for maximum coverage of jurisdiction	++	++	–	– –	+
	Acquisition procedure	+	+	+	+	+
	Time between request and access	+	+	+	+	+
	Average physical access score	+	+	–/o	–	+

* For specific user groups free access is provided.

sachusetts' government are positively assessed for GII development. However, the ease to obtain parcel information covering entire Massachusetts is hampered by the 351 entities that need to be contacted. The other four cases have restrictive access policies in place, but the ease to acquire the datasets is more favourable than the situation in Massachusetts. In order to obtain the datasets of the entire Denmark and the Netherlands only one point needs to be contacted. The Metro integrated parcel dataset is available through MetroGIS for MetroGIS participants, other need to contact each of the seven counties. Potentially the Northrhine Westphalian datasets are available from one contact point. However, currently the 54 parcel information providers need to be contacted.

The above has resulted in an assessment of the fitness-for-use vale for each of the (integrated) datasets. Based on the fitness-for-use value, it is expected that parcel information will not be heavily used because of (1) the restrictive access policy, and/ or (2) the poor technical characteristics in addition to difficulties in accessing the parcel information (see Table 8.15).

8.6 Use findings

This section concerns the case study findings of the use of the parcel information. It will provide qualitative information about the extent to which which user group uses the parcel information.

Denmark

Primary users of the parcel map are: cadastral authorities, private land surveyors, counties and municipalities. Secondary users are the utility companies, which need incidentally parcel information for development purposes. The utility companies typically do not have a full copy of the cadastral database. There are until now only a few examples of value-adding services including cadastral maps driven by the private value-adding companies. There are many other examples (more than 100) where public authorities are using cadastral maps as background for presentation of thematic information on the Internet but based on municipal GIS/ Mapservers. Average revenues (over 2002, 2003 and 2004) are as follows:

- Central Government ......3,9 million DKK (€534,000)
- Counties ....0,4 million DKK (€54,000)
- The Municipalities ....1,7 million DKK (€228,000)
- Private companies ....1,7 million DKK (€228,000)

"It is a general opinion, that the society do not get the full benefit from using all the vast amount of information collected during the last 30 years in geographical related registers in the public administrations for different, specific purposes i.e. the Building and Dwelling Register and The Cadastre" (Laursen, 2001).

The research did not find duplicate efforts collecting parcel information.

Netherlands

The *Kadaster* concern has approximately 26.500 customers with a stable need

Table 8.15 Assessment of the fitness-for-use value of parcel information

	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Internal technical characteristics	+	+	0	–	0
External technical characteristics	+	+	–	–	+
Access policy*	– (+)	–	– (+)	++	– (+)
Physical access	+	+	–/ 0	–	+
Assessed general fitness-for-use value	0/+	0/+	–/0	–/0	0

* For specific user groups free acces is provided

for cadastral information. The number of users of *Kadata* service with a stable need is 2.250.

A wide variety of professional users is being served: financial institutions, real estate agents, project developers, *Prorail*, the *Vereniging Eigen Huis*, engineering firms, architects, and supermarket chains (*Albert Heijn*), among others. These are typically secondary users of the parcel dataset. In addition, the *Kadaster* also provides extracts from this database, for example, information per zip code, and areas or centroids of zip code districts (based on *Kadaster*, 2004b, article 21). In addition, the *Kadaster* has created the product "Nederland zoals het was" (website Woonomgeving), which is a collection of old parcel maps of the Netherlands (created by the *Kadaster* and subsidised by Ministry of Education, Culture and Science).

Information from the *Kadaster* are used in the following value-added products:

- www.abfresearch.nl: development of the value of buildings (including a linkage to VEH);
- www.nbwo.nl: value development of buildings (based on 50.000 taxations per month);
- building index of the Netherlands (developed in cooperation with OTB)
- www.experian.nl;
- www.dimmo.nl: value of buildings per zip code (6ppc, municipality).

The *Kadaster* generates approximately €10 million through the provision and sales of services and information to professional customers. This is approximately 5% of the €200 million budget of the *Kadaster*. The public notaries are responsible for approximately another 70% (€140 million) sales of products. These 'sales' are the direct result of the statutory requirements for transferring real property. The *Kadaster* is among the few public organisations that collects a fee both for information provision and for information collection.

Northrhine Westphalia

Use of the ALK is primarily in the public sector and utilities. Secondary users are architects, and engineering and planning companies. The value for value-adding companies and other potential users of the framework information is not in balance with the current level of prices (Ganswindt, 2004, p. 4).

Because of the use barriers, the turnovers are small for geobasisdata (Micus, 2003, p. 9). In 1999, the *Katasters* generated together 646,000 DM (€323,000) from the sales of extended or additional use rights of parcel information (Micus, 2001a, p. 11). This is less than 12,000 DM (€6,000) per *Katasteramt* (Micus 2001a, 11). In 2003, the *Landesvermessungsamt* sold for approximately €1,000,000 information from the ALK to clients like electricity companies, telecommunication companies (interviews). These users all requests bits and pieces. Not one client could afford to buy the ALK for entire Northrhine Westphalia because of the high price (i.e. €3,400,000).

The city of Aachen offers a value-added service: the *Einzelhandels-Informations-System* (EIS) (website Aachen), a Chamber of Commerce application to find free business buildings, or to find current businesses. It uses the ALK as one of its base layers, but is also interoperable with the DTK10 from the *Landesvermessungsamt* (supermarkets, for example, will show on every scale level). Another example is InVeKos where farming information is added to the parcel layer to prove EU funding.

Massachusetts

Requests for parcel information vary from local government to local government. For example, the Boston parcel information and appraisal information CD-ROMs are sold between 300 and 400 times a year. In smaller communities fewer requests are received. The City of Newton receives once or twice per month a request for its information, while the Town of Hull, for example, has never received a request for the entire parcel dataset.

Primary uses of parcel information are in government (MassGIS, 2003; Geagan et al., 2004). Also utilities use parcel information. Their needs are, however, incidental: they typically need those parcels connected to the location of their pipelines and cables for planning and maintenance purposes. Given the mixed quality of parcel information in Massachusetts, this has been and still is a difficult task to do (e.g., paper sheets, not georeferenced). Utilities sometimes scan and georeference the information themselves.

Contrary to Minnesota where title insurance companies use the County websites frequently for their parcel information, title companies in Massachusetts go directly to the registry of deeds for their (administrative) information. They rely on administrative databases and do not have a GIS, or a digital parcel dataset in place (Jones, 2004).

According to interviewees, MLS is an example of real estate agents using Boston's parcel information (see www.mlsplug-in.com). Further, mortgage companies and commercial brokers use, for example, the information from the City of Boston's Assessing Department. However, on these websites the assessor's information comes from the Assessing Department, but the geometric information comes from MapQuest (Navtech road centrelines) or Yahoo mapping (NavTech road centrelines), among others.

In several instances, government has added some value to the parcel datasets. For example, several cities (City of Newton, City of Boston) provide access to both the geometric and the administrative (mass appraisal) information. Others show an overview of neighbourhood sales and allows for overlays with aerial photographs (e.g., The City of Newton) or have added to the base maps a feature that provides every other 10 feet or so images of the street from several directions per photo point (see website MA Town of Dedham). In addition, it provides the location of the sewer system, manholes, easements, fences among other topographic detail. The City of Boston has developed the Available Property Inventory. This inventory represents land and buildings currently in the possession of the City of Boston's Department of Neighbourhood Development that are potentially suitable for development (see website MA City of BostonA).

The research has not found other entities than local communities that collect, and create parcel information. There is one company that resells parcel information from Boston (100,267 parcels), Hyannis (50,000 parcels), and Worcester (70,000 parcels) (website Boundary Solutions).

Metropolitan area of Minneapolis and St. Paul

Primary users of the integrated parcel dataset of MetroGIS are in government. Employees of over 300 organisations that participate in MetroGIS have free access to the integrated parcel dataset through the one-stop DataFinder. Between March 2003 and March 2004 the dataset was downloaded 513 times, averaging 36 times per month (MetroGIS, 2004a and 2004b, p. 6). The Metropolitan Council, Watershed Districts, State agencies, and Emergency services are among the organisations that have cross-county jurisdiction. It is in this group that the need for the integrated parcel dataset was most pressing. Previously they had to contact each of the counties separately, acquired parcel datasets with different quality and access policy. The integrated parcel dataset has resulted in time and money savings in these organisations. Before the MetroGIS era information was sold between governments leading to duplicate datasets throughout government. Now information is commonly shared and the duplication of datasets is minimised (at least in government).

Secondary use is in utilities, title insurance companies, engineering firms and academics. The utilities use parcel information for their planning activities. These are incidental needs, which do not require continuous access to the integrated parcel dataset. MetroGIS is exploring ways to share the parcel information with the utilities (CDPWG, 2003). Title insurance companies use the County websites frequently for their parcel information, among other means. Engineering firms have incidental business needs for the parcel information.

The integrated parcel dataset is not available to the private sector. Private sector users have to go to each of the individual counties for the parcel information. Few commercial value-adding activities were found, and counties generate little money with the sales of the parcel information. Hennepin

County, for example, had in 2002 65 requests and generated $21,000 from the sales of parcel information (personal communication).

Generally, local government does not need to use the integrated parcel dataset since they rely on the more comprehensive parcel dataset from the County they reside in. However, the policy development of the integrated parcel dataset also benefited local government's use of the county parcel datasets. For example, the price of the County's parcel information for the City of Roseville has dropped dramatically since 1995. In 1995, Roseville paid $3,000 for the entire dataset for the area of Roseville. The information handling would cost approximately another $1,000. It was too expensive for Roseville to buy each month a new dataset. Now with MetroGIS and the Ramsey County GIS User Group in place the access has been improved significantly because Ramsey County provides actively the information, and it can be downloaded through ftp.

All counties add some value to the datasets. All have linked the county parcel dataset the tax-assessment databases. Further, all counties provide online access to the parcel administrative information, while most provide online access to the geometric parcel information.

There is one company that resells parcel information from the Metropolitan area. This private company has collected the information for the seven counties, put them in a common coordinate system and if necessary converts it into shapefiles. This effort is a duplication of MetroGIS' efforts.

Use findings summarised

The use of parcel information in all cases is primarily in state and local government and secondary users such as real estate managers, notaries public, utilities, architects, and engineering companies (see Table 8.16). These findings provide evidence that the general fitness-for-use value assessment (earlier presented in Table 8.15) should be treated with the necessary caution. Secondary users want bits and pieces and generally the external data characteristics are not as important since their needs are likely to be in limited areas of a jurisdiction and for limited purposes. Limited external technical characteristics of the framework datasets may not have an impact on the use within this group. In addition, secondary users by definition only need the information for similar purposes as collected. Even restrictive use restrictions are not impeding their use of the information. Secondary users residing within government are often confronted with restrictive use restrictions, but do not have to pay for access to the parcel information.

In all cases the research found few tertiary users, users that create value-added products based on parcel information. Some potential users indicated that the use conditions of the parcel datasets do not allow this, others indicated that the prices of the parcel information are too high to create profitable value-added products. In Massachusetts, where prices and use restrictions are

Table 8.16 Use component of the parcel datasets

	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Primary users					
State agencies	Y	Y	Y	Y	Y
Municipalities	Y	Y	Y	Y	Y
Counties	Y	Y limited	Y	N/A	Y
Secondary users					
Professionals (notary, real estate, architects, engineers, etc.)	Y	Y	Y	Y, N	Y
Utilities	Y	Y	Y	Y	Y
Tertiary users					
VA Resellers	N	N	N	N	N
Value added services	Few	Few	Few	Few	Few
Duplication	N	N	N	N	Y

such that reuse is promoted, the investment to integrate and link the 351 datasets into one dataset has been assessed as too high for the creation of value-added services for Massachusetts. The cadastral authorities themselves provide some value-added services, for example, free web viewing and searching. The Dutch cadastre also provides extracts and generalised information from its administrative database.

8.7 Conclusions

In chapter 4 and 5 the theoretical GII demands for framework layers are described. Chapter 6 and 7 have provided the research framework that has been the foundation for researching the parcel information cases. This chapter has assessed the extent to which the technical and non-technical characteristics of the parcel datasets have been decisive for its use value and consequently the impact of the access policies on the development of the GII. The findings are summarised in Table 8.17. This section elaborates on two findings: both the technical and the non-technical parcel data characteristics are decisive for the use value, and the institutional setting of the parcel datasets is decisive for the technical data characteristics and to a smaller extent for the non-technical parcel data characteristics.

8.7.1 Technical and non-technical data characteristics decisive for use value

The research found evidence that both the technical and the non-technical characteristics may be decisive for users to use parcel information.

From a point-of-use perspective, all cases have shown significant use in primary and secondary user groups, but few value-adding activities to the

Table 8.17 Technical, non-technical and use characteristics of the parcel datasets

		Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Technical	Internal	+	+	0	–	0
	External	+	+	–	–	+
Non-technical	Access policy	–	–	–(+)	++	–
	Physical access	+	+	–/0	0/–	+
Use	User groups	Primary and secondary	Primary and secondary	Primary and secondary	Primary and secondary	Primary and secondary
	Value added products	–	–	–	–	–

parcel datasets were found. In the instances of restrictive policies and cost recovery prices, this may be because of these non-technical factors. In Massachusetts it may be because of the required investment of contacting 351 data providers and harmonizing 351 datasets including the digitisation of tax assessor's paper sketches (covering approximately 33% of Massachusetts) and the integration of the other 66% digital datasets (with different content, logical consistency, exchange format, documentation, reference system, positional accuracy, poorly demarcated areas, among other aspects) into one dataset covering entire Massachusetts. Even with open access policies in place or even with information available at no cost, value-adding companies are likely to judge the cost for integration as too high. The research expected that the title insurance industry integrated the parcel datasets for Massachusetts since they insure the validity of the deed. However, title insurance companies rely on the information registered at the Registries of Deed.

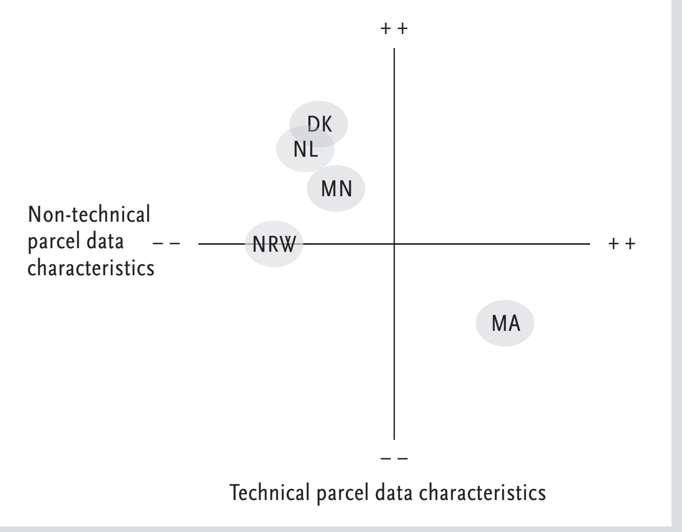
Thus the cause for the limited tertiary use of the parcel dataset may be both in the access policy and in the technical data characteristics (see Table 8.17 and Figure 8.11).

8.7.2 Impact of institutional setting deciding on fitness-for-use value

The GII requirements for GII framework datasets require harmonised technical and non-technical data characteristics for GII framework datasets. Harmonised or uniform data characteristics can be achieved through the adherence to one single technical data model and one unambiguous legal, financial, and physical access framework. The research found that the way the responsibility for parcel information is organised has major implications on the extent to which the technical and non-technical characteristics of the parcel dataset are harmonised.

In the cases where parcel information is centrally organised (the Netherlands, Denmark) the parcel information covers the jurisdiction entirely in digital format, has harmonised content, the most accurate information, one standard data model, and no gaps, or overlaps in the dataset. A consistent restrictive access policy was found. Denmark has documented comprehensive

Figure 8.11 Found parcel data characteristics for tertiary users



metadata, and published its parcel dataset in the national clearinghouse. The Dutch *Kadaster* gives less priority to metadata documentation and uses marketing strategies to direct people to its own site. The technical characteristics of both datasets are sufficient as a framework layer in a national GII.

In the cases where the responsibility is decentralised in local governments (county, towns and cities) heterogeneous datasets were found from a technical and non-technical data characteristics point of view. Information policies in these instances were consistent, but physical access characteristics vary from dataset to dataset.

Decentrally managed datasets imply that for state-wide or region-wide coverage several datasets need to be integrated. The integration of datasets may be promoted by the inclusion of relevant datasets in a clearinghouse environment and adequate metadata documentation. The datasets may also be integrated by an (government) entity, which requires significant resources and effort from all parties involved in such a process. And such a process needs a leader or problem-owner (see further chapter 3). Two decentrally organised datasets (Northrhine Westphalia, Metro) are integrated and harmonised (to some extent) because of the efforts of a centrally operating organisation, respectively *Landesvermessungsamt* and MetroGIS.

In Metro, MetroGIS initiated with its stakeholders the creation of the integrated parcel dataset. The relative weak institutional embedding of MetroGIS forced MetroGIS to follow a 'polder model' strategy. Within MetroGIS, the culture of information sharing and respecting participants' needs (data producers) has positively contributed to the creation of the integrated parcel dataset. Respecting the participants' needs included respecting the restrictive access policies of the counties. The role of the restrictive access policy for the integrated parcel dataset and its underlying sources of the Counties on the development of the Metropolitan GII, in this case the integrated parcel dataset is indirectly apparent: no access is allowed to non-participants. Respecting participants´ needs also implied that MetroGIS did not choose to interfere with the practices of the data producers, for example to require specific content. Several interviewees stated "Without MetroGIS there would not have been an integrated parcel dataset." Similar developments are found in Northrhine Westphalia where the State mapping agency (*Landesvermessungsamt*) and the counties are building a digital parcel dataset with statewide coverage. In Massachusetts, the centrally operating organisation, MassGIS, lacks the resources to accomplish comparable results for Massachusetts.

Coordination to overcome institutional barriers

For decentrally organised parcel information collection, strong cooperation between public information providers may be a way to further develop GII. It is questionable whether local governments will invest in such an operation since the benefits will ultimately be received by the state or federal budget and not by the town bearing the cost. Another option then is institutional reform. However, proposals for centralising land registration would result in a redistribution of governmental powers and would meet great resistance (Onsrud, 1990). The enforcement of an institutional reform just for the sake of GII development is unlikely.

In the Netherlands, however, municipalities have been forced to merge in order to better address developments in society (Tweede Kamer, 1998-1999). In 2004, also Denmark started the process of a structural reform of government (the Municipality Reform, *Kommunalreformen*). Effective from 2007, a structural reform of local authorities in Denmark will be carried out in which 271 local authorities will be amalgamated to form approximately 100 large units. These units will take over tasks previously performed by the 14 counties, which will be amalgamated at the same time to form five new regions (website DK AKF). Such developments are likely to promote GII development, especially if information collection of GII framework datasets is the responsibility of local government.

8.7.3 Summary

In the instances where the parcel information is the centrally organised (the Netherlands, Denmark) the parcel information covers the jurisdiction entirely in digital format, has harmonised content, the most accurate information, one standard data model, and no gaps, or overlaps. Two decentrally organised datasets (Northrhine Westphalia, Metro) are integrated and harmonised (to some extent) because of the efforts of another centrally operating organisation, respectively Landesvermessungsamt and MetroGIS. In Massachusetts, the centrally operating organisation, MassGIS, lacks the resources to accomplish comparable results for Massachusetts.

From a technical GII perspective, the parcel datasets in Denmark and the

Netherlands qualify as good, the Metro dataset as sufficient, the Northrhine Westphalian dataset as potentially good, and the situation in Massachusetts as poor. The research found a direct link between the organisational setting and the technical and non-technical characteristics of the datasets from a GII perspective. Therefore, one may conclude that choices in institutional setting many years or even centuries ago have been decisive for the current stage of development of GIIs and its prospects.

9 Case study results for large-scale topography

9.1 Introduction

This chapter provides the results of the case study findings for the topographic datasets in Denmark, the Netherlands, Northrhine Westphalia, Massachusetts and the Metropolitan region of Minneapolis and St. Paul. The comparison and analyses is based on the theoretical framework presented in the chapters 3, 4 and 5.

First, general information about the definition and use of topographic information is provided. Then the findings of the technical and non-technical parcel data characteristics are presented and a fitness-for-use value assessed. Further, use characteristics of the topographic datasets are provided and finally conclusions drawn.

9.2 Large-scale topographic information

A topographic dataset may be defined as: a dataset showing "the configuration of a surface and the relations among its man-made and natural features" (website Princeton). Examples of topography are roads, buildings, trees, edge of pavement (street, freeway, bicycle path, etc), road centre line, street furniture, fences, waterways, railways, land use, and special objects: swimming pools, playground. Reader accustomed with the US terminology it is explicitly stated that topographic information in this study may be commonly referred to as planimetric information in US terminology.

Topographic information can be collected through surveying, but for larger areas mostly photogrammetry is used to collect the information at the larger scales. The raster information is upgraded to vector information through triangulation and digitisation. The features of interest (roads, buildings) are recognised and accordingly created in vector format. This process is relatively costly.

Large-scale topographic information is often considered a framework layer for the local levels of GII (see Rajabifard et al., 2000). Topography is among the datasets that are prioritised in INSPIRE (2004, annex I, II and III). The transportation network is part of the topography (annex I), and the hydrography (annex I), and buildings and facilities (annex III). Also the US NSDI includes topography in its framework layers transportation and hydrography (see website FGDC).

A large-scale topographic dataset can be used for many purposes: local planning, management of the public space ((rail-) roads, civil works, public gardens), water management, route planning, geographic analysis purposes (environment, forestry, health), and many more. Among the users of large-scale topographic information are local communities, utilities, and private sector companies.

Local government needs the information for many of their daily operations, i.e. maintenance, design and planning of public space, and taxation purposes. In addition, the information may be used for road management (traffic accidents mapping and analysing) or, with administrative geographic information (e.g., building information), for emergency services such as crime mapping, shortest path analyses, and more general disaster management purposes. A specific government use example may be in forest management. For example, for the inventory of timber acreage: the characteristics of the land itself, the general environment, the routes to and from the forest, the effects of environmental events on the forests (fire, heavy rains, etc) forest density, forest maturity, and weather characteristics (STIA, 2001, p. 10-12). Moreover, features in the large-scale topographic information may be used as a reference in other datasets, for example, a parcel dataset that includes buildings (see Kadaster, 1996, p. 55).

Similarly utility companies, both private and public, need topographic information for the management (maintenance, planning and design) of their cable and pipeline framework, site selection and the planning and design of tower sites for public impact analyses, among other purposes (see also STIA, 2001, p. 10-6).

Private sector companies may be interested in the information for route planning, location and relocation seeking activities (site selection, real estate businesses, relocation of businesses or people).

9.3 Organisational context in the case studies

Denmark

In Denmark, large-scale topographic mapping is in the *digitale Tekniske Grundkarte* (TK). Municipalities, often with the utility companies, finance topographic mapping at the large scales. Utility companies own about 15% of the datasets. In three counties, all municipalities except one cooperate with each other in the Grundkort Ost cooperation (in the counties of Fyn, Vestsjaelland and Storstrorns). In the other 11 counties individual municipalities take care of the large-scale topographic mapping sometimes in cooperation with utilities or the Danish Cadaster (KMS).

Netherlands

The large-scale base map of the Netherlands, the *Grootschalige Basiskaart Nederland*, has been developed since the beginning of the 1980s. Since 1 January 2001, the GBKN covers the Netherlands entirely (GBKN, 2003). This is the result of the cooperation of several regional public-private-partnerships, around 25 "self-registering" municipalities in the National Joint Venture of the Large-Scale Base Map (*Landelijk Samenwerkingsverband GBKN*). In the LSV board the

Cadastre, KPN Telecom, umbrella organisations for municipalities, for utility companies (energy and water supply) and the Union of Water Boards are represented. 10 Regional Joint Ventures and 25 municipalities are responsible for the dataset in their territory (cf. Murre, 2002).

***Northrhine Westphalia*[20]**
Large-scale topography is included in the *Automated Liegenschaftskarte* (ALK). The Large-scale base mapping is a responsibility of the authorities of the county government (*Kreisen and Kreisfrei* cities). The Landesvermessungsamt is coordinator of the creation of one statewide dataset for Northrhine Westphalia. So far this dataset covers Northrhine Westphalia for 87% digitally (website LVA). In certain parts of Northrhine Westphalia local government cooperates through 'Rahmenvertrage' with utilities in order to accelerate the process of digitisation.

Massachusetts
The utilities have made substantial investments in GIS and related base mapping and infrastructure information development. For topographic information, local government may rely on information from the private and (semi-) public utilities. In a few instances local communities collaborated with a utility (e.g., MWRA) and in a few instances they had their own topographic project. The city of Newton, for example, contracted in 1994 and 1999 a private company to map their area. The town of Barnstable did this in 1995 (website MA Town of Barnstable).

Cooperation between local governments for the collection of large-scale topographics to take advantage of the economies of scale has not been found. One interviewee said it as follows: "The communication between towns about GIS is still at the 'grass-root' level and not so much at the decision-making levels."

Metropolitan area of Minneapolis and St. Paul
In the Metropolitan region of Minneapolis and St. Paul a wide variety of structures can be found that have created topographic datasets. The originator of the topographics varies from public (public-public partnerships), to public private partnerships (county-utility), to private. In Dakota, Scott and Ramsey County, county-wide topographics are collected by or with heavy involvement of the county. Also some utilities have topographics in place. However, the other counties (Anoka, Carver, Hennepin, Washington (see LMIC, 2004)) do not have, or limited topographic information.

20 The dataset that is discussed for Northrhine Westpahlia, the *Automatisierten Liegenschaftskarte*, is the same dataset as discussed in Chapter 8. The information concerning this dataset is also provided in this chapter in order to make it the reader easy to compare the different datasets.

Table 9.1 Organisational setting for topographic information provision in cases researched

	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Number of organisations responsible for large-scale topographic information	>68	35	54	–	–
Nature of organisations involved in topographic information	Public Private PPP	Public PPP	Public (PPP)	Private Public PPP	Public Public-public PPP

PPP = public-private partnerships
– = unknown

The coordination of the Metropolitan GII is in MetroGIS. MetroGIS relies on an informal voluntary structure for participants. Large-scale topographic information are not among MetroGIS priorities.

Organisational setting for topographic information in case summarised
Table 9.1 summarises the organisational setting.

9.4 Technical topographic information characteristics

This section builds on the theoretical framework provided in chapter 4. Technical data characteristics may be split in internal and external characteristics. The internal data characteristics decide the extent to which its primary and secondary users can use it. The external data characteristics may decide then the extent to which other users are able to use the dataset. This section provides the case study findings for the internal and external data characteristics of the researched parcel datasets.

9.4.1 Internal technical data characteristics

In chapter 4, the GII and user requirements for the internal technical characteristics of a dataset are provided. Content, positional accuracy, currency and update frequency, structure of the data, and consistency in the dataset's elements are among the dataset's internal technical characteristics. Here, the datasets found in the case studies are evaluated based on these elements and at the end of this paragraph the findings summarised.

Content
Denmark
Technical map series exists of TK1, 2, and 3. TK3 is the most detailed one used in urban areas. The TKs have among 55 different layers. TK1 includes buildings, house numbers, street names, place names, forest areas, urban areas, fences, land use descriptions, (small) lakes, and street centre lines (website DK Kortcenter). TK2 and TK3 are datasets with core content. They include full

Table 9.2 Content comparison per county dataset in MetroGIS

Content	Anoka	Carver	Dakota	Hennepin	Ramsey	Scott	Washington
Tax parcel boundaries	Y	Y	Y	Y	Y	Y	Y
Deed/title	Y	–	Y	Y	Y	Y	Y
Right of way plats	Y	–	Y	Y	Y	Y	Y
Building footprints	–	–	Y	–	Y	Y	–
Other planimetrics	–	–	Y	–	Y	Y	–
Building centroids	–	–	–	–	Y	–	–
Geocoded roads	–	–	Y	–	–	Y	–
Road names	Y	–	Y	Y	Y	Y	–
Road centrelines	Y	–	Y	Y	Y	Y	–

Source: LMIC, 2004

roads and waterways, and more detailed buildings. All datasets have the address theme included. TK3 includes a link through cadastral identifiers to the cadastral map.

Netherlands
The core dataset contains hard topography (buildings, constructions, paved roads), soft topography (waterways, most topographic boundaries as hedges, fences) and semantic information (street names, house numbers, names of waterways) (Murre, 2002). There are municipality datasets whose comprehensive content includes, for example, utility poles, and street furniture (see also GBKN, 2005).

Northrhine Westphalia
ALK contains parcel boundaries and numbers, boundaries of districts, survey control points, outlines of approximately 7 million houses and buildings, house numbers, street names, results from official soil assessment, type of land use and topographic details like kerbs, and cycle tracks (Hawerk, 1995, p. 19; see also OBAK, 2002; OSKA, 2003). Figure 8.5 shows an example of the ALK.

Massachusetts
The datasets available in Massachusetts contain hard topography (buildings, constructions, paved roads, road centre lines, bridges/tunnels), soft topography (waterways, swamps, lakes), administrative boundary information (state, town, county, zip code, tax zones, inspection zones, street right of way). Some datasets also include semantic information (street names, house numbers, names of waterways). Comprehensive datasets may also have included street trees, sidewalks, bus routes and stops, sewer/drain network, and property boundaries including easements (e.g., Town of Brookline). Figures 9.5 and 9.6 show examples of topographic mapping in Massachusetts.

Metropolitan area of Minneapolis and St. Paul
The content of the counties' topographic datasets that are available varies

Table 9.3 Content of the topographic datasets

	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Content	Core	Core-comprehensive	Comprehensive	None-comprehensive	None-comprehensive

from comprehensive (Dakota county) to core (Ramsey County) (see Table 9.2). Comprehensive information from Dakota county includes 64 layers including buildings, roads, street furniture, hydrants, gravel roads, road centre lines, sidewalks, flagpoles, parking lots, and mobile homes. Through the property identification number the dataset is also linked to the administrative information allowing searches on street name and house number. The core content of Ramsey includes Tax Map Labels, Parcels, Structures (building footprint), Bridges, Pavement Edge, Railroads, Street Centre lines, Trails, Lines of Interest, Depth to Groundwater, Other Schools, Public Schools, Parcel Addresses, and Municipality Names. The physical features include: airports, dams, water and water towers.

Content of topographic datasets summarised

Table 9.3 summarises the Content of the topographic datasets.

Positional accuracy

Denmark

The technical maps are available at a variety of scales. The following scales were found (AUC et al., 1999 and 2000; interviews):

- For TK3: 1:500/1,000 (urban areas)
- For TK2: 1:2,000/4,000 (rural areas)
- For TK1: 1:10,000 (rural areas).

TK3, 2 and 1 have a positional horizontal accuracy of better than 10 centimetres, 25 and 80-100 centimetres respectively.

Netherlands

The GBKN has a mapping scale of 1:500 or 1:1,000 in suburban areas and 1:2.000 in rural areas. The positional accuracy of the GBKN is 5 centimetres in the south of the Netherlands and the large cities for hard topography, to 20-40 centimetres in the rural areas for soft topography.

Northrhine Westphalia

Generally the scale of ALK is 1:1,000. However, because of historical reasons many other scales exist (1:500, 1:2,500) (website ALK lexikon; Manthorpe and Walker, 2001, p. 130). ALK has a positional horizontal accuracy of generally 20-30 centimetres.

Massachusetts

The research found the following scales for topographic data: 1:480-1:1,200 in the urban areas to 1:5,000 in the less populated regions. The accuracy varies from dataset to dataset. Generally, the horizontal positional accuracy varies from 76 centimetres for the 1:1,200 scales to several metres for 1:5,000 scales.

Metropolitan area of Minneapolis and St. Paul
Scale of the existing county datasets is generally 1:2,400 (urban)-1:12,000 (rural). Positional accuracy varies from 15 centimetres in one dataset to 64-300 centimetres in another.

Currency and update frequency
Denmark
The update frequency of the TKs varies between 1 and 3 years in urban areas (TK3 and 2) up to 6 years in rural areas (TK1).

Netherlands
The currency of the GBKN is one year in the urban areas, and two years in the rural areas.

Northrhine Westphalia
ALK' s currency is 2 years or more up-to-date (< 2 years). Generally, the ALK is daily updated (e-mail correspondence; website Geocatalog1). The Micus report (2001b, p. 9), however, mentions the currency of the information as a barrier. Because of limited budgets and personnel, some counties are not able to create the ALK on time. As a result the quality of ALK may be different in different ALK datasets. Micus (2003, pp. 8, 43) found that it might take years before new buildings are included in the ALK.

Massachusetts
The currency in the datasets varies from 1991 to 2003.

Metropolitan area of Minneapolis and St. Paul
In one county, the update frequency varies from every 3 years to every year for specific highly dynamic areas. Non-dynamic areas are less frequently renewed (some areas latest information dates from 1989, see website MN Dakota County1). Other counties creating topographic information are working on an ad hoc basis.

Data structure
Denmark
The TKs are in vector format with spaghetti data structures (Daugbjerg et al., 2001; interviews). In specific instances, users may have converted the spaghetti structure into polygons.

Netherlands
GBKN is available in vector format. For webmapping services this information was converted to raster format (Van Eekelen, 2004). The dataset has a spaghetti structure, although certain parts have an 'area' structure. There is

discussion about upgrading the GBKN to an object-oriented dataset. However, the utilities only use the information for viewing and referencing their own information to the topography and do not require object-orientation.

Northrhine Westphalia
The ALK is available in analogue and digital format. When the information is in digital format, it is in vector format and object oriented. Also the multiple meaning of data elements is kept, for example, when a parcel boundary is also an administrative boundary (Köln, 2004).

Massachusetts
There are topographic datasets available in vector format. The structure of the dataset varies from object oriented to spaghetti structure with in some instances an object orientation (polygons) for one type of objects and a spaghetti structure for others. According to interviewees, these datasets have clean topology.

Metropolitan area of Minneapolis and St. Paul
Datasets have spaghetti structure with in at least one for some objects polygons. All information has coordinate geometry (COGO).

Consistency in dataset(s)
Denmark
Topographic information collection and processing is generally adhering to the national standard data model: the *Specifikationer for Tekniske kort* (see AUC et al., 1999 and 2000). The specifications developed overtime (TK1988, TK1990, TK 1993, TK1999, TK2001 or TK 2003 (website DK clearinghouse). For example, the Specifications for Technical Maps have been revised radically to adapt them to an object-oriented model conception (Daugbjerg et al., 2001). Thus, each standard is unique and uses different specifications. TKs with different specifications have different characteristics. An example of an upgrade of a standard is found in the standard of TK1. In the 2003 version all visible elements (larger than 10 m^2) are mapped. The previous standard only requires the inclusion of objects larger than 25 m^2.

Despite the national model, there is no consistent uniform topographic dataset for Denmark: the TKs exists generally in three different qualities (TK1, TK2 and TK3) and therefore the maps do not form a homogenous nationwide product. The quality varies from area to area, adhering to different versions of the specifications since not all TK producers have already adapted their information to the latest standard. Further, interpretation of the specifications is up to the municipalities. They may, for example, choose to leave features out, which they may do out of lack of resources or because of different priorities. This has resulted in technical maps of different quality; the technical maps are not uniform throughout the country (TK1 in Jutland ≠ TK1 in Sjaelland).

Consequently, the demands on the geometric connection, accuracy and completeness of the map features have been substantial (Daugbjerg et al., 2001).

The specifications in AUC et al. (1999 and 2000) require that the technical information is linked with the information from the Danish registers for the building number and the national road register for the name of the road. The TKs, however, do not align always with the cadastral dataset or the top10dk. The Common Object Type (FOT) project aims to make the collection and processing of the information of 20 common features of the top10dk and the technical maps more efficient (Brande, 2002a).

Netherlands

The GBKN covers the Netherlands completely. However, currently, the GBKN is not uniform with respect to the structure and content specification, and the process of updating. Especially where regional areas are adjacent there may be overlaps of information, or information may not fully fit. In 2000 and 2001 guidelines were provided to uniform the structure, content specification and the organisational structure for updating the GBKN (Murre, 2002). However, the GBKN in Southern Netherlands still has the so-called 'staple map' showing only the front of the buildings, and only includes buildings within 35 meter from public roads (see Figure 9.1 and Figure 9.2).

Northrhine Westphalia

There is no consistent digital parcel dataset for Northrhine Westphalia. This is explained by the 87% coverage of the Statewide digital dataset. Over the past years significant progress has been made in integrating the local datasets into one state dataset. However, the content is consistent throughout Northrhine Westphalia. The logical consistency is conform state guidelines (OBAK, 2003) with optionally local supplements. This logical data structure of ALK describes the data geometry on the line and point levels. The appointment of object keys (described in the OSKA, 2002), that are applicable to all cadastre agencies in Germany, established the semantic elements (meaning).

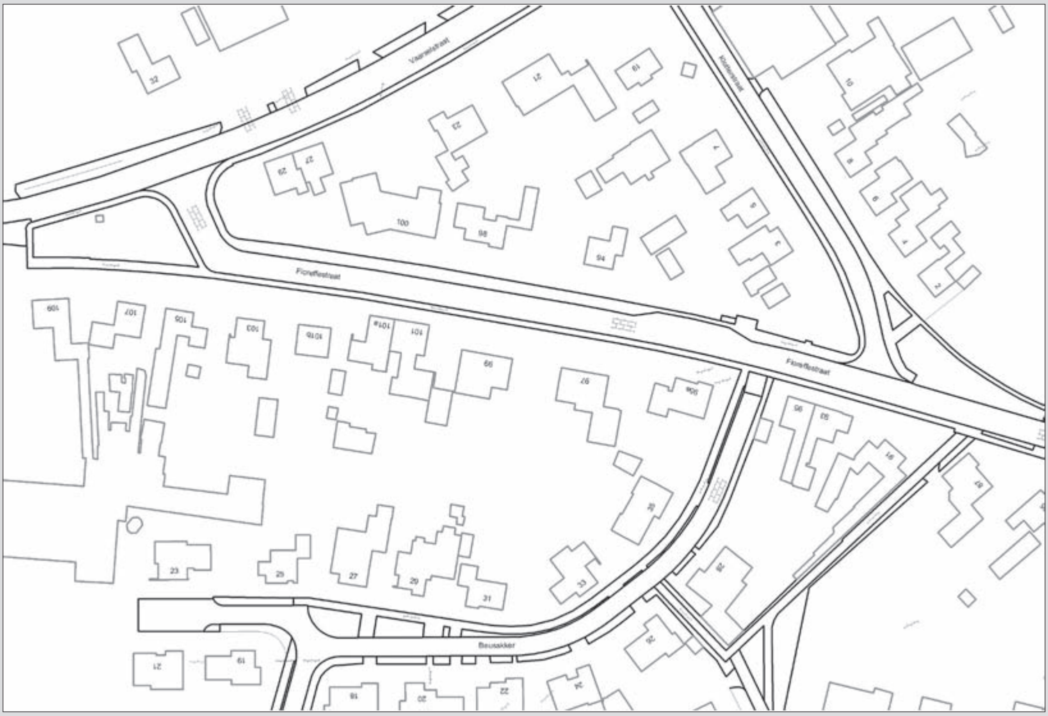
Massachusetts

There is no consistent uniform topographic dataset for the entire Massachusetts available. Data models, specifications, standards, exchange format, among others varies from dataset to dataset, if any exists.

Metropolitan area of Minneapolis and St. Paul

There is no consistent uniform topographic dataset for the entire Metropolitan area. There is not a common data model or data specifications. Datasets, if any, vary from source to source.

Figure 9.1 The standard GBKN



Source: LSV GBKN

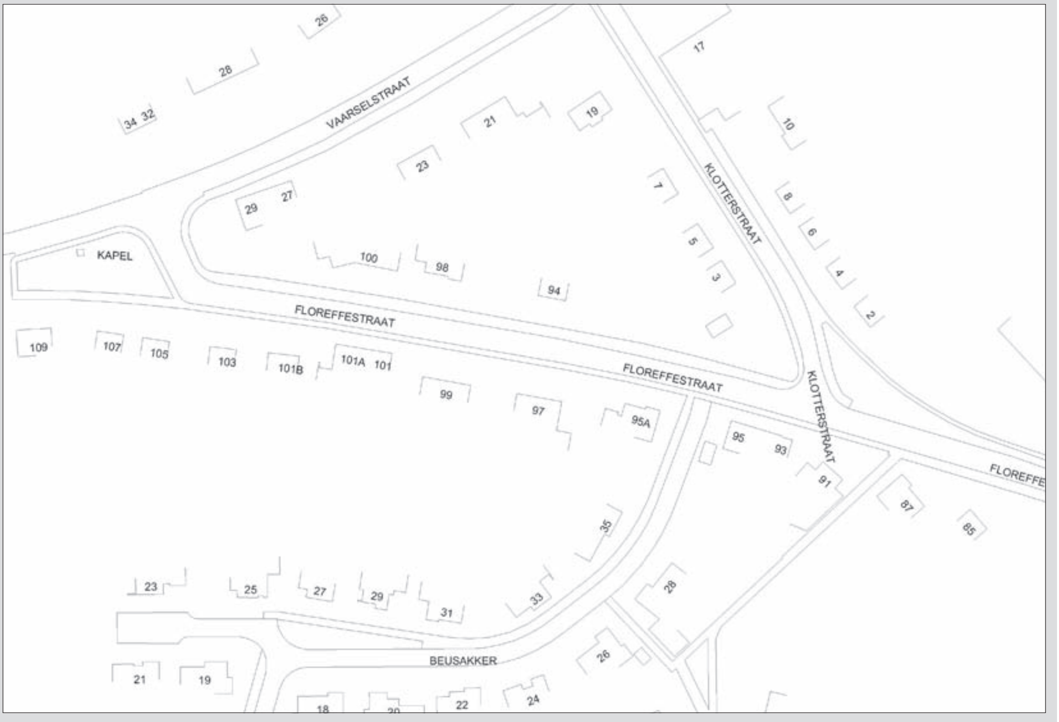
Internal technical data characteristics summarised

The internal quality is composed of the positional accuracy, the currency and update frequency, data structure and the consistency within the dataset.

In four cases, for the urban areas the positional accuracy compares very well with each other: Denmark, the Netherlands, Northrhine Westphalia and Metro. In Massachusetts less accurate information seems to be sufficient. In the rural areas, the information in Metro is significantly less accurate than the information in the European cases. In the European cases, the topographic information is periodically updated with a comparable update frequency (1-3 years). In the US cases, updates are in many instances ad hoc, related to available moneys and therefore it is not surprisingly that public sector entities sometimes are using more than 10-year-old topographic information. In Metro, the update frequency of more than 10 years may be explained by the dynamics of a certain area. This is an indication of efficient resource management.

None of the cases has shown consistent uniform topographic information for the complete jurisdiction. In three cases, there is no complete digital coverage and in the other two cases (Denmark and the Netherlands) content, data specifications, and data structure may vary from source to source (see Table 9.4).

Figure 9.2 The 'staple' GBKN in the South of the Netherlands



Source: LSV GBKN

9.4.2 External technical data characteristics

In Chapter 4, the GII and user requirements for the external technical characteristics of a dataset are provided. Scale or resolution, the area a dataset covers, the level of interoperability, documentation of the metadata and sustainability of the technical data characteristics are part of a dataset's external technical characteristics. Here, the datasets found in the case studies are evaluated based on these elements and at the end of this section summarised.

Coverage

Denmark

Together, the datasets of the utilities and local government cover Denmark completely. It requires the integration of 68 datasets. Not one party has initiated the integration of the individual TKs into one seamless national TK.

Netherlands

The GBKN consists of 35 datasets, which cover the Netherlands entirely. It is expected that in 2006 the 35 datasets align with each other so that one seamless national product can be acquired. The information collection and maintenance remain at the source (decentrally).

Table 9.4 Internal technical data characteristics of topographic datasets

	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Content	Core	Core-comprehensive	Comprehensive	None-comprehensive	None-comprehensive
Horizontal positional accuracy (cm.)	10, 25, 80/100	5-10 urban 20-40 rural	20-30	None/50-300	None/15/65-300
Currency (years)	1-6	1-2	1	None/2-10	None/1-10
Data structure	Spaghetti/object	Spaghetti	None-object	None-object	None/spaghetti/object
Quality consistency throughout the (integrated) dataset	Poor	Sufficient	Reasonable	None	None

Northrhine Westphalia

Together, the datasets of the 54 Cadastres cover Northrhine Westphalia entirely. Some parts of these local datasets, however, are only available in paper format. In addition, the Landesvermessungsamt NRW and the local authorities is working towards a single layer for Northrhine Westphalia. In 2005, this harmonised ALK dataset had approximately 87% digital coverage (website Stand ALK).

Massachusetts

For topographic information government relies heavily on the datasets collected by the (private) utilities. Information at the large-scales exists for the Boston area from several sources including one private utility and one semi-public utility and several towns or cities have created their own topographic dataset. Other regions of Massachusetts may rely on the MassGIS' 1:5,000 colour orthophotos, the 1:5,000 scale street network, 1:12,000 scale wetland information, topographic contours (3 m interval) and zoning information which has variable scale sources but was developed for town-level planning purposes. Each of these datasets cover Massachusetts entirely. However, at larger scales not one dataset covers Massachusetts entirely. "The cities and towns that have large-scale topographic information are either (a) rich or (b) better managed" as one interviewee has put it. It is unclear to what extent it is possible to acquire information that together has full large-scale topographic coverage of Massachusetts.

Some towns use information collected in 1991, or 1995 as their core topographic dataset, just because they were unable to collect the information themselves. Several local communities have checked their old information with the more recent and freely downloadable 2001 colour 1:5,000 imagery from MassGIS. One interviewee indicated that the 1:5,000 (1":480', with metre accuracy) imagery of MassGIS is insufficient for local purposes. Towns typically need 1:1,200 with 77 centimetre accuracy.

Metropolitan area of Minneapolis and St. Paul

In several Metropolitan counties topographic information is unavailable. On-

Table 9.5 Coverage of the digital topographic datasets

	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Coverage area	DK	NL	NRW	MA	Metro
Number of datasets for jurisdiction coverage	68	28	54	–	–
Digital coverage (in vector format)	100	100	87	–	≈40%*

* Percentage accounts for the areas of Dakota County, Ramsey County and Scott County.
– = unknown/not possible

ly three counties have full topographic coverage. In other counties the topographics may be available for individual towns or cities.

Findings for coverage of topographic datasets summarised
Table 9.5 summarises the findings for coverage of the topographic datasets.

Interoperability
Denmark
The datasets are in the national coordinate system (the Reference System 34/45 ed50). The datasets adhere to varying versions of the national standard model (see section 9.4.1.5). No attempt has been initiated to integrate the individual TKs with each other. Especially in Sjaelland it is expected that difficulties in the geometric and semantic connection between the datasets will appear. In specific instances the topographic information aligns very well with the parcel information and imagery (see Figure 9.3).

The technical maps are available in the *Dansk Selskab for Fotogrammetri og Landmåling et Forslag* (DSFL) exchange format. Not all datasets are conformant to the latest version of the DSFL standard. The maps can further be delivered in proprietary exchange formats.

Netherlands
GBKN uses the national coordinate system (*Rijksdriehoeksmeting* (RD)) as the reference network. The exchange format and data model are based on national open format (NEN 1878) and standard (NEN 3610). The GBKN consists of 35 datasets. However, one municipality has integrated eight of these individual datasets into one. Thus, in practice the GBKN consists of 28 separate datasets. These datasets generally align with each other. It is expected that in 2006 the GBKN is one seamless national product.

The buildings of the GBKN are used in the cadastral dataset (map) and align very well. In instances where the Kadaster maintains the GBKN, the GBKN and the cadastral information are in one database.

Northrhine Westphalia
The ALK uses the national reference system (Gauss-Krueger projection, Bessel ellipsoid and the Potsdam Datum). The standard exchange format is the *Einheitliche Datenbankschnittstelle* (EDBS). The structure is published. The informa-

Figure 9.3 Example of Danish Tekniske Kort: Grundkort Fyn

Source: Grundkort Fyn

tion is also available in proprietary vector formats.

Despite the use of a common standard, it has been reported that the use of heterogeneous software systems within cities and counties is a barrier for the access and use of the ALK (Micus, 2001, p. 9).

The topography in ALK aligns with the parcel information.

Massachusetts

The datasets researched use the state coordinate system.

The software used is proprietary and so are the exchange formats, which vary per dataset. The data models used are not standard and specific to company operations. This implies that, for example, naming conventions/designations may differ from dataset to dataset.

The alignment of topographic datasets varies from excellent (Newton) to approximate (Boston) to no alignment (paper information). The alignment between datasets from different sources is unclear. Some examples below may provide some insight.

In Figure 9.4 two aerial photos of the same area are shown. The City of Newton uses the left image, and the City of Boston the right image. Figure 9.5 shows the topographic information of the same area for again the City of Newton and the City of Boston. Linking both datasets to each other is likely to result in gaps, and/or overlaps in the new dataset.

Even within one local jurisdiction information does not need to align with each other. For example in the Town of Brookline, the aerial imagery does not align with topographic information (see Figure 9.6).

Metropolitan area of Minneapolis and St. Paul
The datasets available are referenced to the county coordinate systems. On request the information will be converted to the state coordinate system. The datasets are available in proprietary exchange formats.

In Dakota County the parcel and topographic dataset align, but the orthophoto does not always. In Ramsey County no link exists between the parcel dataset and the topographics. So there is no relation between the location of a building and the parcel that it is located within: the topographic layer does not align with the parcel dataset (see example Ramsey County in 8.2.2.3).

Interoperability of topographic datasets summarised
Table 9.6 summarises the interoperability.

Documentation of metadata

Denmark
In many instances, the metadata documentation of the TKs is incomplete, and not published. Within the municipalities the lack of metadata documentation is not evident since the use of the information is limited to the primary (Danish) users: municipality employees, and utility companies. The clearinghouse service provides the metadata of 36 (of the 68) datasets in Danish.

In the Danish clearinghouse, the following metadata is specified: purpose, intended application scale, usage, information type, information language, reference documents, sample of the information, source, horizontal accuracy, temporal accuracy, geographic reference system, geographic area, objects and attributes, restrictions on use, copyright owners, data exchange format, online access, responsible organisation, and contact information (see website DK clearinghouse). The price of the information is published for the counties of Jylland and Fyn, and the Kommunen Roskilde, Gladsaxe, Herlev, and Albertslund (website DK clearinghouse). The clearinghouse also refers to sites of the owners of the intellectual property rights.

Figure 9.4 Municipality boundary of Newton (Middlesex County) with Brighton (Suffolk County)

Source: City of Newton, Massachusetts, USA

Produced by courtesy of the Boston Atlas website, Boston Redevelopment Authority, Boston, MA, USA

Netherlands

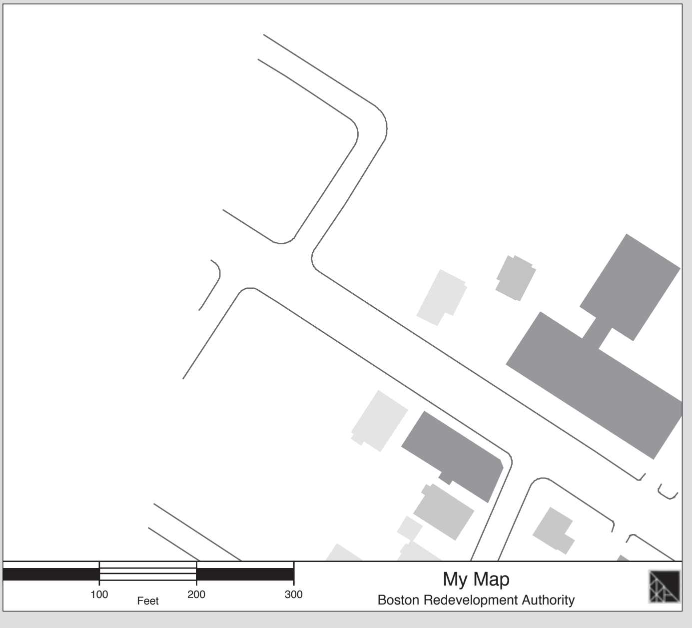
GBKN has core metadata documented. No metadata standard is used and it is only available in Dutch.

The GBKN website provides the following metadata: dataset title, abstract of the content, possible use of the dataset, content, data type, reference sys-

Figure 9.5a Topographic dataset of the City of Newton

Source: City of Newton, Massachusetts, USA

Figure 9.5b Topographic dataset of the City of Boston



Produced by courtesy of the Boston Atlas website, Boston Redevelopment Authority, Boston, MA, USA

tem, on-line resource, and examples of the dataset.

The reference document GBKN product specifications (GBKN, 2005a) provides additional metadata about the content of the information.

For the web-application (raster data) prices are published on the website.

Figure 9.6 Alignment between parcel and building information (left) and building information and aerial (right) at Goddard Avenue, Town of Brookline (MA)

Source: Town of Brookline, a Municipal Corporation located in Norfolk County, Massachusetts, USA

Northrhine Westphalia

Metadata documentation varies heavily throughout Northrhine Westphalia and often no metadata is documented. The City of Bochum, however, has documented the scale, language, content, data of metadata creation, quality aspects of the information (positional accuracy, currency, logical consistency, reference data, among others), prices and use restrictions, and contact information (see website ATKIS).

Currently a GDI-NRW working group metadata defines a common concept for metadata collection in the cadastre. This concept will consider the metadata profile currently developed at the AdV-level.

Massachusetts

Metadata documentation in the topography varies throughout government agencies in Massachusetts from comprehensive to not documented. Metadata in the utilities' information is poor.

Metropolitan area of Minneapolis and St. Paul

The metadata in the topographic datasets is documented with adherence to the state standard Minnesota Geographic Metadata Guidelines (MGMG). The completeness of the metadata fields varies from dataset to dataset. In Dakota County the metadata documentation uses the MGMG standard as far as the metadata is available. Most fields are filled in, including an explanation of the attributes, and their feature codes. Geographic reference information is complete, distribution information included, and lineage is described to some extent (see website MN Dakota County2).

In Ramsey County the metadata documentation uses the MGMG standard as far as the metadata is available (see e.g., website MN DataFinder Ramsey).

Metadata documentation for topographic information summarised
Table 9.7 and 9.8 summarise the metadata findings.

Sustainability of qualities

Denmark

The public sector, often with the private and (semi-) public utilities, has invested substantially in large-scale topography. The collection of large-scale topography is, however, not the legislated tasks of a public sector entity. Legislation does not require its' creation. Some parties collect the information on an ad hoc basis; others periodically renew their information.

Although in several instances municipalities cooperate, there have not been initiatives found for integrating the existing TKs into one seamless national dataset.

Netherlands

There is no legal obligation for anyone including government to collect, process and manage topographic information. The National Joint Venture *Grootschalige Basiskaart Nederland* (GBKN) oversees the overall progress of the GBKN for quality and policy parameters. The participants in GBKN agreed to adhere to the GBKN product specifications (see GBKN, 2005a) allowing for a certain sustainable and harmonised quality of the dataset.

The GBKN is in the process to become part of the national Authentic Registration program (see GBKN, 2005b), which will make it the preferred source for government for large-scale topography with guaranteed qualities and a single access policy.

Northrhine Westphalia

The information collection and creation of ALK is anchored in legislation, guaranteeing to a great extent the existence, availability and quality of the dataset (see *Katastermodernisierungsgesetz*, 2005; *Vermessungs- und Katastergesetz* (VermKatG NW (par. 9) see also: website LVA). The dataset has a seal of authority (Brox et al., 2002).

Massachusetts

The collection of large-scale topography is not the legislated tasks of a public sector entity. The private and (semi-)public utilities, however, have invested substantially in large-scale topography. Occasionally local communities collaborated with a utility and in a very few instances they have had their own topographic project. With few exceptions, large-scale topographic information collection is on an ad hoc basis.

Metropolitan area of Minneapolis and St. Paul

The collection of large-scale topography is not the legislated tasks of a public

Table 9.7 Metadata documentation in topographic datasets

Metadata documentation	Parcel dataset	Denmark	Netherlands	Northrhine Westphalia[1]	Massachusetts[2]	MetroGIS (Minnesota)[3]
Metadata documented on the internet	core					
	dataset title	Y	Y			
	dataset reference date	Y	Y			
	dataset language	Y	–			
	dataset topic category	–	–			
	abstract describing dataset	Y	–			
	metadata point of contact	–	–			
	metadata date stamp	–	–			
Conditional core metadata	dataset character set	Y	Y			
	geographic location of dataset	Y	Y			
	metadata language	–	–			
	metadata character set	–	–			
Optional core metadata	dataset responsible party	Y	Y			
	spatial resolution of dataset (scale)	Y	–			
	distribution format	Y	–			
	additional extent information for the dataset	–	–			
	spatial representation type	Y	Y			
	reference system	Y	Y			
	lineage	–	–			
	on-line resource	Y	Y			
	metadata file identifier	–	–			
	metadata standard name and version	–	–			
Comprehensive metadata	detailed information about the technical quality of the dataset	Y	–			
	the use and access restrictions imposed	–	–			
	standard order process information (contact information)	Y	Y			

1 Metadata varies between the 54 datasets from none to comprehensive.
2 Metadata varies among datasets in Massachusetts.
3 Metadata varies among datasets in MetroGIS.

Source Denmark: website DK clearinghouse

Table 9.8 Metadata documentation in the topographic datasets

	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Metadata documentation	None/core	Poor	None-comprehensive	None-comprehensive	None-Comprehensive
Metadata standard	State standard	None	None	None	None/state standard
Metadata language	Danish	Dutch	German	English	English

sector entity. In one county new information creation is based on the extent of change in physical features (dynamics) of the jurisdiction. Other counties that do collect topographic information do it on a more ad hoc basis.

External technical data characteristics summarised

The external qualities are composed of the scale, coverage of the dataset, the content, its interoperability characteristics, the metadata documentation, and the sustainability of the technical characteristics of the dataset. Table 9.9 summarises the external technical data characteristics for the cases.

Scale in the available datasets is generally in the range of 1:1,1000 for urban areas. Rural areas in Northrhine Westphalia and the Netherlands are mapped on a larger scale than those in the US cases, and Denmark.

In only two jurisdictions one may obtain large-scale topography that fully covers the jurisdiction subject to this research: in Denmark and the Netherlands. In Northrhine Westphalia only a small percentage is in analogue format, and the Landesvermessungsamt in cooperation with local government has managed to create a topographic digital dataset covering 87% of Northrhine Westphalia so far. In Metro and Massachusetts, significant percentages of government do without large-scale topographic information.

In the European cases, special national transfer formats have been developed, although the information is also available in proprietary formats. In the US cases topographic information is only provided in proprietary formats.

The datasets that are published in the Danish clearinghouse have comprehensive metadata documented. However, not all large-scale topographic datasets are provided in the clearinghouse. The Dutch dataset has limited non-structured metadata documented, where in the other jurisdictions the metadata in the datasets varies from non-existent to comprehensive.

None of the datasets, except the ALK in Northrhine Westphalia, has the seal of authority.

Because of the decentral nature of the datasets in a jurisdiction, the datasets are not necessarily interoperable with each other, either in geographic context (gaps/overlaps) or in data model used, among other characteristics. In the Netherlands and Northrhine Westphalia one organisation supervises this integration process, while in Denmark, Metro, and Massachusetts the separate datasets are still stand-alone datasets. The Dutch GBKN requires users to integrate the 28 datasets by themselves. However, most of these datasets align already very well and it is expected that in 2006 the GBKN is seamless. However, although significant progress has been made to address the gaps/overlap

Table 9.9 External technical data characteristics of the topographic datasets summarised

External qualities	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Coverage area	DK	NL	NRW	MA	Metro
Digital coverage (vector format)	100%	100%	87%	66%	<40%
Number of datasets for jurisdiction coverage	68	28	54 (1)	N/A	N/A
Standard adherence	National jurisdiction wide/De facto (proprietary)	De facto/ jurisdiction wide (open and proprietary)	De facto/ jurisdiction wide (open)/none	De facto/ jurisdiction wide (proprietary)/ N/A	De facto/ jurisdiction wide (proprietary)/ N/A
Data model	Varying versions of national standard	De facto/ Jurisdiction wide harmonised	De facto/ jurisdiction wide harmonised/ none	Stand alone/ N/A	Stand alone/ N/A
Metadata documentation	None-comprehensive	Poor	None-comprehensive	None-comprehensive	None-comprehensive
Quality assurance	Project based	Project based	Seal of authority backed by legislation	Project based	Project based

N/A = not available

problems, and the content of the dataset is not harmonised. Also Northrhine Westphalia is working actively towards one seamless dataset. They are in the process to obtain 100% digital coverage for topography included in one dataset. Users interested in jurisdiction-wide topographic information coverage for Denmark need to integrate the available datasets by themselves. In addition to the integration, users of the datasets in Massachusetts and the Metropolitan region of Minneapolis and St. Paul need to collect large-scale topographic information for significant portions of these jurisdictions by themselves to obtain full coverage of these jurisdictions.

Generally, the collection of topographic information is not formalised in legislation. Northrhine Westphalia is the exception where the parcel mapping is extended to topographic objects. In all other cases, the collection of topographic information is voluntarily.

9.5 Non-technical data characteristics

This section builds on the theoretical framework provided in chapter 5: the non-technical data characteristics. Here the following non-technical data characteristics of the researched topographic datasets are provided: the legal accessibility, the financial accessibility and the physical accessibility of the topographic datasets.

9.5.1 Legal access

Legal accessibility consists of legal means to enhance access and legal means to restrict access.

Enforceable access

Denmark

According to interviewees, the large-scale topography is not subject to the freedom of information act or any other access legislation. It was explained that for geographic information, it is critical to understand that the Danish freedom of information act rules about cases. A case is a government decision about some person, or information, which can easily be related to that person. Geographic data (maps) are not considered cases. Therefore, it is reasoned that the Danish Freedom of Information Act does not apply to geographic data; the technical map is not subject to the freedom of information act.

Netherlands

The public-private partnership of GBKN ensures that access to the complete GBKN cannot be enforced through a freedom of information act request. However, individual datasets especially those fully owned by government entities may be subject to the Dutch' Freedom of information act (*Wet openbaarheid van bestuur*) (see Daalder, 2005, p. 96; Raad van State, 1986).

Northrhine Westphalia

The ALK is subject to the Cadastre Act (*Katastermodernisierungsgesetz*, 2005). Access to the entire ALK may be enforced through a request to the Cadastre Act. Access to the administrative information (ALB) is not open to the public because of privacy restrictions. A legitimated interest must be shown to access the information.

Massachusetts

State, municipal, and county government have to comply with the provisions of the Massachusetts Public Records Law. Access to government information must be provided on request. Utilities, however, are under no obligation to give their information to anyone. Access to their information cannot be enforced through a request through the public records act.

Metropolitan area of Minneapolis and St. Paul

Data classified as public information must be provided upon request. This also applies to public information with a commercial value. Large-scale topographic information are classified as public information with a commercial value. Partnerships with private entities, for example utilities, do not impact the applicability of the Minnesota Statutes.

Intellectual property rights

Denmark

The municipalities and utility companies claim copyright and database rights.

Netherlands

The LSV GBKN or the self-registering municipalities claim copyright and database right in the dataset.

Northrhine Westphalia

All local governments in Northrhine Westphalia claim copyright and database right in their information (see, for example, website LVA1).

Massachusetts

Utilities control the use of their information through copyright and additional use restrictions. Government entities provide the information without copyright. Although it is not prohibited, local governments and state agencies do generally not copyright information.

Metropolitan area of Minneapolis and St. Paul

The counties, public private partnerships, or public-public partnerships claim copyright in the topographic datasets.

Use restrictions

Denmark

Use of the TKs is restricted to one's own purposes and redistribution is prohibited.

Netherlands

The contract arranges for notification of the GBKN organisation as source of the information. No redistribution is allowed without permission. The use conditions are similar throughout the Netherlands and uniform for requests for the entire dataset.

Northrhine Westphalia

In Northrhine Westphalia users of public geographic information are granted a limited use right as described in the copyright act (*Urheberrechtsgesetz*) and further in the Cadastre Act (VermKatG NW: §3 Abs. 1).

Information (Ergebnisse) from local government can only with permission of the concerned organisation be multiplied, made public, or provided to third parties. Copies and processing the information for internal use are permitted. This also applies to digital information (see *Katastermodernisierungsact*, 2005, §5(2)).

The *Landesvermessungsamt* further requires that the text *Copyright-Vermerk*

© *Geobasisdaten und/oder Topographische Karten: Landesvermessung NRW, Bonn* is added to the dataset for use in presentations and copies of the provided dataset (website LVA1).

Massachusetts

Data of the utilities is provided under the condition of non-disclosure. Information from the towns or cities are provided without use restrictions.

Metropolitan area of Minneapolis and St. Paul

A license is necessary for the use of topographic information. None of the information can be redistributed to a third-party.

Privacy

Denmark

The EU Directive on the protection of individuals with regard to the processing of personal information and on the free movement of such information (EU, 1995) has been implemented in Danish legislation. Current interpretation by the interviewees is that privacy legislation does not apply to the use of the datasets.

Netherlands

The EU Directive on the protection of individuals with regard to the processing of personal information and on the free movement of such information (EU, 1995) has been implemented in Dutch legislation (*Wet bescherming persoonsgegevens*). The GBKN includes personal information in the context of the Wet bescherming persoonsgegevens and therefore has to meet the provisions of this Act (Zuurmond and De Vries, 2002). Interviewees, however, stated that privacy is no issue in the use of the GBKN dataset.

Northrhine Westphalia

The new *Katastermodernisierungsgesetz* (2005) arranges that the geographic framework information, including the parcel dataset, can be provided for any use if the ownership information (e.g., name and birth date) is taken out. Apparently this privacy constraint only applies to ownership information and not to land use (living) information given the sales of such a product by the Northrhine Westphalia *Landesvermessungsamt*.

Previously, "ALK [was] accessible to the general public in accordance to the rights of protection of individual interests (privacy). Person-related information can be provided to users with a special interest, e.g., in buying a parcel. Not person related information is accessible to all without any restrictions" (Hawerk, 1995, p. 18).

Massachusetts
Interviewees indicated that privacy law does not apply to large-scale topographic information.

Metropolitan area of Minneapolis and St. Paul
Interviewees indicated that privacy legislation does not limit the use of large-scale geographic information.

Liability
Denmark
The utilities waive liability. The municipalities do not include a liability waiver in the contract.

Netherlands
The GBKN organisation(s) waive liability.

Northrhine Westphalia
–

Massachusetts
The utilities waive liability.

Metropolitan area of Minneapolis and St. Paul
The counties or other topographic information producers waive liability.

Legal access to topographic information summarised
Table 9.10 provides an overview of the legal accessibility of the topographic datasets. In none of the cases topographic information covering an entire jurisdiction can be acquired through legislation. In four of the five cases this is because of the involvement of semi-public or private utilities in the collection and processing of the topographic information. The involvement of the utilities is further one cause for the restrictive access policies that were found in all cases; topographic information is only provided on the condition of no redistribution to third parties and against cost recovery prices.

Privacy legislation has only in Northrhine Westphalia an impact on the use of the dataset.

9.5.2 Financial access

Denmark
Generally, the TKs are available for a fee of approximately 85 DKK (€11) per ha (incl. VAT) for urban areas, and 5 DKK (€0,65) per ha (incl. VAT) for rural areas (see, for example, website DK Kortcenter, website DK Grundkort Øst, web-

Table 9.10 Legal access to the topographic datasets

Legal access	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Access legally enforceable?	Yes, for insignificant parts of the dataset/No*	Yes, for insignificant parts of the dataset/ No*	Yes, for insignificant parts of the dataset	Yes, for complete topographic dataset/No*	Yes, for complete topographic dataset/No*
Use restrictions?	Use restricted to internal purposes	Use restricted to internal purposes	Use restricted to internal purposes	Use restricted to internal purposes* (none)	Use restricted to internal purposes
Privacy legislation limiting the use	N	N	Y	N	N

* For information from utilities.

site Grundkort Fyn), the price of the technical information of Denmark (urban area: 250,376 ha, rural area: 2,023,818 ha) would be over 40 million DKK (€5,200,000). The price of 12,5% of the updating cost would result in an annual 5 million DKK (€650,000) for updates.

However, individual municipalities or other information providers may have different prices. The towns of Herlev and Gladsaxe start with a 1000DKK (€129) fee and charge in addition 150DKK (€19) per ha (website DK clearinghouse). In many instances, the TKs can freely be viewed on the internet.

On request, government should indicate the calculation basis for the published charge (EU, 2003 article 7).

Netherlands

The complete dataset can be bought for €1-2 million. On-line viewing information can be unlimited for €150,000 per year. For smaller areas there are separate fees for rural, urban and infrastructural datasets. Fees are in the range of €38 per ha for urban areas (Hoefsloot, 2005), and approximately €5 per ha for rural areas (see website GBKNa). Individual municipalities may have higher prices (see website GBKNa). According to one interviewee the dataset is not regarded as a source of income. The total cost by far outweigh the total number of sales and revenues. The dataset is in the very first place necessary to fulfil the (public) tasks of the participating organisations, and not so much generating money from sales. The LSV, however, created a marketingplan to promote the use of GBKN (Van Eekelen, 2003). The different joint ventures and self-registering municipalities may have different prices. If the public records act applies to the dataset (see section 9.5.1.1), it does not imply anything about prices (see Tweede Kamer, 1988-1989; Tweede Kamer, 1989-1990). On request, government should indicate the calculation basis for the published charge (EU, 2003 article 7).

Northrhine Westphalia

The *Katastermodernisierungsgesetz* (2005, par. 4) rules that access of the ALK within government is without cost. The free access provision doe not apply access for commercial purposes. For commercial purposes the *Gebührenordnung* (VermGebO (2002 and 2004)) still rules for the fee for information of the Cadastre (VermKatG NW, par. 13 (5)). Hawerk (1995, p. 18) states that the provision of ALK is "more or less based on cost recovery" (see also Micus, 2003, p. 74). There is a standard fee of €75 for vector information (VermGebO: 2.3.6). Further, the fee for the information depends on the category of the layers, the information density, the size of the area requested and the format requested (analogue, vector, raster). Further, there are different fees for different uses. The fee schema provides the fees for the EDBS format. Fees for other formats are in percentages of the EDBS fee. Moreover, legislation rules that no fee is assessed for municipalities belonging to the same county (*Kreis*) (if the fee cannot be charged to third parties) for direct access to information (VermGebO NRW: 40; the VermGebO NRW (2002, 2.3.5; 2004, article II (25))). Further, the Land NRW does not have to pay a fee for ALK information if the information is necessary for the execution of *Länder* tasks (after par. 12(7) VermKatG). Finally, universities may obtain free access to the dataset for academic uses.

The fee schedule in the fee ordinance is related to the number of hectares requested starting with a fee for 1-500ha (see VermGebO, 2002, par. 2.3.2.1.1). The fee per ha varies from €4-€15 per ha for requests not exceeding 500 ha (VermGebO, 2002, art. 2.3.2.1.1). The standard ALK costs for more than 200,000 ha €1 per ha (VermGebO, 2004, art. II (12)). ALK information with full coverage of Northrhine Westphalia would cost approximately €3,400,000. Yearly updates cost 15% of the initial fee (VermGebO, 2002, art. 2.3.5.2). This would approximately be €510,000.

In certain parts of Northrhine Westphalia local government cooperates through contracts with utilities. The utilities finance the creation and maintenance of ALK, and can use the information freely (Micus, 2003, p. 42).

On request, the counties should indicate the calculation basis for the published charge (EU, 2003 article 7).

Massachusetts

Financial access to large-scale topographic information is heterogeneous. For copies of government information a reasonable fee to recover the costs of complying with a public records request may be assessed. Local government generally provides access to their information for a price covering the cost of providing the information, i.e. $50-$100 per CD. However, for many large-scale topographic information the public records act is not available. One utility has provided its information to local government for a symbolic 1 dollar, others charge per ha 40% of the collection cost. Such a dataset would cost $20,000 for the typical sized town (<170 km^2) (approximately €1.10/ha (1/5/2005)).

Metropolitan area of Minneapolis and St. Paul

Counties provide access to their information on a cost recovery basis. Dakota county charges for topographic information of urban areas costs $550/sq. mile (= $2.12/ha= €1,60/ha) and of rural areas €$20/sq. mile (= €0,06/ha). The complete dataset would cost $29,000 (€22,000), and subscription to annual up-

Table 9.11 Financial access to the topographic datasets

Financial access	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Price complete dataset for private sector	CR € 5,200,000*	CR € 1-2 million	CR € 3,400,000	CR/OA N/A	Partial CR N/A
Price per ha (urban)	€ 11	€ 38*	€ 4-15**	€ 0 – 1.10	€ 1.60-11.41
Price per ha (rural)	€ 0.65	€ 5*	€ 4**	€ 0 – 1.10	€ 0.06
Price of yearly updates	€ 650,000*	€ 510,000	–	–	–
Price complete with limited use rights	–	€ 150,000 (webviewing)	–	–	–

N/A = not available.
CR = full cost recovery.
OA = ≤ marginal cost of dissemination.
* Approximate figures.
** For requests < 200,000 ha.
Partial CR = partial cost recovery.

dates approximately $7,000 (€5,300) per year. Other counties are free to have different fees. Scott county, for example, charges $6 per acre (= $14.83/ha = €11.41/ha) for its topographic information (1:1,200) (website MN Scott County).

Financial access to topographic information summarised
Table 9.11 presents the overview of the financial accessibility of the topographic datasets.

9.5.3 Physical access

Denmark
Denmark has a wide variety of geoportals including the national claeringhosue (website DK clearinghouse). However, none of the geoportals, including geodata-info.dk, has all TKs included.

For some datasets geodata-info provides price information (Jylland, Fyn, Roskilde Kommune, Gladsaxe, Herlev, and Albertslund) (see website DK clearinghouse). Use restrictions in geodata-info provided are often “the use right can be acquired from the municipality” or similar wording. Individual websites of data producers provide use restrictions (e.g., Grundkort Fyn). The data producers’ website are, however, not referred to in geodata-info.dk. A user needs to make a specific request to obtain a copy or access the dataset. Users need to identify themselves and explain their intended use before being allowed to access the dataset. A license agreement must be signed before accessing the information.

The TKs can be provided by e-mail, on a diskette, or CD-ROM. One municipality is experimenting with on-line downloading of the technical map. Many other municipalities provide free web-mapping services.

A single point of access for the complete technical korte is lacking. To obtain full coverage of Denmark of the technical map one needs to contact 68 organisations. The Tekniske grundkort for Jylland has one access point: *Naturgas Midt-Nord* (website DK Kortcenter). Also the *Tekniske grundkort* for Fyn is distributed by one organisation, *Grundkort Fyn*, a formal cooperation between the 32 municipalities in Fyn County (website DK Grundkort Fyn). Further, the *Grundkort Øst* (website DK Grundkort Øst), a cooperation of 36 municipalities and 1 associated municipality in Vestsjaelland County and Storstrorns County, which cooperates with 7 other municipalities in these counties, includes all the counties of Vestsjaelland Amt and Storstrorns Amt except one municipality: two access points. Finally, the municipalities in Roskilde county (11 municipalities), Frederiksborg county (19 municipalities), Copenhagen county (11 municipalities) and Sonderjyllands county (23 municipalities) need to be contacted separately.

The initiative *Kommunekort* (see website DK Kommunekort; website DK Geodatahotel) attempts to provide one access point for municipal information[21].

Netherlands

The GBKN is not published in the Dutch clearinghouse. Some metadata is provided on the GBKN website (website NL GBKN), including a service which allows to assess for small request the price of a request. Information can be selected on the web through a user-friendly device (e.g., draw a polygon). Since 2004, on-line web-based access through a viewer is available for raster information. GBKN is provided on a CD-ROM or through e-mail.

A license agreement must be signed before accessing the information. The GBKN information can be ordered through an on-line ordering office (*Bestelloket*). For access to the complete GBKN one has to contact the national contact point. For multiple regions request, one will be directed to one of the 4 most appropriate regional organisation responsible for distributing multiple regional requests. Other requests are directed to one of the 35 regional organisations.

Northrhine Westphalia

The Northrhine Westphalian clearinghouse (website Geocatalog) does not include the integrated ALK of the Landesvermessungsamt. Further, only ALK information from four individual Katasters was found here (01 December 2004).

Price and use restrictions are not included in both the metadata of the *Geodatenzentrum* and Geocatalog.de. The *Landesvermessungsamt* has published its restrictions on its website (website LVA1) and so have some individual counties.

The independent 54 counties need to be contacted to obtain information concerning the information of one specific jurisdiction. The *Geodatenzentrum*, which is placed within the *Landesvermessungsamt* will be formally embedded in the new legislation and will take care of cross-county information requests (Katastermodernisierungsgesetz, 2005, paragraph 15).

21 These services are an initiative from the organisation geodata.dk, which is owned by 54 municipalities.

Data cannot be downloaded, and administrative procedures need to be fulfilled to acquire the information. Information is available on CD, e-mail or on paper. The city of Aachen is among the few that provides free views of ALK information through the internet (see website Aachen). Information is delivered after a contract has been signed.

Massachusetts

The central point for access to geographic information in Massachusetts is the MassGIS' website (website MassGIS1). Information from the utilities are not published here. Many Massachusetts cities and towns have on-line GIS datasets available. The information are, however, not downloadable. The exception is information available from the Boston Atlas (website Boston Atlas) and the city of Fitchburg.

A license agreement must be signed before accessing the information of the utilities.

Metropolitan area of Minneapolis and St. Paul

DataFinder is the MetroGIS clearinghouse (website MN DataFinder). Datafinder provides access to topographic datasets of three out of seven counties. The information from the cities, towns, or utilities are not available through Datafinder.

Dakota County and Scott County have published price information and information concerning use restrictions on their website.

All counties require that a license agreement must be signed before acquiring the information. Information can be delivered through e-mailed, through the County FTP site or CD-ROM. Topographic information in Dakota County and Ramsey County can be viewed and queried on-line.

There is not one central point of access for topographic information. Each of the counties needs to be contacted separately. However, in several counties topographic information is not existing or available. Individual cities and towns may then be contacted.

Physical access findings summarised

Table 9.12 shows an overview of the physical accessibility of the topographic datasets.

Transparency

The transparency of available large-scale topographic information in the cases is poor: data producers do not value publishing a dataset in a clearinghouse. Only (several of) the Danish and available Metro datasets are included in the jurisdiction-covering clearinghouse. The Dutch, (most of) NRW and Massachusetts dataset are not included in a clearinghouse facility. Accordingly, the metadata documented in most of the Danish datasets and the available Metro datasets is comprehensive. The Dutch, Northrhine Westphalian, and Massachusetts' dataset(s) are generally poorly documented.

Access means
With the exception of the few public topographic datasets in Massachusetts, for request for entire topographic datasets, the requestor needs to identify himself, the purpose of the use specified and a contract must be signed before accessing the dataset.

Time between request and access
None of the cases allows for downloading the dataset from a website, although in Denmark one municipality is piloting such a service. In Metro some counties provide access through ftp. In the other cases topographic information is available on CD-ROM or e-mail for small requests. In addition, in all cases examples are available of free on-line viewing of topographic information, except for the Netherlands. It is common practice in Metro and Denmark, while only few local governments provide access to their information in Northrhine Westphalia. In Massachusetts, on-line viewing is typically available for the few purely public datasets.

One access point
Only the Dutch GBKN is available from one access point. In Northrhine Westphalia, the state mapping agency with the counties is working towards such a situation, but currently 54 entities need tob e contacted to obtain full coverage of Northrhine Westphalia. In Denmark, Metro and Massachusetts each of the data producers needs to be identified and contacted. This may be a time-consuming process since data producers do not commonly use the clearinghouse. In Massachusetts and Metro it is unclear to what extent it was possible to acquire topographic information that together would cover these jurisdictions entirely.

9.5.4 Policy consistency

Denmark
For the technical maps each individual supplier is responsible for its own policies. As a result, the access policies of the suppliers of the technical map are not uniform throughout Denmark. However, many restrictions are alike: restrictive. Pricing principles and use restrictions may, however, differ per dataset and use category.

Netherlands
For requests for the complete dataset one has to adhere to one single policy. Policies for smaller requests vary from provider to provider. In this sense it

Table 9.12 Physical access to components of topographic datasets

Physical access	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Publication dataset	Metadata published in clearinghouse/ limited metadata on providers' site	Limited metadata published on provider's website	Limited metadata published on provider's website	Limited metadata published on provider's website/no publication	Metadata published in clearinghouse/ limited metadata published on provider's website/ no publication
Time between request and access	Adequate-immediate	Adequate-immediate	Adequate	Adequate/ immediate/none	Adequate/none
Acquisition procedure	Contract	Contract	Contract	Contract/FOIA request	Contract
Number of points to contact for maximum coverage of jurisdiction	68	1	54 (1*)	–	–
Online viewing (free)	Y/N	N	N	Y/N	Y/N

* One if integration process is completed.

is consistent with the national policies for access to public information: they vary from source to source.

Northrhine Westphalia

The *Gebührenordnung* (VermGebO (2002 and 2004) rules for the fee for information of the Cadastre (VermKatG NW, par. 13 (5)). Further, the Katasters use restrictive policies as allowed by the Cadaster Act (*Vermessungs- und Katastergesetz*). The policies are consistent for Northrhine Westphalia.

Although the *Gebührenordnung* provides the legal framework for the price setting of the ALK, it is generally regarded as complex and difficult to understand, it is generally regarded as complex, difficult to understand, and inflexible to be of use for internet applications. Especially for request for areas smaller than 200,000 ha the criterion 'information density' seems to be ambiguous. Requestors of areas covering more than 200,000 ha only have to cope with one price per ha, but this price is not mentioned in the metadata of the *Geodatenzentrum* and not in the geocatalog.de.

Massachusetts

The policies for topographic information in Massachusetts are not consistent. The private and semi-public utilities have restrictive access policies in place for use restrictions and pricing. Local government policies for topographic information adhere to the open access principles as the MassGIS on-line downloads for 1:5,000 colour imagery.

Metropolitan area of Minneapolis and St. Paul

In the Metropolitan area the policies for large-scale topographic information are generally restrictive. Fees vary significantly between data providers.

9.5.5 Non-technical characteristics of the large-scale topographic datasets

In chapter 5 the non-technical GII requirements are described. A dataset should have as few use restrictions as possible, consistent access policies throughout government, with prices that do not impede the use of the information. Users require transparency of available information and access should be provided through electronic means. Further, an ideal situation would provide for as few contact points, preferably one, per framework dataset, even if the dataset were integrated from several other datasets. Table 9.13 summarizes the findings for the topographic datasets.

In three of the five case studies, access to a dataset covering the entire jurisdiction cannot be enforced through a request to a public record act or other legislation. The public-private or public-public partnerships have put the information to some extent outside the public sector. This, however, does not imply anything to the restrictive policies of the other cases.

In the instances of restrictive policies a contract must be signed before accessing the datasets. All cases have restricted the ability for reuse of the information either through cost recovery pricing or through restrictive use conditions. The few public topographic datasets in Massachusetts are the exception.

Concerning the physical accessibility of the datasets, only the Dutch dataset is available from one access point. In Northrhine Westphalia, the state mapping agency and the counties is working towards such a situation, but currently 54 entities need to be contacted to obtain full coverage of Northrhine Westphalia. In Denmark, Metro and Massachusetts each of the data producers needs to be identified and contacted. This may be a time-consuming process since data producers do not commonly use the clearinghouse. In Massachusetts and Metro it is unclear to what extent it was possible to acquire topographic information that together would cover these jurisdictions entirely.

The lack of one central place for acquiring topographic datasets covering an entire jurisdiction puts significant demands on the information requestor or potential value adder. A clearinghouse and comprehensive metadata may be a first step to address the difficulties of potential users. The research showed, however, that only the Netherlands and to some extent Denmark fulfils these needs of jurisdiction-wide users of topographic information.

9.6 Assessing the fitness-for-use value

Together, sections 9.4 and 9.5 provide the assessment that has been made for the topographic datasets. Table 9.14 and Table 9.15 present an overview of the findings.

Table 9.13 Non-technical characteristics of the topographic datasets

	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Access legally enforceable?	For (small) parts of dataset/none	For (small) parts of dataset/none	For (small) parts of dataset	For complete dataset/none	For complete dataset/none
Use restrictions?	Use restricted to internal purposes	Use restricted to internal purposes	Use restricted to internal purposes	Use restricted to internal purposes/none	Use restricted to internal purposes
Financial access	CR	CR	CR	CR/OA	CR
Policy consistent?	None	Harmonisation	Harmonisation	None	None
Publication dataset	Metadata published in clearinghouse/ limited metadata on providers' site	Limited metadata published on provider's website	Limited metadata published on provider's website	Limited metadata published on provider's website/no publication	Metadata published in clearinghouse/ Limited metadata published on provider's website/ no publication
Acquisition procedure	Contract	Contract	Contract	Contract/FOIA request	Contract
Time between request and access	Adequate-immediate	Adequate-immediate	Adequate	None/adequate/ immediate	None-adequate
Number of points to contact for maximum coverage of jurisdiction	68	1	54 (1*)	–	–

* One if integration process is completed.
CR = cost recovery.
OA = open access.
– = unknown/not possible.

The technical data characteristics, both internal and external, of the European topographic datasets are assessed to be in a reasonable stage of development. The quality consistency in each of these datasets needs to be improved, but each of them is potentially sufficient for use as a framework layer in a GII. The external data characteristics of the Dutch' dataset are assessed to be well-developed. Especially the 100% coverage of the Netherlands and the integration of the local topographic datasets into one dataset are highly valued. The metadata documentation, however, is not meeting the standards of the GII. The Danish datasets together also cover Denmark completely. However, users interested in a full coverage dataset need to integrate the individual datasets themselves with the likelihood that the datasets do not connect well, both geometrically and semantically. Metadata documentation is relatively well developed in several Danish' datasets, although some Danish datasets have none documented. The most comprehensive content is in the dataset of Northrhine Westphalia, including both parcel information and full topographic detail. This dataset, however, is not covering the entire jurisdiction of Northrhine Westphalia and some parts are still in analogue format. This inconsistency has resulted in poor scores in the technical data characteristics. Potentially, however, with full digital coverage, the Northrhine Westphalian situation would be assessed to be in an advanced stage of GII framework dataset development.

The technical characteristics of the datasets in Massachusetts and the Metropolitan region of Minneapolis and St. Paul are assessed as poorly developed from a GII perspective. The stand-alone status of the available datasets (e.g., lack of harmonised data models, ad hoc data collection), and the lack of large-scale topographic information for significant parts of these jurisdictions provides a poor prospective for the status of framework topographic information for these GIIs.

The non-technical characteristics for the topographic datasets, the access policies are because of the involvement of utilities, including the US cases, restrictive. The few public topographic datasets in Massachusetts are the exception.

In the Netherlands, even though the dataset is only published on the provider's website, the ease to access the topographic dataset is assessed to be sufficient: only one point needs to be contacted. Potentially the Northrhine Westphalian datasets are available from one contact point. However, currently the 54 parcel information providers need to be contacted. Access to these datasets is further hampered by the non-inclusion of ALKs in the state clearinghouse. In Denmark, initiatives to provide one access point for access to the TKs are lacking. Each of the 68 contact points must be contacted, some of which may be found through the national clearinghouse. In the Metropolitan region, the ease to access the available datasets of the Counties is assessed to be sufficient: comprehensive metadata in the region's clearinghouse. In Massachusetts, large-scale topographic information is not published in the state's clearinghouse. Again, the lack of topographic information for significant portions of both US cases provides a poor prospective for the status of framework topographic information for these GIIs. Therefore, given the requirements in the research framework, the quality of the topographic dataset is poor and the fitness-for-use value low.

The above has resulted in an assessment of the fitness-for-use vale for each of the (integrated) datasets. Based on the fitness-for-use value, it is expected that parcel information will not be heavily used because of (1) the restrictive access policy, and/or (2) the poor technical characteristics and difficulties in accessing the topographic information (see Table 9.15.)

9.7 Use findings

Denmark

The TKs are primarily used for maintenance and planning purposes. Typical users are professional users in technical or administrative public sector. Other important users of the TKs are the utilities. Users are barely found in the social/health sector or private financial sector (Brande, 2002b). Secondary users are architects, engineers, contractors, and chartered surveyors (Brande, 2002b).

Table 9.14 Overall assessment of the technical and non-technical topographic information characteristics

		Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Technical topographic information characteristics						
Internal characteristics	content (*)	+	+	++	– – (+)	– – (+)
	horizontal positional accuracy	+	++	++	– –	– –
	currency	+	++	++	– –	– –
	data structure (*)	–	–	– –	– – (+)	– – (0)
	quality consistency throughout the (integrated) dataset	–	–	– –	– –	– –
	average internal data characteristics score	0	0/+	0	– –	– –
External characteristics	digital coverage (vector format)	++	++	+	– –	– –
	number of datasets for jurisdiction coverage	–	+	–	– –	– –
	standard adherence	0	+	–	– –	– –
	data model	0	+	–	– –	– –
	metadata documentation	+	– –	– –	– –	– –
	quality assurance	–	–	++	– –	– –
	average external data characteristics	0/ +	+	–	– –	– –
Non-technical topographic information characteristics						
Access policy	legal access	–/ – –	–/ – –	–	– – (++)	–
	financial access (**)	–	–	– (++)	– (++)	–
	average access policy score (**)	–	–	– (+)	– (++)	–
Physical access	publication of the dataset(s) (*)	–	– –	– –	– –	N/A (++)
	number of points to contact for maximum coverage of jurisdiction	–	++	–	N/A	N/A
	acquisition procedure	+	++	+	+	+
	time between request and access	+	+	+	+	+
	average physical access score	0	+	–/ 0	N/A	N/A

* (score) = the assessment for individual datasets.
** For specific user groups free access is provided.
N/A = not applicable/possible.

In Herning Kommune, these secondary uses are limited to 10 to 20 parties.

Restrictions of many kinds (formats, data structure, skills, organisational etc.) have impeded the use of geographic information on a broader scale. Few value-added products that are based on technical dataset were found, aside from the products created by the owner(s). This may be because of the, at a

Table 9.15 Assessment of the fitness-for-use value of topographic information

	Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Internal data characteristics	0	0/ +	0	– –	– –
External data characteristics	0/ +	+	–	– –	– –
Access policy	–	–	– (+)	– (++)	–
Physical access	0	+	–/ 0	– –/ N/A	+ +/ N/A
Assessed general fitness-for-use value	0	0/ +	–/ 0	– –	– –

N/A = not applicable/possible.

national level, heterogeneity of the information, and its price and restrictive use conditions.

The cost of topographic information collection of one utility is partly funded with the sales of the technical information. The municipalities barely generate income from the sales of information. The activities of their 'mapping' divisions are almost fully covered with public money.

In Denmark, coordination at the local GII level is lacking. This has resulted in duplicate information collection and often incompatible large-scale topographic datasets.

Netherlands

Major users are municipalities, utilities, waterboards and cadastre. Secondary users are architects, and urban area developers (Murre, 2002). The Dutch police (*Korps Landelijke Politiediensten*) does not use the GBKN, it has preferred to use a private sector street centre line dataset because of the cost and the technical characteristics of the GBKN.

Also the commercial sector does not use the complete GBKN because of its price and value adding services based on the GBKN are non-existent. The new GBKN webmapping service may promote value adding services.

The LSV GBKN organisation receives approximately 800 orders per year for single regional information. These are small orders of approximately €150-1000. The LSV has generated in 2003 €180,000 and in 2004 €300,000 (until October).

The GBKN is not the only large-scale topographic information available in the Netherlands. For example, the Digital Topography datasets (*DTB droog en nat*) from the Ministry of Transport, Public Works and Water Management (*Adviesdienst Geo-informatie en ICT*) includes several attributes that are also included in the GBKN. The DTBs, however, only cover a small part of the Netherlands. Further, the Dutch Hydrological Organisation (*Dienst der Hydrografie*) has detailed information available about the waterways that they need to map. In addition, individual public entities such as *Waterschappen*, Provinces and Municipalities may collect topographic information independent of the LSV GBKN. The LSV is increasingly aware of these duplicate efforts and explores ways for better cooperation. One recent achievement in this respect is the cooperation between the LSV GBKN and the Ministry of Transport, Public Works and Water Management and ProRail (Den Boer, 2005).

Northrhine Westphalia
Use of the ALK is primarily in the public sector and utilities. Secondary users are architects, and engineering and planning companies. The value for value adding companies and other potential users of the framework data is not in balance with the current level of prices (BMWA, 2004, p. 4).

Because of the use barriers, the turnovers are small for geobasisdata (Micus, 2003, p. 9). In 1999, the cadasters generated together 646,000 DM (€323,000) from the sales of extended or additional use rights of ALK (Micus, 2001, p. 11). This is less than 12,000 DM (€6,000) per cadaster (Micus, 2001, p. 11). In 2003, the Landesvermessungsamt sold for approximately €1,000,000 information from the ALK to clients like electricity companies, telecommunication companies (interviews). These users all requests bits and pieces. Not one client could afford to buy the ALK for entire Northrhine Westphalia because of the high price (i.e. €3,400,000).

The city of Aachen offers a value-added service: the *Einzelhandels-Informations-System* (EIS), (website Aachen), a Chamber of Commerce application to find free business buildings, or to find current businesses. It uses the ALK as one of its base layers, but is also interoperable with the DTK10 from the *Landesvermessungsamt* (supermarkets, for example, will show on every scale level). Another example is InVeKos where farming information is added to ALK to prove EU funding.

Massachusetts
Local government and utilities use the topographic information. Architects and academics use (some of) the information. The research did not find private sector value-added products based on large-scale topographic information. Several public value adding products were found. For example, through the commercial company Mapjunction, the City of Newton provides views of the aerial photo, buildings, streets, parcels, open spaces, MBTA lines, MBTA stops, street edges, wetlands, streams, zoning, 10ft contour lines, easements, floodplains, among other information layers (see website Boston Atlas, see also website MA Town of Dedham). The Town of Dedham also adds to the base maps a feature that provides every other 10 feet or so images of the street from several directions per photo point (website MA Town of Dedham).

Revenues generated by the utilities remain private information.

The research found evidence that for several areas more than one topographic dataset exists, indicating duplicate efforts.

The City of Boston department of Assessing still uses topographic information from 1991 (BECo.). The topographic information, however, is only used for analysis purposes and visualisation help. The topography is sufficient for this department's purposes. For other departments in the city the old information is insufficient. One example is a situation where the town planners presented plans based on old information, without knowing that on a presumed empty

Table 9.16 Use component of the topographic datasets

		Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Primary users	Municipalities	Y	Y	Y	Y(n)	Y(n)
	Counties	N	Y	Y	N/A	Y(n)
	Utilities	Y	Y	Y	–	Y
Secondary users	Emergency services	–	–	N	(y)	–
	State agencies	N	Y	Y	N	N
Tertiary users	VA Resellers	N	N	N	N	N
	Value added services	Few	None	None-few	None-few	None
Duplication		Y	Y	N	Y	Y

N/A = not applicable.

area a new ten story building has been built. Since the information the City of Boston Redevelopment Authority uses information from 1995, one can imagine that this has not been limited to one instance.

Metropolitan area of Minneapolis and St. Paul

The use of the topographic information is primarily in government organisations and utilities. Some utilities bought the county dataset(s) once and are maintaining it themselves, others have a partnership with county government. Some utilities digitised the paper information from the county maps. Also public land developers use the topographic information. Dakota County has created or extracted several (value-added) products from its framework dataset: street (road centre line) maps, property address map, zip code map, including free views to the information through a web viewer (or a pdf file) (see website MN Dakota County3).

Revenue in one county has varied between $20,000-40,000 per year.

Some public GIS groups sell their information, and similar to the provisions in Minnesota legislation (MGDPA, 13.03 3 subd 10) they appropriate the income towards a special fund, which can only be used for the maintenance or upgrades of the dataset that generated the income. Such constructions are found in the cooperation between Dakota County, its cities and Dakota Electric and between the members of the Ramsey County GIS user group. Both use this structure for the topographic mapping.

Although several counties went into public-private or public-public partnerships, coordination at the MetroGIS level is lacking for topographic layer. For topographic information, there is a perception of information duplication. Interviewees indicated that there are at least four similar datasets in four different organisations. All three private utility companies (electric, gas, telecom) have topographic information and so do many of the local governments.

Use findings summarised

In the researched cases large-scale topographic information does not satisfy the technical and non-technical GII user requirements (see Table 9.16). Consequently the structural use of all researched datasets is limited to the primary users of the information, often also the collector of the information. Further, it is surprising that topographic information is not existing or not available for several parts of the two US cases.

In all cases uses within the user groups are similar. Primary users of large-scale topographic information are users operating at the local levels of government and utilities. Secondary users are engineers and planning agencies.

Tertiary users are, however, few or non-existent. Restrictive policies and pricing may be causes. In addition, the incomplete datasets, lack of transparency concerning the existence, availability and content may be other causes for the lack of value adding services. These explanations may also explain the research findings of duplication of similar information collection in four cases.

9.8 Conclusions

In Chapters 4 and 5 the theoretical GII demands for framework layers are described. Chapters 6 and 7 have provided the research framework that has been the foundation for researching the topographic information cases. This chapter has assessed the extent to which the technical and non-technical characteristics of the topographic datasets have been decisive for its use value and consequently the impact of the access policies on GII development (see Table 9.17). This section elaborates on two findings:

1. Both the technical and the non-technical topographic information characteristics are decisive for the use value, and
2. The important role of partnerships, especially between public organisations and utilities, in developing GII.

9.8.1 Technical and non-technical data characteristics decisive for use value

Since population density of a system is directly linked to the level of geographic detail necessary for the maintenance and development of the system, it was reasoned that each of the cases had similar needs for topographic information, and consequently expected to find similar technical characteristics.

The case study research, however, found different technical characteristics for the topographic datasets in the different jurisdictions (see Figure 9.7 and Table 9.17). Generally, the European jurisdictions seem to be occupied with large-scale topographic information that serve the primary and secondary users well. Tertiary users may not be reached because of the prices, use restrictions, but also because of the cost associated with integration of datasets from too many sources. This latter issue has been resolved to a large extent

Table 9.17 Case study findings for large-scale topography

		Denmark	Netherlands	Northrhine Westphalia	Massachusetts	MetroGIS (Minnesota)
Technical	Internal	0	0/ +	0	– –/N/A	– –/N/A
	External	0/ +	+	–	– –/N/A	– –/N/A
	Non-technical					
Non-technical	Access policy	–	–	–	– (++)	–
	Physical acces	0	+	0	– –/N/A	+ +/N/A
Use	User groups	Primary and secondary	Primary and secondary	Primary and secondary	Primary and secondary	Primary and secondary
	Value added products	–	–	–	–	–

N/A = not applicable.

in the Netherlands by the strong willingness to cooperate in a public-private partnership. In Northrhine Westphalia it is the state mapping agency (Landesvermessungsamt) that has reached a harmonised 87% coverage of Northrhine Westphalia so far. In Denmark the research did not find initiatives that address the integration of existing local datasets into one national dataset, although in several parts the utilities and local governments cooperate for the creation of datasets covering more than one municipality. The issue of pricing and use restrictions remains in all European cases a barrier for further use.

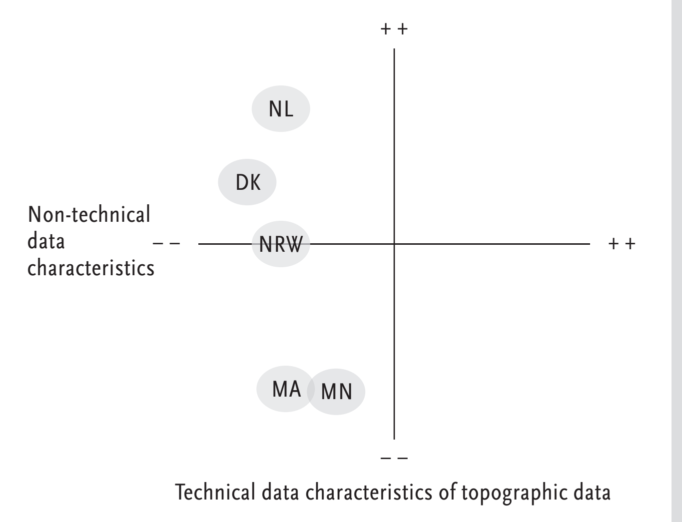
The situation in the two cases in the United States differs from the European cases with respect to jurisdictional coverage of the datasets. The research did not find datasets with full jurisdictional coverage or datasets that together would cover the jurisdiction entirely at the large-scale levels. In addition to the limited technical characteristics, the restrictive access policies block the further use. It is unclear to what extent other datasets (road centreline dataset, aerial photos, parcel information, smaller scale raster data) satisfy the needs of public tasks for planning and maintaining the public area in areas where topographic information is lacking. In Massachusetts, several instances were found where local governments use topographic information that has been collected more than a decade ago.

9.8.2 Important role of partnerships in developing GII

In Chapter 1 and 2 the special role of large-scale information in the development of a GII was provided. One of the characteristics of the large-scale information is that high level of detail is relatively costly to collect and process. In Chapter 5 it has further been stated that the extent of awareness of the value of geographic information for society may be decisive for the choice of the most appropriate funding model for government geographic information provision.

This research found that at the local levels the costs for large-scale topographic information collection are such that often government can only satisfy its geographic needs through cooperation with other parties. The five case studies show that there may be a special role for the private sector in meeting

Figure 9.7 Found quality of topographic information and access policy



GII objectives. Especially utilities may play a critical role in the collection, creation and maintenance of large-scale topographic information. They are not only a major user of quality large-scale topographic datasets, in four of the five researched cases utilities are also important for the collection of large-scale topography. Through public private partnerships (PPP), or independent of government they supported the GII through collecting, creating and maintaining the digital large-scale topographic information. In a PPP there is a win-win situation to share the high cost of collection and maintenance, while all members could use the information. In all case studies the utilities are, however, privatised or semi-public entities. Partly because of competition with other utilities, utilities do not provide the created topographic information to others, unless use restrictions are agreed upon and a price has been paid. Not necessarily they would like to generate high volumes of sales, but certainly do not want other utilities to free ride on their investments. In this way cost recovery policies may lead to available large-scale information whereas they otherwise may not have been available at all.

However, the restrictive policies limit the use of the datasets to primary and secondary user groups. Tertiary use will not be promoted and is likely to barely develop because of the high prices and restrictive use conditions.

Promoting cooperation

Generally, the collection of topographic information is not formalised in legislation. Northrhine Westphalia is the exception where the parcel mapping is extended to topography. In all other cases, the collection of topographic information is voluntarily. This, however, does not imply that it is not needed. In almost all cases identical developments can be recognised. In the late 1980s, beginning of the 1990s the utilities started to digitize their analogue maps for their service area (Denmark, Massachusetts) sometimes in cooperation with public parties (Netherlands, Minnesota). Sometimes local governments were doing the same (Netherlands, Denmark) for their jurisdiction. Because of the differences in service areas of the utilities and the administrative boundaries such a situation would not be ideal.

In the Netherlands the utilities and (local) governments cooperated to overcome the impediments and started to build the GBKN through a public-private-partnership. In several counties in MetroGIS utilities cooperated with the county or a county geographic data user group (association of towns and cities) cooperated with the county to create a topographic layer. In Massachusetts one semi-public utility shared its information with governments in its service area. In other instances, cooperation on a national/ state level was lacking (Denmark, Massachusetts, MetroGIS) which resulted in the continuation of a suboptimal situation.

If the information collection is not formalised information sharing and other cooperative efforts need to be initiated to meet the GII requirements. Champions are in such instances key for success of the effort (see Craig, 2001; Rietdijk, 2000, p. 222). Denmark and Massachusetts and to a smaller degree Metro lacked such a champion.

9.8.3 Summary

Finally, the research has assessed the situation in the Netherlands with one access point, strong cooperative structures, development towards one harmonised dataset with harmonised access policies as more promising and currently of value for the GII than the other datasets. The topographic datasets in Northrhine Westphalia and Denmark have potential and the US cases are least developed from a GII perspective because of their local focus without initiating state-wide or regional-wide cooperative efforts.

In all cases the role of the utilities is important for the availability of topographic information. Their involvement, and accordingly cost recovery policies, have resulted to the availability of large-scale information whereas they otherwise may not have been available at all.

10 Fitting the case studies in the GII maturity matrix

10.1 Introduction

Chapter 3, 4 and 5 provide the foundation for the GII maturity matrix. It accounts for institutional GII aspects as well for technical and non-technical data characteristics. Institutional aspects may be vision, leadership, communication and self-organising ability. In addition, awareness for GII, financial resources dedicated to GII development, delivery mechanisms, access policies, and dataset characteristics are evaluated. Chapter 8 and 9 provided the assessment of the parcel and large-scale topographic datasets in the researched jurisdictions.

Each of the researched cases may now be categorised in one of the four stages for each of these maturity matrix components. This may clarify the found differences and commonalities between the cases. The level of GII development may further provide guidelines for the most appropriate access policy for a specific situation.

10.2 Denmark

10.2.1 GII development in Denmark

Denmark has many well functioning building blocks for a Geographic Information Infrastructure. Denmark is well assorted with digital geographic information both at the small and large scales. Further, human resources are available up to the academic level. The latest technology is available and used, international standards for webmapping and interoperability are known and often implemented. However, most geographic information is acquired and used for a specific institutional purpose. It has a specific addresser and a specific addressee and uses a specific code that restricts its use for other purposes. The individual elements exist relatively independent from each other, and need to be integrated to function as a real GII (personal communications).

Table 10.1 provides the GII maturity matrix for Denmark. A real leader for the development of the Danish GII is lacking. Leadership for the development of the Danish GII may be in the Service community for Geodata. Others opt for the leadership in KMS or Geoforum. Universities are involved at the technical level.

In 2005, Denmark is still developing a vision for their GII. The current developments can best be characterised as common sense. The Service Board for Geodata (*Servicefællesskabet for Geodata*) was established in 2002 as a coordination body, but includes only representatives from the public sector (website DK XYZ). Some of the objectives of the Service Board are “to: (1) to develop and formulate a vision and a strategic framework for development of geographic information in Denmark; (2) To secure co-operation on information, access to data modelling, and (3) to promote development of coherent geographic information services" (SADL, 2003a). The Director of the Danish Cadastre (KMS) is the chairman of the service board. The secretariat of the board is placed within KMS. The participation in the service board is voluntarily. This has resulted in a loose cooperation, with a small secretariat, and no money specific for its activities. A further communication channel is in the Danish society for geographic information, Geoforum. Geoforum has 40 organisations as member and approximately 500 individual members. Its mission is to encourage the wider use of geographic information.

In Denmark several portals exist, all serving different purposes. The national clearinghouse is Geodata-info.dk with comprehensive metadata for many both public and private datasets. Anybody supplying geographic information has the opportunity to publish its information in this clearinghouse. There is no mandatory publication. The Danish version of the site includes information from over 40 organisations, including seven counties and about 30 municipalities. Most municipalities, however, do not publish their information in geodata-info.dk. Information from Herning Kommune, for example, are not published in geodata-info.dk because it is no priority.

The database has been implemented according to the CEN standard and will eventually be developed further to comply with the ISO TC211 standard (Brande, 2002b; Daugbjerg et al., 2001). All documents are in XML (text documents in law specified for exchange), or GML.

The Ministry of the Environment is responsible for geodata-info.dk. KMS is responsible for running the service and is the only party funding it. KMS started the clearinghouse because of a former legal task to coordinate the Danish GII. This task has been cancelled. The clearinghouse is now run on the lowest cost basis.

The metadata are offered in Danish. The English version of the clearinghouse contains the descriptions of only 32 datasets. Some municipalities, and other information suppliers are listed in the English service, but are not providing any metadata information about their dataset. The only information provided is the name and contact information (no list of information!).

Another portal of interest may be the portal for municipal geographic information (see website DK Kommunekort).

Aside for the financial resources for individual datasets, the resources for GII development sec are limited and provided on an ad hoc basis. Both the Service board and the national clearinghouse are funded on a project basis, rather than that their existence is guaranteed through sustainable funding mechanisms.

Table 10.1 The GII maturity matrix for Denmark

Aspect	Stage: Stand alone/ initiation	Exchange/ standardisation	Intermediary	Network
Vision	Focus on individual organisation	**Developed with all public stakeholders**	Implementation	Commonly shared, and frequently reviewed
Leadership	Focus on individual organisation	**Questioned**	Accepted	Respected by all stakeholders "champion"
Communication	Focus on individual organisation	**Open between public parties**	Open between all stakeholders	Open and interactive between all
Self-organising ability	Passive problem recognition	**Neutral problem recognition**	Actively helping to solve identified problems	Actively working on innovation
Awareness for GII	Professionals in one organisation: organisational "GII"	**Professionals of organisations together: GII**	Awareness at many levels including decision making	Commitment at all levels/ continuous support in politics and management
Financial sustainability	**Limited to projects**	Neutral	Guaranteed for certain period	Sustainable but frequently reviewed
Delivery mechanism status	Project	Product portal (geo-portal)	**Clearinghouse**	Clearinghouse with information/service provision (e.g., downloads)

10.2.2 Parcel dataset

In chapter 8 the Danish parcel dataset has been positively evaluated (see Table 10.3 and also table 10.2). The technical data characteristics, both internal and external, are assessed to be in an advanced stage of development. From a technical perspective, the Danish parcel dataset is sufficient for use as a framework layer in the Danish GII. Minor improvements would be the positional accuracy of the information, object-orientation of the information and comprehensive metadata documentation on the object level in addition to the dataset level.

Also the physical access component has been positively evaluated: the dataset is available from access point, comprehensive metadata is documented and published in the national clearinghouse, and after subscription the parcel dataset can be immediately available. However, access to the entire parcel dataset cannot be enforced through legislation, and the dataset is subject to restrictive access policies. These have limited the use of the cadastral dataset to the primary and secondary users. Few value-added products based on the parcel dataset were found.

The current access policies need to be changed in order to further stimulate the use of the parcel dataset and to increase its role in the Danish GII. A change in access policy from cost recovery to open access is likely to result in macro-economic advantages, which may result in higher taxation income for the Danish national government. In order to guarantee the current technical parcel data characteristics, the potential loss of income for KMS due to a change in access policy needs to be compensated by national government.

Table 10.2 Institutional issues for Danish parcel dataset

Issues	Stage: Stand alone/ initiation	Exchange/ standardisation	Intermediary	Network
Awareness for spatial framework dataset (and information policy options)	Project based	Awareness among professionals within sector	Need commonly understood	**Formalised in (flexible) legislation**
Financial sustainability	Limited to projects	Neutral	Guaranteed for certain period	**Sustainable, but frequently reviewed**

Table 10.3 Technical, non-technical and use characteristics of the Danish parcel dataset

		Denmark
Technical	Internal	+
	External	+
Non-technical	Access policy	–
	Physical access	+
Use	User groups	Primary and secondary
	Value added products	–

However, only if sufficient awareness exists among politicians or high-level bureaucrats, and sustainable funding has been agreed upon, open access policies for tertiary users of parcel information are likely to satisfy the Danish GII objectives better than the current cost recovery policies (see also chapter 5 section 4.4).

10.2.3 The topographic datasets

Topographic mapping is in the *Tekniske Kort*. From a technical GII perspective, the situation of the TKs is reasonable (see Table 10.5). Together, the datasets of the utilities and local government cover Denmark completely, the currency and accuracy is reasonable to good, but the consistency between the different TKs is poor: content, data specifications, and data structure may vary from source to source. The institutional status of the datasets is in the beginning stages of development (see Table 10.4). Users interested in a full coverage dataset need to integrate the individual datasets themselves with the likelihood that the datasets do not connect very well, both geometrically and semantically.

Further, access to TKs cannot be enforced through a request to a public record act or other legislation. Moreover, the TKs cannot be re-distributed and prices are based on cost recovery principles. A contract must be signed prior to accessing the datasets. These characteristics do not promote the use of the TKs.

Finally, the physical access component has been assessed as reasonable. A single point of access for the complete *Tekniske Kort* is lacking. In order to obtain full coverage of Denmark of the technical map one needs to contact 68 organisations. This may be a time-consuming process since TKs are not commonly published in the national clearinghouse. The datasets that are published in the Danish clearinghouse have comprehensive metadata documented. However, not all large-scale topographic datasets are provided in the clearinghouse and some TKs datasets have no metadata documented.

The TKs are primarily used for maintenance and planning purposes. Typical users are professional users in technical or administrative public sector. Other important users of the TKs are the utilities. The technical data are barely used in private sector value-addeded products. This is probably due to the, at a national level, heterogeneity of the datasets and the restrictive use conditions. Further, the policies have resulted in duplicate efforts.

The status of the *Tekniske Kort* is such that the existing datasets may be integrated into one consistent Denmark covering dataset. For the counties of Jyllland, and Fyn already one dataset is available and for a considerable portion of Sjaelland cooperation between municipalities exist through the *Grundkort Øst*. In order to promote the integration process further, coordination at the local level is needed. Leadership at the local level may result from the structural reform of Danish local government, which is likely to benefit the local GII. In 2004, Denmark started a process of a structural reform of local government (the Municipality Reform, *Kommunalreformen*). The 271 local authorities will be amalgamated to form approximately 100 large units. These units will take over tasks previously performed by the 14 counties, which will be amalgamated at the same time to form five new regions (website DK AKF). The reform will result in less municipalities, less players on the local level and likely to result in knowledgeable local government employees in all municipalities able to stress the importance and need for one TK for Denmark with their municipal councils. The geographic characteristics of the many islands in Denmark may speed up this process.

Also the initiative www.kommunekort.dk (see website DK Kommunekort and also website DK Geodatahotel) should be continued in order to increase the transparency of access points for municipal information. It is recommended to promote the documentation of metadata for TKs and link the Kommunekort service to the national clearinghouse.

Further, the TKs are the largest scale topographic information that is available in Denmark. In a true framework dataset function it should be the basis for topographic information at smaller scales.

The development of the *Tekniske Kort* has benefited from cost recovery policies. Without the ability to control the use of the dataset, utilities are likely not to have contributed to the development of the *Tekniske Kort*. The possibility to integrate existing datasets would not have been possible if the datasets did not exist, which for a major part is explained by the participation of the utilities, and the ability to control the use of the dataset.

Table 10.4 Institutional issues for Danish topographic datasets

Issue	Stage: Stand alone/ initiation	Stage: Exchange/ standardisation	Stage: Intermediary	Stage: Network
Awareness for geographic framework dataset (and data policy options)	Project based	**Awareness among professionals within sector**	Need commonly understood	Formalised in (flexible) legislation
Financial sustainability	**Limited to projects**	**Neutral**	Guaranteed for certain period	Sustainable, but frequently reviewed

Table 10.5 Case study findings for Danish large-scale topography

		Denmark
Technical	Internal	0
	External	0/ +
Non-technical	Access policy	–
	Physical access	0
Use	User groups	Primary and secondary
	Value added products	–

The integration may be time-consuming due to the adherence to different TK standards, and question is who will bear the cost of such an operation? The cost recovery policies may also here provide some means for municipalities to recover the cost.

10.2.4 Promoting GII development in Denmark

Denmark has many well functioning building blocks for a geographic information infrastructure. Denmark is well assorted with digital geographic information both at the small and large scales. Further, sufficient human resources are available. The latest technology is available and used, international standards for webmapping and interoperability are known and often implemented.

However, coordination of the GII and a formal policy on a GII is lacking, which has resulted in duplicate data collection, incompatible datasets, and uncoordinated initiatives. The current coordinating body is, similar to the Metropolitan region and the Netherlands, solely comprised of public entities. A true GII approach should also incorporate private sector interests, especially in the area of non-technical data characteristics. The GII may further benefit from active involvement of academics. In involving the user community, the organisation Geoforum may play a critical role in GII development. Increased cooperation between the public and private sector and within the public sector itself should contribute to increased awareness for the Danish GII. Especially more open access policies for tertiary users adding value to the core datasets should stimulate further development.

10.3 The Netherlands[22]

10.3.1 GII development in the Netherlands

Coordination

Partly the NGII has developed through a planned government approach and partly as an organic process. This process is taking place gradually and in close relationship with people working in the field.

A coordinating Minister for geographic information was appointed in 1990: the Minister of Housing, Spatial Planning and the Environment (Ministerie van Binnenlandse Zaken, 1990). This coordinating Minister set about harmonisation and cooperation by the interested parties. This led to cooperation in Ravi, the consultative body for the public geo- information sector, in 1993. Initially participation in Ravi was mandatory for certain (public) agencies or groups. Presently, the members participate in Ravi on a voluntary basis.

The formal coordination has been divided between the coordinating Minister and the Ravi, between which a formal agreement existed until 2002 (Tweede Kamer, 2001-2002). Ravi focuses on the field coordination. It initiates and stimulates the commitment within and outside the geographic information community, and promotes the concept and development of the national geographic information infrastructure (NGII).

In 2005, the Ministry of Housing, Spatial Planning and the Environment has indicated that it will take the lead again in the coordination of the Dutch GII. The introduction of a GI-council and/or the merge of Ravi and the Netherlands Clearinghouse for Geographic information organisation into one new GI-user council were suggested. The outcomes of this re-organisation are yet uncertain.

Further, the organisational merge of two providers of framework datasets in 2004, the *Kadaster* and national mapping agency (*Topografische Dienst Nederland*), into one organisation has provided the geographic information sector with a strong player. The new organisation is responsible for the parcel dataset, for the 1:10,000 and smaller scales topographic mapping, has a major share in the large-scale base map (GBKN) organisation(s), sits in the board of the National Clearinghouse Geographic information, and in the board of the Ravi. In addition, the legal tasks of the national mapping agency include the promotion of an effective Geographic Information Infrastructure (Kadaster, 2003a). The impact of the dominance of this new organisation on the development of the Dutch GII is yet undecided.

These developments have resulted in a situation of uncertainty concerning the roles of the Ministry of Housing, Spatial Planning and the Environment, Ravi and the *Kadaster*.

22 Major parts of this section are drawn from Kok and Van Loenen (2005).

Development of a vision

In the beginning of the nineties, Ravi brought together the major information producers and created a common goal for the geographic information community: establishing four uniquely defined, ubiquitous, and interlinked core datasets (registration of parcels, natural persons, enterprises, and buildings). Each of the individual organisations was responsible for the establishment of a part of the structure plan for land information (Ravi, 1992). The community worked together on the implementation of this NGII vision. After its visit to the United States, Ravi extended the vision, although the land information plan remained to be a guideline (see Ravi, 1995). The new strategy document provided a more comprehensive view on the NGII. This document emphasised the role of the geographic information community in the implementation of the new task of national government: "to ensure the widest possible access for members of our society to communication media and the rich divers information sources". Further, the renewed vision stressed the need to (1) involve user needs in this process, (2) start a clearinghouse, (3) document metadata, (4) explore international developments, and (5) to represent the geographic information community actively in national policy discussions. The vision has been reviewed several times (Ravi, 1995; VROM, 1998; Ravi, 2003), but the core of the initial vision still holds.

Communication channels

The Ravi comprises several public services and authorities with an important role in the provision of geographic information. Government ministries, provinces, and water boards are represented. These organisations aim to improve the NGII by means of cooperation and agreement. The Association of Netherlands Municipalities, however, does not perform a formal role in Ravi. In addition, the private sector founded the Ravi Business Platform in order to respond to private user needs. The Ravi Business Platform is the private sector equivalent of the Ravi, and performs as a geographic information platform of private entities. The business platform is now an independent, but relatively weak, body. Also leading academics are involved by taking part in GII discussions, workshops, projects, and share their knowledge with the other parties involved.

Self-organising ability

The self-organising ability of the geographic information community in the Netherlands has developed from single organisations performing their predefined tasks to consortia of organisations willing to address societal challenges with GII solutions. The community is or has been actively participating in national discussions on access policies, standardisation, and initiated the clearinghouse in 1996. The community is further considered critical for the success of the execution of the e-government program (Tweede Kamer, 1998-1999a), and many geographic datasets (parcel dataset, buildings, topographic dataset 1:10,000, and addresses) have obtained a special authentic status (Tweede Kamer, 2002-2003a; Tweede Kamer, 2002-2003b).

The user demands are increasingly important to the producers, but the needs of the users are not commonly understood or heard. However, a call for proposals of the Minster of Industry and Economic Development for innovative knowledge projects accomplished by consortia of public, private, and academic organisations stimulated the community to work on the tender proposal *Space for Geoinformation* (Ravi, 2003). This proposal works out the original NGII vision, accounting for the shift in the geographic information sphere over the last decade, partly as a result of technological, social and economic developments. It concerns a shift of the build-up of domain specific geographic information aimed at limited application for the development of the NGII to support the enormity of complex social problems. *Space for Geographic information* aims to integrate the geographic information discipline with adjacent disciplines such as water, transport, nature and environment, and emergency. The proposal is demand-oriented, integrates technological know-how and alpha and gamma-related sciences, and promotes the exchange of knowledge between the geographic information community and adjacent communities (Ravi, 2003). Consortia of more than 120 public, private, academic, research and development, and international organisations, and knowledge centres support the proposal. Together, the consortia provided a financial commitment of €27 million for the execution of the proposal (Kok, 2003). The proposal attracted on 28 November 2003 €20 million public funding for projects promoting the innovation of the NGII. Together with the co-funding from the accepted projects, a total of €40 million is available for GII development. The geographic information community has welcomed the Space for Geographic information program with great enthusiasm. The initial start-up problems, among other problems (see, for example, Scholten, 2005; Bregt, 2005), seem to be resolved and the program now moves ahead attracting significant amounts of project proposals.

Technically access to the datasets is being provided through the establishment of National Clearinghouse Geographic information, an electronic metadata information desk. The clearinghouse provides a means for finding available dataset, public and/or private, via the Internet. At the moment the NCGI provides only metadata, free of charge, contained in a central database. However, the metadata in the service is limited and outdated and the service is barely used..

In addition to the improvement of the NCGI, the Dutch GII can still gain significantly from the development and introduction of open standards, such as GML, from metadata documentation and from the object-orientation of information. However, the biggest challenges for the further development of the Dutch GII are the restrictive use conditions and prices of the framework datasets

The Dutch GII maturity matrix is provided in Table 10.6.

Table 10.6 The Dutch GII maturity matrix

	Stage			
Aspect	**Stand alone/ initiation**	**Exchange/ standardisation**	**Intermediary**	**Network**
Vision	Focus on individual organisation	Developed with all stakeholders	**Implementation**	Commonly shared, and frequently reviewed
Leadership	Focus on individual organisation	**Questioned**	Accepted	Respected by all stakeholders "champion"
Communication	Focus on individual organisation	Open between public parties	**Open between all stakeholders**	Open and interactive between all
Self-organising ability	Passive problem recognition	Neutral problem recognition	**Actively helping to solve identified problems**	Actively working on innovation
Awareness for GII	Professionals in one organisation: organisational "GII"	**Professionals of organisations together: GII**	**Awareness at many levels including decision making**	Commitment at all levels/ continuous support in politics and management
Financial sustainability	Limited to projects	Neutral	**Guaranteed for certain period**	Sustainable but frequently reviewed
Delivery mechanism status	Project	Product portal **(geo-portal)**	Clearinghouse	Clearinghouse with information/service provision (e.g., downloads)

10.2.2 Parcel dataset

In chapter 8 the Dutch parcel dataset has been positively evaluated (see Table 10.7). The technical data characteristics, both internal and external, are assessed to be in an advanced stage of development. From a technical perspective, the Dutch parcel dataset is sufficient for use as a framework layer in the Dutch GII. However, the status of metadata documentation is surprisingly poor for the technical status of the dataset, especially in comparison with the Danish and the Metropolitan parcel datasets. The Dutch parcel dataset is being promoted through other means than the traditional clearinghouse mechanism: marketing strategies (e.g., banners on real estate sites) are used to direct people to the *Kadaster* site. Also the publication of the dataset can be improved. The Dutch clearinghouse has dated information about the parcel dataset documented. This is probably due to the poor development of the Dutch clearinghouse. Obviously the technical improvement for the parcel dataset is in adding comprehensive metadata documentation to the parcel dataset, both on the object level and the dataset level.

Despite the poor metadata, the physical access component has been positively evaluated: the dataset is available from one access point, and after subscription the parcel dataset can be immediately available. However, access to the entire parcel dataset cannot be enforced through legislation, and the dataset is subject to restrictive access policies. These have limited the use of the cadastral dataset to the primary and secondary users. Few private value-added products based on the parcel dataset were found.

Similarly to the Danish and Metropolitan parcel datasets, the current access policies need to be changed to further stimulate the use of the parcel da-

Table 10.7 Technical, non-technical and use characteristics of the Dutch parcel dataset

		Netherlands
Technical	Internal	+
	External	+
Non-technical	Access policy	–
	Physical access	+
Use	User groups	Primary and secondary
	Value added products	–

Table 10.8 Institutional issues for Dutch parcel dataset

	Stage			
Issues	**Stand alone/ initiation**	**Exchange/ standardisation**	**Intermediary**	**Network**
Awareness for geographic framework dataset (and information policy options)	Project based	Awareness among professionals within sector	Need commonly understood	**Formalised in (flexible) legislation**
Financial sustainability	Limited to projects	Neutral	Guaranteed for certain period	**Sustainable, but frequently reviewed**

taset and to increase its role in the Dutch GII. A change in access policy from cost recovery to open access is likely to result in macroeconomic advantages, which may result in higher taxation income for the Dutch national government. To guarantee the current technical parcel data characteristics, the potential loss of income for the *Kadaster* because of a change in access policy needs to be compensated by national government. However, only if sufficient awareness exists among politicians or high-level bureaucrats, and sustainable funding has been agreed upon, open access policies for parcel information are likely to satisfy the Dutch GII objectives better than the current cost recovery policies (see also chapter 5 section 4.4; Table 10.8).

10.2.3 The topographic datasets

In the Netherlands, 10 regional public-private partnerships and 25 self registering municipalities cooperate in the national Joint Venture of the Large Scale Base Map (*Landelijk Samenwerkingsverband GBKN*) for large-scale topographic mapping, the GBKN. In chapter 9 the GBKN has been relative positively evaluated (see Table 10.9). The technical data characteristics, both internal and external, of the Dutch large-scale topographic base map are assessed to be in a reasonable stage of development. The quality consistency in the dataset needs to be improved, but the GBKN is potentially sufficient for use as a framework layer in a GII.

The external data characteristics of the Dutch dataset are well developed. The 100% coverage of the Netherlands is highly valued together with the alignment of the local topographic datasets for inclusion in one dataset. The

Table 10.9 Case study findings for Dutch large-scale topography (GBKN)

		Netherlands
Technical	Internal	0/ +
	External	+
Non-technical	Access policy	–
	Physical acces	+
Use	User groups	Primary and secondary
	Value added products	–

Table 10.10 Institutional issues for Dutch large-scale topography (GBKN)

	Stage			
Issues	Stand alone/ initiation	Exchange/ standardisation	Intermediary	Network
Awareness for geographic framework dataset (and data policy options)	Project based	**Awareness among professionals within sector**	**Need commonly understood**	Formalised in (flexible) legislation
Financial sustainability	Limited to projects	**Neutral**	Guaranteed for certain period	Sustainable, but frequently reviewed

metadata documentation, however, is not meeting the standards of the GII: the GBKN has limited and non-structured metadata documented.

Technical improvements are the comprehensive documentation of metadata at the dataset level and in the future on object level. Further, the current spaghetti structure needs to be upgraded towards an object-orientation structure to be considered a true framework dataset.

Concerning the access policy for the GBKN, access to the entire GBKN cannot be enforced through a request to a public record act or other legislation. Moreover, the GBKN cannot be re-distributed and prices are based on cost recovery principles. A contract must be signed prior to accessing the datasets. These characteristics do not promote the use of the GBKN.

Even though the dataset is only published on the provider's website, the ease to access the GBKN is assessed to be sufficient: only one point needs to be contacted.

Major users are municipalities, utilities, waterboards and cadastre. Secondary users are architects, and urban area developers (Murre, 2002). The national police agency does not use the GBKN, it has preferred to use a private sector street centreline dataset because of the cost of and the technical characteristics of the GBKN. In addition, because of its price, value-adding services based on the complete GBKN are non-existent.

The GBKN has benefited from cost recovery policies. Without the ability to control the use of the dataset, utilities are likely to not have contributed to the development of the GBKN. Similarly, the self-registering municipalities would not have provided their datasets to the GBKN organisation. Because of cost recovery policies, the GBKN organisation managed to reach the current quality level of full coverage of jurisdiction, alignment with cadastral dataset, in the near future consistent minimum content and likely to have consistent access policies for the GBKN. This has made the GBKN one of the core layers of local government and the utilities, and on which potentially many other users may build.

Within the program Stroomlijning Basisgegevens (2004) (streamlining core data) there is discussion to upgrade the status of the GBKN from voluntarily use within government and voluntary collection into a legislated framework layer with guaranteed qualities and as the preferred topographic source for government (see also GBKN, 2005b, see Table 10.10). Such a development would not have been apparent if the dataset did not have its current qualities, which for a major part are explained by the participation of the utilities in the partnership.

10.3.4 Promoting GII development in the Netherlands

The Dutch GII is well-developed with respect to the vision, the development of several core datasets, including the parcel dataset and to some extent the GBKN, and the self-organising ability of the sector. Communication is open between all stakeholders, but the lead for GII development is unclear. The GII is in an urgent need regarding the leadership issue. The Ministry of VROM has suggested several new directions to address the leadership issue within the public sector. A true GII, however, needs broad outreach and agreement, including formal involvement of the private sector. Further, the Dutch GII should take advantage of the GII expertise of the academic sector. Possible roles for the private and academic sector may be actively and passively providing advice to the coordinating agency on a wide variety of issues directed at GII development. In involving the private sector and academics the GII is likely to move towards the needed user oriented GII. Such a user oriented GII may further be promoted through guaranteed government funding and open access policies for the core datasets of the GII.

10.4 Northrhine Westphalia

10.4.1 GII development in Northrhine Westphalia

Table 10.11 shows the GII maturity matrix for Northrine Westphalia. In Northrhine Westphalia, coordination of the GII is in the Centre for Geographic information (CeGI), a public-private partnership. The overall goal of GDI.NRW is to enable the geographic information market and to enhance the access to geographic information (website CeGI). In addition, a permanent decision-body has been appointed by the Minister President's office; the GI-Commit-

Table 10.11 The GII maturity matrix for Northrhine Westphalia

Aspect	Stage Stand alone/ initiation	 Exchange/ standardisation	 Intermediary	 Network
Vision	Focus on individual organisation	**Developed with all stakeholders**	**Implementation**	Commonly shared, and frequently reviewed
Leadership	Focus on individual organisation	**Questioned**	**Accepted**	Respected by all stakeholders 'champion'
Communication	Focus on individual organisation	**Open between public parties**	**Open between all stakeholders**	Open and interactive between all
Self-organising ability	Passive problem recognition	**Neutral problem recognition**	Actively helping to solve identified problems	Actively working on innovation
Awareness for GII	Professionals in one organisation: organisational "GII"	**Professionals of organisations together: GII**	**Awareness at many levels including decision making**	Commitment at all levels/ continuous support in politics and management
Financial sustainability	Limited to projects	**Neutral**	**Guaranteed for certain period**	Sustainable but frequently reviewed
Delivery mechanism status	Project	**Product portal (geo-portal)**	Clearinghouse	Clearinghouse with information/service provision (e.g., downloads)

tee NRW (Committee for Geoinformation in Northrhine-Westfalia). It creates strategies for the creation of GDI, judges incoming project proposals referring to GDI, and advices the Minister President's office on geographic information (Riecken, 2000).

The high level of awareness at both the executive and political levels and the integration of geographic information in the national and regional e-government initiatives are promising for the further development of the GDI. NRW (see Deutscher Bundestag, 2003; Landtag, 2004). The technical solutions are being implemented, the access issues are being addressed, and the pricing and accompanying use restrictions are being discussed. The challenge over overcoming the institutional barriers is acknowledged at all levels and significant progress has been made to include the international concepts of a GII into the GDI.NRW.

The increased attention for geographic information may be explained by the increased use geographic information within public administration (see Riecken, 2000). Another explanation may be in the change in the discussion within the geographic information sector from technical issues to institutional issues. The federal GIW-committee, for example, focused for 2,5 years on technical issues. These issues are typically for in-crowd technical specialists and have now been solved (Ganswindt, 2004, p. 2). The challenge is now in addressing the institutional issues (Ganswindt, 2004, pp. 2-3), and this requires the support of the political and executive decision-making levels.

In Germany, the *Geocatalog* service (website Geocatalog) performs the function of a national clearinghouse since September 2003. It includes datasets from both public and private parties. Information concerning Northrhine

Table 10.12 Case study findings for the large-scale parcel and topographic information of Northrhine Westphalia

		Northrhine Westphalia
Technical	Internal	0
	External	–
Non-technical	Access policy	–
	Physical acces	0
Use	User groups	Primary and secondary
	Value added products	–

Westphalia can be found through this service. CeGi and the private company Conterra GmbH maintain the *Geocatalog*. In addition, in Northrhine Westphalia two portals exist that may function as a clearinghouse: *Geobasisdatenportal*, and the *Geodatenzentrum*. The *Geobasisdatenportal* (website Geobasisdatenportal) is the clearinghouse for the geographic framework information. Access is limited to the state authorities through the intranet of the LDS (Küpper, 2003). The *Landesvermessungsamt* runs the State *Geodatenzentrum Liegenschaftskataster* (Centre for cadastral information) (website Geodatenzentrum).

10.4.2 The Automatisierten Liegenschaftskarte (ALK)

The *Automatisierten Liegenschaftskarte* includes both parcel and large-scale topographic information. Therefore, the ALKs in Northrhine Westphalia were included in the case studies parcel in formation and for large-scale topographic information.

Information collection in Northrhine Westphalia is largely decentralised and carried out mostly on the regional and local levels, which means that the processing and maintenance of information is mostly tailored to local and regional requirements. This leads to built-in-incompatibility for both the range and freshness of the information collected and the collection criteria, periods and priorities. This, and the insufficient level of standardisation of the ALK is an obstacle for the extensive and easy use of information. In fact, additional time, labour and money often have to be spent on using different information sources (Riecken, 2001).

The ALK has been assessed from the perspective of a GII. Table 10.12 provides the overview. In Northrhine Westphalia, the quality of ALK at the local level is excellent (object-oriented, current, orientation towards open international standards, seal of authority, complete and comprehensive content). Further, the information collection and creation of ALK is anchored in legislation, guaranteeing to a great extend the existence, availability and quality of the datasets (see Table 10.13). However, at the state level the dataset has no complete digital coverage (some parts are still in analogue format), local datasets overlap, different exchange formats may be used, and the datasets have no uniform quality. These inconsistencies have resulted in poor scores in the technical data characteristics. Potentially, however, with full digital coverage the Northrhine Westphalian situation would be comparable to the situation in Denmark and

Table 10.13 Institutional issues for the large-scale parcel and topographic information of Northrhine Westphalia

	Stage			
Issues	**Stand alone/ initiation**	**Exchange/ standardisation**	**Intermediary**	**Network**
Awareness for geographic framework dataset (and data policy options)	Project based	Awareness among professionals within sector	Need commonly understood	**Formalised in (flexible) legislation**
Financial sustainability	Limited to projects	Neutral	Guaranteed for certain period	**Sustainable, but frequently reviewed**

the Netherlands and sufficient as framework layer in the NRW.GDI.

Access to the entire ALK datasets can be enforced through a request to the Cadastre Act. However, the ALKs cannot be re-distributed and prices are based on cost recovery principles. A contract must be signed prior to accessing the datasets. These characteristics do not promote the use of the ALKs. The access policy has been assessed from a GII perspective as poor.

The *Landesvermessungsamt* together with the local authorities is working to full coverage of Northrhine Westphalia in an integrated ALK dataset. However, until complete digital coverage has been reached, the 54 local cadastral offices need to be contacted for the parcel information. Further, potential information producers and users lack sufficient knowledge about the scope, quality, currency and availability of core and user-specific geographic information (see Riecken, 2001). Metadata documentation varies from source to source, but is generally poor to non-existent. In addition clearinghouse (website Geocatalog) does not include the integrated parcel dataset of the *Landesvermessungsamt*, and only ALK information from four individual locals governments was found here (01 December 2004). The limited documented metadata, and the number of access points for full coverage are the causes of the physical accessibility score of reasonable.

Use of the ALK is primarily in the public sector. “Potential private sector users complain that they come with too much or too little detail and inadequate possibilities for selection or aggregation. This is often not a problem of the base information as such, but of the lacking value chains linking them to end user needs and business models. Today the value chains of geographic information often consist, at best, of the information producer and the user alone. This constitutes a monolithic economic system with low efficiency” (Brox, et al., 2002). For the use part Micus’ findings of 2001 are still valid: the incomplete availability and currency of information, the lack of transparency, and the high price and restrictive use rights have for most customers a frightening effect (Micus, 2001a, p. 13; Micus, 2001b, p. 8). Only based on a full coverage of Northrhine Westphalia, the market will develop geographic information products and services (Micus, 2001b, p. 8).

10.4.3 Promoting GII development in Northrhine Westphalia

At this moment, the incomplete coverage of the ALK for Northrhine Westphalia is among the priorities of the Northrhine Westphalian geographic

Table 10.14 The Massachusetts' GII maturity matrix

	Stage			
Aspect	**Stand alone/ initiation**	**Exchange/ standardisation**	**Intermediary**	**Network**
Vision	**Focus on individual organisation**	**Developed with all stakeholders**	Implementation	Commonly shared, and frequently reviewed
Leadership	Focus on individual organisation	**Questioned**	**Accepted**	Respected by all stakeholders "champion"
Communication	Focus on individual organisation	**Open between public parties**	Open between all stakeholders	Open and interactive between all
Self-organising ability	Passive problem recognition	**Neutral problem recognition**	Actively helping to solve identified problems	Actively working on innovation
Awareness for GII	**Professionals in one organisation: organisational "GII"**	**Professionals of organisations together: GII**	Awareness at many levels including decision making	Commitment at all levels/continuous support in politics and management
Financial sustainability	**Limited to projects**	**Neutral**	Guaranteed for certain period	Sustainable but frequently reviewed
Delivery mechanism status	**Project**	**Product portal (geo-portal)**	Clearinghouse	Clearinghouse with data/service provision (e.g. downloads)

information sector. Besides the necessary coverage, also metadata documentation, the state clearinghouse, adherence to identical information specifications, and adherence to open exchange formats (GML) need priority. This would result in excellent technical data characteristics, but are no guarantee for increased use. Therefore, the restrictive access policies need to be changed into more open policies. A change in access policy for tertiary users from cost recovery to open access is likely to result in macroeconomic advantages, which may result in higher taxation income for central government. To guarantee the current technical parcel information characteristics, the potential loss of income for the local government because of a change in access policy needs to be compensated by state government. The current levels of awareness among politicians and high-level bureaucrats is such that a change of access policies for the ALKs is likely to satisfy the NRW.GDI objectives better than the current cost recovery policies.

10.5 Massachusetts

10.5.1 GII development in Massachusetts

Legislation has established MassGIS as the official state agency assigned to the collection, storage and dissemination of geographic information (see G.L.M. c. 21A, s.4b). MassGIS is the Commonwealth's Office of Geographic and Environmental Information, within the state's Executive Office of Environmental Affairs (EOEA). The legislation gives MassGIS the mandate: "to collect, consolidate, store and provide geographic and environmental information in order to improve stewardship of natural resources and the environment, promote economic development and guide land-use planning, risk assessment, emergency response and pollution control" (see chapter 7 section 8.2).

Further, the Massachusetts Geographic Information Council (MGIC) frequently meets, featuring presentations by geographic information professionals. The council serves as the primary forum promoting the sharing of high quality geographic information concerning the physical, social, and economic environment of Massachusetts by state, federal, and local governments and the private sector (website MassGIS).

MassGIS received from the state budget, as part of the EOEA budget, a total of $510,000 for the year 1999 (Commonwealth of Massachusetts, 1999). Since then this amount has decreased into a $279,000 in 2004 (Commonwealth of Massachusetts, 2005). This budget decrease of 47% (without inflation) has forced MassGIS to focus on the needs of its parent agency, the EOEA and the state, and not necessarily on those of others within Massachusetts. Therefore, the coordination of GIS activity in regional planning agencies as well as in city/town government has been limited.

One interviewee said it as follows: "The communication between towns about GIS is still at the 'grass-root' level and not so much at the decision-making levels." The Massachusetts state model for coordination of geographic information technology scores in the NSGIC assessment a shared 26th position in the US (NSGIC, 2004). However, MassGIS' Web Mapping Services was one of the 3 winners of Urban and Regional Information Systems Association (URISA)'s 2005 Exemplary Systems in Government (ESIG) award in the category of Enterprise Systems (see website MassGIS). URISA acknowledged the MassGIS system as an outstanding example of sharing geospatial data, technology, and professional resources.

Most state agencies rely on the information MassGIS provides. At the local level the GII stakeholders are utilities, and towns and cities. Private sector involvement in the development of the Mass GII has been limited to mapping (imagery) and consultancy to the users of the information (e.g., local governments).

The central point for access to geographic information in Massachusetts is the MassGIS website (website MassGIS1). The datasets that are provided are described and can be downloaded. If one cannot download information, one may also order information on CDs through the web site.

The main focus of the MassGIS website is state agencies. There is some information from other governments than the state. Private sector information is, however, not published. Also large-scale information available from the towns and cities are not included in the service. The MassGIS website could function as a clearinghouse for the state, but its scope should be extended

Table 10.15 Institutional issues for Massachusetts' parcel datasets

	Stage			
Issues	Stand alone/ initiation	Exchange/ standardisation	Intermediary	Network
Awareness for geographic framework dataset (and information policy options)	**Project based**	**Awareness among professionals within sector**	Need commonly understood	Formalised in (flexible) legislation
Financial sustainability	**Limited to projects**	**Neutral**	Guaranteed for certain period	Sustainable, but frequently reviewed

Table 10.16 Technical, non-technical and use characteristics of the Massachusetts parcel datasets

		Massachusetts
Technical	Internal	–
	External	–
Non-technical	Access policy	++
	Ease to access	0/–
Use	User groups	Primary and secondary
	Value added products	–

and a search facility included, together with adherence to the FGDC metadata standard, in order to be a well functioning clearinghouse.

10.5.2 Parcel datasets in Massachusetts

Chapter 8 has evaluated the status of parcel mapping in Massachusetts from the perspective of a GII (see Table 10.15 and Table 10.16). Parcel information in Massachusetts has been assessed in all technical categories to be insufficient from a GII perspective. This is explained by the wide variety of technical characteristics of the 351 datasets of which significant percentages are not in digital format and/or not adhering to a standard data model. The MassGIS parcel information standard is being adhered to by a significant, but relative to the other cases, small amount of local governments (10-45%). Accordingly, the datasets in Massachusetts vary so much in their characteristics that a Massachusetts-wide parcel information coverage with some kind of harmonised characteristics is not expected to be achieved shortly.

For the non-technical data characteristics the open access policies of Massachusetts' government are very positively assessed for GII development. However, the ease to obtain parcel information covering entire Massachusetts is hampered by the 351 entities that need to be contacted. These datasets are not included in the state clearinghouse, metadata varies heavily, and information is generally not directly accessible.

Use of the parcel information is in local government (MassGIS, 2003; Geagan et al., 2004) and incidental users are utilities. It may be because of the difficulty of finding the information from local government that few commercial users use the parcel information with the notable exception of real estate agents. The research did not encounter any duplicate parcel datasets.

10.5.3 The topographic datasets

Chapter 9 has evaluated the large-scale topographic datasets in Massachusetts. In Massachusetts, topographic mapping is primarily accomplished by private or semi-public utilities. The technical and non-technical data characteristics are assessed to be poorly developed from a GII perspective (see Table 10.17 and Table 10.18). In order to obtain Massachusetts covering large-scale topographic information, one will need to (a) contact each city, town, or utility, b) cope with different access policies (fees, use restrictions), (c) deal with significant differences in technical data characteristics, and (d) conclude that in many instances topographic information is non-existent.

The ad hoc basis of information collection, the fragmentation in information specifications, and the lack of topographic information for certain areas provide a poor basis for these datasets to become a framework layer for topography for Massachusetts.

The central point for access to geographic information in Massachusetts is the MassGIS' website (website MassGIS1). Information from the utilities are not published here. Many Massachusetts cities and towns have online GIS datasets available. This information is, however, not downloadable. The exception is information available from the Boston Atlas (website Boston Atlas) and the City of Fitchburg.

Further, utilities control the use of their information through copyright and additional use restrictions. These use restrictions limit the use to the internal use of an organisation: no re-selling is allowed. It has been stated that without the ability to control the dataset, and to collect some money, the utilities probably would not have entered into information sharing arrangements with the public sector.

Local government and utilities use the topographic information. Architects and also academics use (some of) the information. The research did not find private sector value-addeded products based on large-scale topographic information. Several public value-adding products were found, such as linkages to parcel datasets, and the inclusion of images.

The research found evidence that for several areas more than one topographic dataset exists, indicating duplicate efforts. The 1:5,000 colour imagery of MassGIS covers Massachusetts, is freely available and widely used as a base map, but interviewees indicated that it is insufficient for local planning and maintenance purposes.

Table 10.17 Institutional issues for Massachusetts topographic datasets

	Stage			
Aspect	**Stand alone/ initiation**	**Exchange/ standardisation**	**Intermediary**	**Network**
Awareness for geographic framework dataset (and data policy options)	**Project based**	Awareness among professionals within sector	Need commonly understood	Formalised in (flexible) legislation
Financial sustainability	**Limited to projects**	Neutral	Guaranteed for certain period	Sustainable, but frequently reviewed

Table 10.18 Case study findings for Massachusetts large-scale topography

		Massachusetts
Technical	Internal	– –/N/A
	External	– –/N/A
Non-technical	Access policy	– (++)
	Physical access	– –/N/A
Use	User groups	Primary and secondary
	Value added products	–

10.5.4 Promoting GII development in local Massachusetts

Given the requirements in the research framework, the data characteristics of both the parcel datasets and the topographic datasets is poor. The research has, however, not found a direct relation between the quality of the large-scale information and its access policy. The poor data characteristics may rather be found in the decentralised way government is set up, the culture of local independence, and the lack of efforts to coordinate local government activities.

The research concludes that the barrier for GII development in Massachusetts is the lack of coordination at the local levels. Although local government and utilities have similar needs for base mapping, their cooperation has been very limited. Also cooperation between local governments for the collection of large-scale topographics to take advantage of the economies of scale, has not been found. In order to come to the full utilisation of the Massachusetts GII, the lower levels of government need to cooperate. A coordination body serving the needs of the local communities may promote this cooperation. MassGIS may take this role, and according to its legislated tasks it should, but the limited resources have forced MassGIS to focus on the needs of state agencies, and not so much on satisfying local government needs.

The current position of MassGIS can historically be explained, but from the perspective of the development of the *state* GII it should perhaps be located differently in state government. Alternatives used in other states that might be relevant for MassGIS would be to designate it as a public non-profit organisation. Another approach might be to include the central GIS coordination function that MassGIS provides as part of the state Information Technology Office.

A first and easy step towards promoting the GII would be to publish the metadata of the parcel and public and private topographic datasets on the MassGIS website. This would increase the transparency of datasets, their characteristics, and potentially their use.

10.6 MetroGIS

10.6.1 GII development in the metropolitan region of Minneapolis and St. Paul

MetroGIS is the accepted leader for GII development in the metropolitan area. MetroGIS is an initiative that helps local governments in the seven county Twin Cities metropolitan area more effectively carry out their operations and manage costs through collaboratively addressing GIS-related needs. MetroGIS provides the forum to implement consensus-based policies and procedures, data characteristics needed to achieve the common information, and a central portal for access. MetroGIS has no legal standing but relies on an informal voluntary structure for participants collaboratively develop and implement regional solutions to common geographic information needs. MetroGIS relies upon stakeholders for funding, contracting and legal services, and official standing to receive and spend funds. MetroGIS's core stakeholder community include 7 counties, 191 cities, 59 school districts, 39 watershed districts, and several regional government interests. State and federal interests, although not core, are also actively involved, as are utilities, non-profits, and for-profits. MetroGIS may therefore be characterised as a facilitator of GII development in the Metropolitan area.

MetroGIS together with its stakeholders has set its priorities and based on these it operates. The mission of MetroGIS is to provide an ongoing, stakeholder-governed, metro-wide mechanism through which participants easily and equitably share geographically referenced information that are accurate, current, secure, of common benefit and readily usable. The desired outcomes of MetroGIS include:

- improve participant operations;
- reduce costs;
- support cross-jurisdictional decision making (website DataFinder).

To address the mission, MetroGIS has initiated the creation of the integrated parcel dataset, which is only available to stakeholders of MetroGIS. Further, it initiated the acquisition of the privately held road centreline dataset for use within the MetroGIS community (see chapter 5 section 5.5). The achievements of MetroGIS have been enormous in the priority areas, while other areas are,

Table 10.19 Metropolitan region of Minneapolis and St. Pauls GII maturity matrix

	Stage			
Aspect	**Stand alone/ initiation**	**Exchange/ standardisation**	**Intermediary**	**Network**
Vision	Focus on individual organisation	**Developed with all stakeholders**	**Implementation**	Commonly shared, and frequently reviewed
Leadership	Focus on individual organisation	Questioned	**Accepted**	Respected by all stakeholders "champion"
Communication	Focus on individual organisation	**Open between public parties**	Open between all stakeholders	Open and interactive between all
Self-organising ability	Passive problem recognition	**Neutral problem recognition**	Actively helping to solve identified problems	Actively working on innovation
Awareness for GII	Professionals in one organisation: organisational "GII"	**Professionals of organisations together: GII**	**Awareness at many levels including decision making**	Commitment at all levels/continuous support in politics and management
Financial sustainability	**Limited to projects**	**Neutral**	Guaranteed for certain period	Sustainable but frequently reviewed
Delivery mechanism status	Project	Product portal (geo-portal)	**Clearinghouse**	**Clearinghouse with information/ service provision (e.g., downloads)**

from the perspective of a GII, still struggling.

One of the major benefits of MetroGIS has been improved attitudes about sharing in the region more than actual acquisition of information as the major benefit of MetroGIS (Craig 2001). Before the MetroGIS era information was sold between governments leading to duplicate datasets throughout government. Now information is commonly shared and the duplication of datasets is minimised (at least in government).

In conclusion, the focus of MetroGIS is meeting the needs of its public stakeholders. The vision, communication and leadership focus on the needs of the public sector, with less priority to private sector needs (see Table 10.19). Financial resources are limited for MetroGIS, with the Regional government as the major provider of MetroGIS' funds. MetroGIS participants contribute to MetroGIS in kind.

DataFinder is the MetroGIS clearinghouse (website DataFinder). It was the winner of the 2001 inaugural Geography Network Challenge (website ESRI). Datafinder is a registered node of the US NSDI Geospatial Data Clearinghouse, complying for information documentation, indexing and searching (see website clearinghouse). DataFinder further allows MetroGIS stakeholders to download information through its DataFinder Café. DataFinder includes information from 18 publishers and a total number of 161 datasets. Datafinder, however, does not publish private sector information, except for the road centre line dataset.

10.6.2 Integrated parcel dataset

In chapter 8 the integrated parcel dataset has been evaluated from the perspective of a GII (see Table 10.20 and Table 10.21). The integrated parcel dataset is an almost completely harmonised product covering 55 parcel attributes for the metropolitan area.

The internal technical data characteristics were assessed to be reasonable. Especially the inconsistencies within the dataset contributed to this conclusion. Although all counties agreed on the content of the regional parcel dataset, the integrated parcel dataset is not a fully harmonised product with respect to the content delivered by the counties. Of the 55 agreed attributes only 11 are populated for all counties (MetroGIS, 2005; website DataFinder Parcel). Further, the positional accuracy is not consistent and overlaps and gaps may exist between county datasets.

The external technical data requirements of the integrated parcel dataset were assessed to be sufficient for the GII. The dataset has full jurisdictional coverage, adheres to the U.S. cadastral model and the standardised metadata is comprehensive on the dataset level. The exchange format is proprietary.

Access to the integrated parcel dataset is restricted by licensing requirements imposed by the counties that supplied the source information. The dataset is freely available to MetroGIS' stakeholders, but others cannot acquire this dataset through MetroGIS. The counties agreed upon a standardised fee schedule for the same information that comprises the integrated parcel dataset distributed to MetroGIS' core stakeholders via DataFinder ($0,05 per parcel).

The Metropolitan region has one contact point for MetroGIS stakeholders and information can be downloaded from this point. Non-stakeholders need to contact the seven counties that collected the original information.

Primary use of the integrated parcel dataset is in government. Especially the government entities with cross-county jurisdiction such as the Metropolitan Council, Watershed Districts, State agencies, and Emergency services have benefited from the integrated parcel dataset. Secondary use is in the utilities, engineering firms, academia, and also title insurance companies use the parcel information frequently. The integrated parcel dataset is not available to the private sector and value-addeded products based on the integrated parcel dataset were not found.

The integrated parcel dataset has resulted in a minimisation of duplicate efforts in government, especially in the organisations with a parcel information need in more than one county.

In Metropolitan region of Minneapolis and St. Paul, MetroGIS initiated together with its stakeholders the creation of the integrated parcel dataset. Within MetroGIS, the culture of information sharing together with respecting participants' (data producers) needs has positively contributed to the creation of the integrated parcel dataset. Respecting the participants' needs included

Table 10.20 Institutional issues for the MetroGIS parcel datasets

	Stage			
Issues	Stand alone/ initiation	Exchange/ standardisation	Intermediary	Network
Awareness for geographic, framework dataset (and information policy options)	Project based	Awareness among professionals within sector	**Need commonly understood**	Formalised in (flexible) legislation
Financial sustainability	Limited to projects	Neutral	**Guaranteed for certain period**	**Sustainable, but frequently reviewed**

Table 10.21 Technical, non-technical and use characteristics of the MetroGIS parcel dataset

		MetroGIS (Minnesota)
Technical	Internal	0
	External	+
Non-technical	Access policy	–
	Physical access	+
Use	User groups	Primary and secondary
	Value added products	–

respecting their restrictive access policies. Through a cost recovery approach, the counties may recover some of their cost for integrating the seven county datasets in one MetroGIS dataset. In MetroGIS all public entities (over 300) are partners and they can use the information against no costs. Private sector users, however, are not in the same position and have to buy the dataset against a high price. The weak institutional embedding of MetroGIS forced MetroGIS to follow this 'polder model' strategy, but the integrated parcel dataset now exists and providers are discussing more open access policies.

The cost recovery price can be asked because of the classification of public information with a commercial value. However, the sales numbers of parcel datasets lack evidence of the supposed commercial value of the dataset. This may imply that the commercial value of the parcel dataset has been, and still is, overestimated. The most appropriate classification of the dataset would then be public information[23]. This change in classification from public information with a commercial value to public information should accordingly result in prices not accounting for the developing cost of the information. Investing considerable amounts of public funds does not imply that the parcel dataset has such value for others that a market price can be asked. Current

23 See also Johnson (2004): "The State of Minnesota Information Policy Analysis Division has informally challenged our licensing process by requesting unlimited access to our data through a request made at the City of Maple Grove. The state has made a claim that GIS parcel data that is produced by Hennepin County is public unless otherwise classified. Hennepin County maintains a declaration of copyright on the data that allows us to restrict distribution of data through our licensing process".

duplicate efforts in the private sector, which have been identified, would probably be non-existent if the counties had early on agreed to a more open policy allowing access for all to the integrated dataset. The limited tertiary use is likely to relate to the restrictive policies.

Several interviewees indicated that providing the information for free would have a minimum impact on the income of the counties and will not impact the quality of the information, while one interviewee would expect that losing an income stream would affect negatively the frequency and quantity of updates. Some interviewees in this case stated that maintaining the licensure at least equals the income generated through sales, and question the necessity of the current restrictive policies.

10.6.3 The topographic datasets

While for the parcel dataset some harmonisation has been achieved for the Metropolitan area, the topographics still have a long way to go (see Table 10.22 and Table 10.23). To obtain a topographic dataset for the Metropolitan area, one will need to (a) contact each city, and county, (b) cope with different access policies (fees, use restrictions), (c) deal with differences in content, quality, and scale, and (d) conclude that in many instances topographic information is unavailable. There is no legal obligation for anyone including government to collect, process and manage topographic information. Accordingly only three of the seven counties in the Metropolitan region have topographic information with full county coverage. In other counties topographic information may be available for individual towns or cities. The City of Minneapolis, for example, has comprehensive topographic information (see websites MN Minneapolis).

Several counties cooperated with the cities or utilities for topographic information collection. In one county the GIS together with the topographic information was developed as a cooperative effort of the county, eleven cities within the county, and a local electric utility. Departments in each had a need for these, but none was able to convince their elected officials to make the investment alone. The cooperative effort convinced those policy makers, by showing them the financial savings of working together and the political embarrassment of not cooperating (Craig, 2001).

In another county, the topographic information collection is the result of cooperation between the County and the county geographic information user group. The user group includes 20 public organisations (see website MN Ramsey County GIS User Group).

Access to the Dakota, Ramsey or Scott County dataset is promoted through the publication in DataFinder. The information from the cities or towns are, however, not available through this service.

The topographic information is not freely available, and its use restricted

Table 10.22 Institutional issues for large-scale topographic datasets in the Metropolitan region

	Stage			
Issue	**Stand alone/ initiation**	**Exchange/ standardisation**	**Intermediary**	**Network**
Awareness for geographic framework dataset (and information policy options)	**Project based**	Awareness among professionals within sector	Need commonly understood	Formalised in (flexible) legislation
Financial sustainability	**Limited to projects**	Neutral	Guaranteed for certain period	Sustainable, but frequently reviewed

Table 10.23 Case study findings for large-scale topography in the Metropolitan region

		MetroGIS (Minnesota)
Technical	Internal	– –/ N/A
	External	– –/ N/A
Non-technical	Access policy	–
	Physical acces	+ +/ N/A
Use	User groups	Primary and secondary
	Value added products	–

by the originator of the information. The information is classified as public information with a commercial value, and copyrighted. The use of the available topographic information is primarily in government organisations and utilities. Some utilities bought the county dataset(s) once and are maintaining it themselves, others have a partnership with county government.

It is unclear whether the restrictive access policies have a negative impact on the technical characteristics of the topographic information. It is more likely a lack of cooperation between potential stakeholders (counties, cities, and utilities), is the cause of the, from the perspective of a GII, poor technical data characteristics of the topographic information. Unlike the integrated parcel dataset, Metro-wide large-scale topographic coverage does not have a ‘problem owner’.

One interviewee suggested that MetroGIS participants should take advantage of economies of scale for topographic mapping. For example, the price for the collection of topographic information for a narrow strip of land 400 feet wide for a typical construction project in a city would now be $200/400 per acre. However, if this information is flown for a complete City or County in the MetroGIS area it could be reduced to $20 per acre. This implies that government can collect this information for entire Cities without paying significantly more for it. This approach needs coordination and the willingness of all levels of government to cooperate and contribute.

If large-scale topography is given priority in MetroGIS, then its achievements for the integrated parcel dataset and the road centreline dataset are likely to be exemplary for the future of a topographic layer for the Metropolitan area.

10.6.4 Promoting GII development in the Metropolitan region

MetroGIS benefits and has benefited from the existence of an accepted leader, a champion. The champion together with the enthusiasm of the sector has brought the success of the integrated parcel dataset, the road centreline dataset and the well-developed clearinghouse. Further, the current public orientation of MetroGIS should benefit from the expertise of the private sector in the area. Moreover, improved communication with the private sector in developing the Metropolitan GII may result in win-win situations. For example, the collection and processing of topographic datasets may benefit from private sector involvement, especially from the involvement of utilities. Other areas, which may be addressed are inclusion of private sector datasets in the regional clearinghouse and allowing private sector users to access the integrated parcel dataset and other datasets through the clearinghouse. Private sector involvement may also result in a user oriented GII with access policies promoting tertiary use. Finally, inclusion of the private sector in GII development will further increase the awareness for the Metropolitan GII.

10.7 Overall assessment

This chapter has provided some insights in the development of the GIIs in the case-studies. Focus in the assessment has been the large-scale spatial framework information. The assessment of the five cases show that in each case some GII elements are better developed than others. Generally the European GIIs are more advanced in their development than the Massachusetts GII and the Metropolitan region of Minneapolis and St. Paul.

10.7.1 Case study findings

In this research, some of the datasets can be categorised from a technical GII point of view as in stage one where others can be categorised as in more advanced stages. Especially the Danish cadastral dataset fits the technical GII requirements well. The parcel and topographic datasets in Massachusetts and the topographic datasets in Metro are datasets that qualify for stage one (stand-alone). In Massachusetts, parcel information is heterogeneous of quality varying from high quality digital to analogue non-geo-referenced datasets. It would be time and money consuming to integrate these datasets into one jurisdiction wide dataset. In Metro, the topographic information is available in three of the seven counties. Full coverage cannot be reached since for a significant area no topographic information is available.

In the Netherlands and Denmark for large-scale topography and in Metro for county-wide topographic information, both public and private parties invested in the collection of the datasets purely necessary for executing their public or private tasks. Reuse by others than the partners was not the primary focus of the cooperation. However, now these datasets may be considered a framework layer for their jurisdiction, the sometimes heterogeneous quality, the use restrictions, and prices are potential barriers for the further development of the datasets and the GII.

In Northrhine Westphalia, the Landesvermessungsamt together with the local governments is working towards a cadastral/topographic map with harmonised characteristics for Northrhine Westphalia. The dataset covers 87% of Northrhine Westphalia, but the content, the seal of authority and the legislated task to collect, process, maintain and disseminate the information together with pressures to open the restrictive policies are promising for the future of the Northrhine Westphalian GII.

Although at first sight the restrictive cases all large-scale datasets have more advanced technical data characteristics than datasets in the open access case, the relation is not so clearly evidenced by this research: the relation between the access policy and quality of a dataset is complex. The research did not find evidence for or against the existence of a relation between the technical data characteristics and the access policy of information. However, the research found evidence that there is a relation between the institutional setting on the one hand and the consistency of the access policy, the physical access characteristics and the technical characteristics of a dataset on the other hand.

10.7.2 Dataset specific recommendations

Jurisdictions with framework datasets embedded in legislation and with advanced technical geographic framework data characteristics, which adhere to restrictive access policies are recommended to change their policies into more open policies for tertiary users: it will promote the development of value-adding services, bring geographic information to the people and as a result build capacity and awareness for the value of geographic information for our society. In the case studies such a situation was found in Denmark for the parcel dataset, in the Netherlands for both the parcel dataset, and in the Metropolitan region for the parcel dataset.

In instances that lack either sufficient level of awareness or advanced technical geographic framework data characteristics cost recovery policies may be more beneficial for GII development. It allows for the cooperation with private sector in building the needed dataset. Ultimately the dataset may acquire a legislated status with open policies.

10.8 Role of access policies in GII development

Two components may be decisive for the most appropriate access policy: awareness at the decision-making levels and sufficient and sustainable financial resources. Chapter 5 suggests that the extent of awareness of the value of spatial information for society is decisive for the choice of the most appropriate funding model for government spatial information provision. Therefore, the most appropriate access policy is likely to be directly linked to the level of GII development. Here, we discuss per stage of framework dataset development the most appropriate access policy.

10.8.1 Stand-alone/initiation stage

In the stand-alone stage, the information provider is unaware of the potential of its dataset. The dataset has not acquired the status of framework dataset and the organisation is internally focused. The information policy is non-existent: the dataset is not available to others due to reasons of security, or simply because of a lack of awareness of the potential of the dataset. In these instances, any change from not providing the dataset to allowing others to use it either through cost recovery or open access policies will promote GII development.

10.8.2 Exchange and intermediary stage of framework dataset development

Focus in the exchange and intermediary stages is on information development and continuation of the existence of the dataset instead of promoting its use among tertiary users[24]. In the exchange and intermediary stages of development, the level of awareness is not sufficient for guaranteed funds for information collection and maintenance. Especially when significant investments must be made to create a framework dataset for an entire jurisdiction, either by integrating existing datasets, or through new information collection. Without sufficient awareness for the spatial framework dataset within government the costs for spatial information collection are such that often government can only satisfy its needs through cooperation with other parties. Substantial gains may be found in public-public or public-private cooperation, for example in cooperative information collection. Cost recovery policies may under such circumstances promote state or nationwide GII development.

24 One should first go through the first stages of GII development (data focus) before entering an advantage stage (use focus).

Public-private partnerships

The case study confirms that in instances with insufficient awareness for geographic information there may be a special role for the private sector in meeting GII objectives. The additional financial resources for spatial information collection may be found in the private sector. However, private entities are only likely to partner with the public entity if their investments are not flowing towards its competitor: private sector will require restrictive policies in exchange for their investment.

Cost recovery policies may promote cooperation with the private sector to share the cost of information collection. These policies further provide the means to control the datasets' use and accordingly the sales of the dataset may provide some financial relief to the partnership. In this way cost recovery policies may lead to large-scale information available to a limited group of users (primary can use, but other users cannot afford it) whereas they otherwise may not have been available at all.

However, cost recovery policies are likely to result in duplicate efforts. The development of privatizing utilities has brought several uncertainties that may impact the data characteristics and/or data availability. The direct competitor of a utility would value the information as high as the collection cost, but is unwilling to pay that price since he would then not take the most advantage of the efforts of his colleague; he would rather collect the information himself.

In the case study public-private partnerships have been found in the collection, and maintenance of topographic information in the Netherlands, Denmark, Metro, and to a smaller extent in Massachusetts and Northrhine Westphalia. Especially utilities may play a critical role in the collection, creation and maintenance of large-scale topographic information. They are not only a major user of quality large-scale topographic datasets, in four of the five researched cases utilities are also important for collecting large-scale topography. Through public-private partnerships, or independent of government they supported the GII through collecting, creating and maintaining digital large-scale topographic information.

Public-public cooperation

Local public entities level may cooperate to take advantage of economies of scale. Especially in topographic information collection, public entities may acquire better technical data characteristics against fewer costs (per ha). Information collection for one town is likely to be more expensive per hectare than information collection for a complete state. Public-public cooperation may also serve and attract secondary users with administrative boundaries different from the current information providers (e.g., towns versus police districts). Public-public cooperation may also result in the use of harmonised data models, adherence to the same standards and other aspects that may not be needed in the individual local governments. Other levels of government and the private sector, however, may benefit significantly from harmonising efforts. The potential economic benefits of higher taxes from the geographic information sector are not directed to those bearing the cost (local level). Cost recovery policies may provide some financial relief and help justify the investment with the local decision makers.

Partnerships and open access?

Open access policies may limit the ability to establish public-private and public-public partnerships. If cooperation between public and private parties implies that information collected is subject to open access policies, the private party is unlikely to invest in such cooperation since potentially competitors may acquire the dataset under an open records request (see also Holland, 1994). Therefore, the access policy may play a significant role in the success of cooperative efforts between public and private organisations investing in GII development.

The situation in Massachusetts may be exemplary. In Massachusetts, the open access policies for government do not allow for recovering the cost of the integration and harmonisation of the local datasets, for example, the parcel dataset. The beneficiary, state or federal government will need to compensate local government. It is, however, questionable whether local governments will invest in such an operation since the benefits will ultimately be received by the state or federal budget and not by the town bearing the cost. With a cost recovery policy in place, local government controls the use of its dataset, which may be integrated in a jurisdiction-wide dataset and a harmonised framework dataset is more likely to be developed.

When the objective of the GII is to promote the widespread use of the geographic information, public-private partnerships would qualify as not promoting GII development. The restrictive policies may result in suboptimum sectoral GIIs, including duplicate datasets. However, although the tertiary user needs are important for GII development, these needs should not always be prioritised. Often it is more beneficial for society that the information is collected and disseminated for a (market) price than maintenance of the status quo of not having the information. When the appropriate institutional framework is not in place, it is business-unwise to collect certain information and provide open access to this information without guarantees about the continued collection and maintenance of the dataset.

For this stage of GII development it would be recommended that the income should be used for improving the dataset with long-term guaranteed availability and in this way allows for developing the GII.

10.8.3 Network stage

In the network stage of GII development, awareness for the value of the framework dataset is ubiquitous. If the awareness for framework spatial information provision is high at the decision-making levels and sufficient financial resources are available, it is likely that the framework information will be collected and maintained. In developing the dataset characteristics the tertiary users will be equally important as the primary and secondary users. Open access to government information policies seem then to be most appropriate. Open access may support GII development by promoting sharing information among government agencies and the high use of government information in private sector solutions. The income generated from the tax on private sector solutions flows back into the GII because of the high level of GII awareness.

Examples of situations with awareness for the value for a specific dataset may be datasets that follow directly from legislation. The access policy in such a situation is purely a political choice and depends on the awareness for a policy option. However, in the case studies the legally embedded parcel datasets adhered in 4 of the 5 cases to cost recovery policies.

Examples of successful open access policies are available from the US federal government. However, also the open access model in the US has not been without discussion. Open access policies can only be maintained overtime if their need is understood and supported broadly by most stakeholders, including academics, private sector, local, state and federal government.

Jurisdictions that lack this awareness as well as commitment for geographic information provision probably need additional information about the (lack of) success of current access policies to introduce successfully more open models.

10.9 Summary

This chapter has provided for each jurisdiction, the findings of the case studies. Through the case studies an assessment has been made about the role access policies may play in developing a geographic information infrastructure. The case studies showed that both open access policies and cost recovery policies may promote GII development. Cost recovery policies promote the involvement of private sector information collection efforts, which increases the likelihood that the expensive large-scale datasets are existing. This is beneficial for the GII in instances where awareness for a framework dataset at the decision-making levels is lacking. Although use is limited to primary and secondary users, public-private partnerships are important for the existence of large-scale spatial framework datasets, and the opportunity remains that the dataset may ultimately become fully supported by public funds. Such a development is, for example, considered in the Netherlands for large-scale topography, and discussed in Denmark for the *Tekniske Kort*. Ideally, in a network stage of GII development, guaranteed public funding for information of infrastructural qualities would be the model to go for.

11 Conclusions

11.1 Introduction

This research centred around the question: *What role do access policies play in the development of a geographic information infrastructure (GII)?*
The three objectives of the research were:

1. to develop a model that describes the different stages of development in geographic information infrastructures;
2. to provide a framework for researching access to geographic framework information policies in the context of the development of geographic information infrastructures, accounting for the level of development of such infrastructure; and
3. to assess the impact of access policies on the characteristics and use of large-scale geographic framework datasets.

This chapter sets forth the main results of the research. The first three paragraphs touch on each of the objectives of the research results. Section 11.5 presents an interesting sidelight: how local governments deal with the issue of access policies in the US. Further, we have used the results as a basis for proposing ways to promote further GII development. Finally, we suggest issues for further research.

11.2 Objective 1: modelling GII development

Our research developed a model that describes the different stages of development for geographic information infrastructures: the GII maturity matrix. The matrix focuses on development from an institutional perspective (see Table 11.1).

The GII maturity matrix is comprised of four stages of GII development. In the most advanced stage or network stage, there is a common understanding about what a GII consists of and what its objectives and ideals are. Further, leadership, open communication channels, and a proactive geographic information sector have led to such capacity, which allows the GII to enjoy broad support at all levels, leading to sustainable funding for GII development. Although the network stage and the initial stage can be identified fairly easily, this is less true for the two intermediate ones. There is no clear demarcation between the different stages; this needs to be subject of further research.

In addition to the GII maturity matrix, we also developed a framework dataset maturity matrix. This matrix accounts for the institutional, technical (quality), and non-technical characteristics (information policy, delivery mechanism) of a dataset. It also distinguishes between user categories that are likely to use the dataset at a given stage of GII development.

In the initial stages of dataset development, the typical user is part of the

Table 11.1 The GII maturity matrix

Issue	Stage: Stand alone/ initiation	Exchange/ standardisation	Intermediary	Network
Vision	Focus on individual organisation	Developed with all stakeholders	Implementation	Commonly shared, and frequently reviewed
Leadership	Focus on individual organisation	Questioned	Accepted	Respected by all stakeholders 'champion'
Communication	Focus on individual organisation	Open between public parties	Open between all stakeholders	Open and interactive between all
Self-organising ability	Passive problem recognition	Neutral problem recognition	Actively helping to solve identified problems	Actively working on innovation
Awareness for GII	Professionals in one organisation: organisational 'GII'	Professionals of organisations together: GII	Awareness at many levels including decision making	Commitment at all levels/ continuous support in politics and management
Financial sustainability	Limited to projects	Neutral	Guaranteed for certain period	Sustainable but frequently reviewed
Delivery mechanism status	Project	Product portal (geo-portal)	Clearinghouse	Clearinghouse with information/ service provision (e.g., downloads)

organisation that produced the information. There may not yet be any access policy for other users. Then, at a later stage, it becomes evident that other users may need the dataset for similar purposes. Some users may only use it for a particular project, while others will have a permanent need. The latter group of users may enter on a partnership programme with the initial information provider. In the intermediary stage value-adding (tertiary) users require access. Finally, all potential users of the dataset are reached either directly or through a wide variety of services.

Ideally, the value of a framework dataset will be commonly understood, and if it is embedded in legislation, it is likely to have a fairly secure future existence. The dataset should have excellent technical characteristics, including harmonised content, full jurisdictional coverage, and accurate, current information. Further, all uses should be promoted through consistent, transparent open information policies. These characteristics will help make the framework dataset a likely basis for the proactive geographic information sector, which continues to enlarge support for the concept of the GII with best practice solutions. Table 11.2 shows the complete geographic framework dataset maturity matrix.

The stages are roughly correct for this matrix, but we did not research where one stage ends and another begins. For example, the point at which information quality and access policy will be used by tertiary users remains unanswered by this research.

Both maturity matrices model GII development from an institutional,

Table 11.2 Development of a framework dataset in the GII maturity matrix

Aspect		Stage: Stand alone/ initiation	Stage: Exchange/ standardisation	Stage: Intermediary	Stage: Network
Awareness for dataset (and information policy)		Project based	Awareness among professionals within sector	Need commonly understood	Formalised in (flexible) legislation
Financial sustainability		Limited to projects	Neutral	Guaranteed for certain period	Sustainable but frequently reviewed
Technical characteristics	Internal	Poor	Sufficient	Good	Excellent
	External	Poor	Sufficient	Good	Excellent
Access policy	Legal access policy Enforceability	No	Yes, for insignificant parts of the dataset	Yes, for significant parts of the dataset	Yes, for complete dataset
	Use restrictions	No access	Use restricted to internal purposes	No redistribution (resell)	Only privacy and security limitations
	Financial access	No access	Market price – full cost recovery	Partial cost recovery	≤ Marginal cost of dissemination
Physical access	Publication dataset	Not published	Limited metadata published on provider's website	Metadata published in clearinghouse	Information, services directly available from clearinghouse
	Acquisition procedure	Not applicable	Ad hoc bureaucracy	Standard order procedure	Online orders
	Time between request and access	None	Inadequate	Adequate	Immediate
	Number of points to contact for maximum coverage of jurisdiction	>100	50-100	2-50	1
Policy from a user's perspective		Not applicable	Minimum and maximum use conditions 'controlled'; harmonisation, some transparency		Uniform transparent policies throughout government
Use		Primary	Primary and secondary	Primary, Secondary and Tertiary	All

framework data characteristics, and an information policy perspective. The relationship among these three components is not absolutely clear. Although full adherence to the institutional ideal (vision, respected leadership, communication among all stakeholders, and a sector that actively addresses society's needs) may result in a high level of awareness for geographic information, there are no guarantees that it would also result in high-quality framework datasets or open information policies. Therefore, the matrix presented must be seen as a first attempt to model GII development.

11.3 Objective 2: researching access policies for GIIs

The second objective centred on the research framework, which provides for assessing the value of geographic information. This framework distinguishes a producer side and a user side for the geographic information. Figure 11.1 presents a graphic overview of the research framework. It consists of a non-technical and technical part of framework data, as well as a use part. The technical characteristics include type of information, scale of information, and quality of information. The non-technical characteristics are determined by the legal, financial, intellectual, and physical access characteristics of the dataset, and by the extras that develop with the use of the dataset.

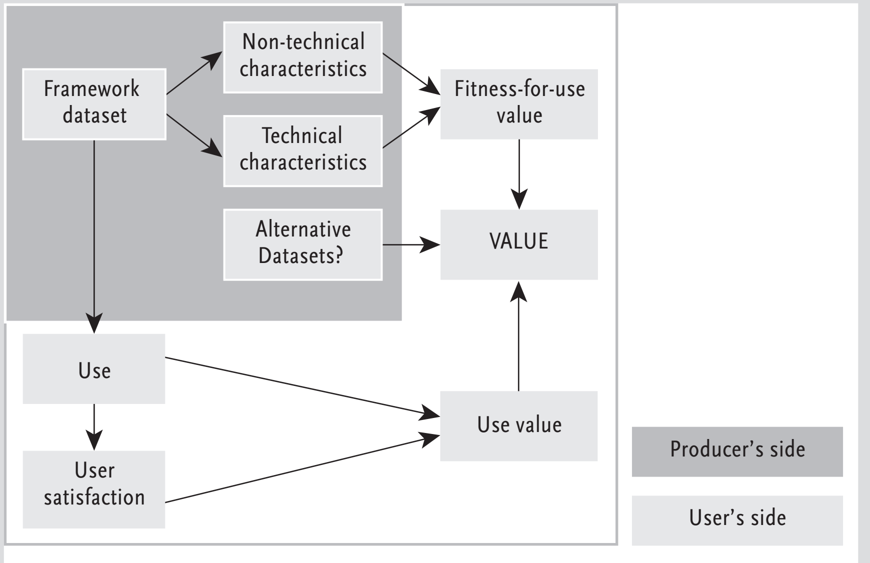
The producer of the information controls the technical and non-technical parts, while the user decides whether the data characteristics meet his needs. The technical and non-technical data characteristics determine the extent to which the dataset will be used: the fitness-for-use value. Datasets in the network stage of GII framework dataset development have a high fitness-for-use value. The actual number of uses, users, and user satisfaction add to the use-value. Another way to determine the value of a dataset is the number of alternative (identical or similar) datasets that are available. A high number of duplicate efforts may be an indication of insufficient fitness-for-use value: for example, access conditions may be too restrictive for the quality provided. In situations where access policies are more expensive than the cost of collecting or duplicating information, the likelihood of duplicate datasets is increased.

Initially, we intended to use the complete research framework in this research, but the methodology decided upon and the expected constraints in identifying sufficient numbers of users (primary, secondary, and tertiary), caused us to focus the research on the producer's side of the model. By selecting knowledgeable experts that represented users in a specific jurisdiction, we also included the user side. Success measures such as the numbers of uses, users, and user satisfaction were only assessed qualitatively. Further research may assess the use value of a dataset quantitatively.

11.4 Objective 3: assessing the impact of access policies on the GII

For two geographic framework datasets, parcel information and large-scale topographic, this research confirms the important role of access policies in the development of a GII. But in assessing the success of specific access policies, the case study findings show two trends: in some instances cost recovery policies have made positive contributions to GII development, in other in-

Figure 11.1 The research framework



stances open access policies are required to promote further GII development.

This paragraph assesses the impact of access policies on the development of a GII. Examining the four research hypotheses helped us assess the roles played by access policy for large-scale geographic framework data in developing a GII. Addressing the third objective enabled us to answer the main research question: *What role do access policies play in the development of a geographic information infrastructure (GII)*.

11.4.1 Testing the hypotheses

Using the four hypotheses of this research, we were able to assess the impact of access policies on the development of a GII.

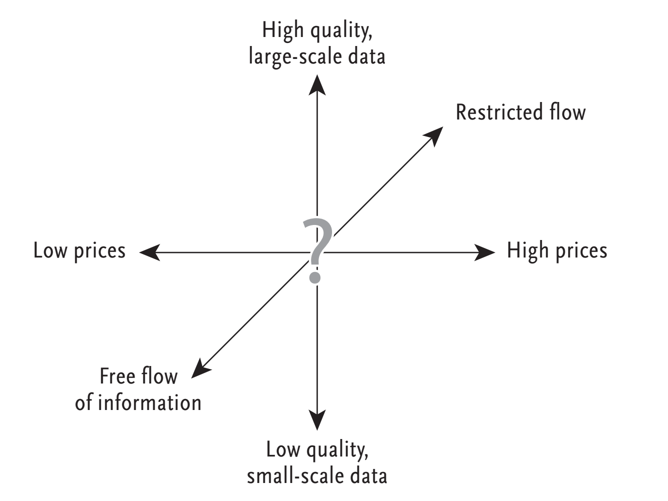
Hypothesis 1: *The extent to which a dataset is used is determined by both the technical and non-technical characteristics of the dataset.*

The research findings confirm that the extent to which datasets are used is determined by their technical (information quality) as well as non-technical characteristics (e.g., access policy).

Datasets with advanced non-technical characteristics (e.g., freely downloadable from a central clearinghouse, no use restrictions), but with technical characteristics that required users to add significant effort and resources to fit the dataset to their needs were not used by tertiary users. Similarly, datasets with advanced technical characteristics, but having restrictive access policies were also not considered.

Hypothesis 2: *The technical characteristics of a dataset and its access policies are balanced: excellent technical characteristics are accompanied by datasets with restric-*

Figure 11.2 The relation between the technical characteristics of geographic information and access policy has not been determined



tive access policies, while poor technical data characteristics are accompanied by datasets with open access policies.

The case studies yielded conflicting information for this hypothesis.

The research identified several GII datasets with sufficient technical characteristics, but with less advanced non-technical characteristics (e.g., the topographic dataset in the Netherlands and the parcel datasets of Denmark, the Netherlands, and MetroGIS). On the other hand, the research also identified GII datasets with insufficient technical data characteristics (the topographic datasets in Denmark, Northrhine Westphalia, Massachusetts, and Minnesota), but with restrictive access policies that were imposed in all instances. Thus, cost recovery does not necessarily signify excellent quality datasets. In the context of open access policies, information from the case studies was not sufficient to draw any conclusions.

Our research did not find any evidence that supported a relationship between the quality and policy of the datasets. Although the links between policy and use and quality of information and use are apparent (see hypothesis 1), the research did not find convincing evidence that directly linked the access policy and the quality of a dataset (see Figure 11.2).

Hypothesis 3: *The stage of development for the components of the 'GII framework dataset maturity matrix' is decisive for the most appropriate access policy for framework datasets.*

The research provides support for hypothesis 3.

The GII maturity matrix shows that the most appropriate policy for a given dataset is likely to be related to its stage of institutional, technical, and non-technical development. Section 11.1 indicated that awareness of the value of a dataset is probably crucial for determining the most appropriate information policy. High awareness among public decision makers for a GII or a framework dataset will probably result in sustainable public financial resources. In such an environment open access policies are likely to benefit development of the GII. Where there is poor awareness of the GII at the decision-making levels, or for a specific dataset, it may result in short-term financial resources without any financial guarantees for the future. Cost recovery policies may then be most beneficial for the development of a GII because they allow for cost sharing arrangements in public-private partnerships and returns on investment to the responsible entity (which is often the lower levels of government). The examples of public-private or public-public partnerships in the case studies (topographic datasets in the Netherlands, Denmark, MetroGIS, and Massachusetts) show the success of cost recovery for GII development at modest levels of GII development.

These findings can be generalised for GIIs. In earlier stages of GII development, the technical characteristics of a dataset may be the driving force; the first priority is to satisfy the needs of the primary users, without considering other user groups. The dataset needs to exist no matter what access policy is used. After the dataset has acquired the sustainable technical characteristics that meet primary users' needs, questions of access need to be addressed. Thus, in the initial stages of GII development, strategies should focus on information collection for primary users; in more advanced stages, GII development may be promoted by stimulating secondary and tertiary use, without endangering the funding mechanism underlying information collection. Thus, in the early stages, information collection is the driver for GII development (implying restrictive access policies), while for advanced GIIs, with advanced technical dataset characteristics, the drivers are the way the information is used, along with more open access policies.

Hypothesis 4: *At an advanced level of GII development only a policy of open access to public information enhances further development.*

The information from this research was not conclusive for testing this hypothesis.

This study confirms (theoretically) that when all levels are aware of the value of a dataset and a given access policy, funding for a framework dataset is likely to be sustainable. Therefore, an open access policy is more beneficial for GII development than any other policy. The case studies did not support any specific best practices for excellent technical and non-technical data characteristics with high levels of primary, secondary, and tertiary use, however.

11.4.2 Institutional setting is critical for fitness-for-use value of a dataset

The research confirms that the technical and non-technical data characteristics are important factors for users when they decide to use a dataset. When we started this research, we assumed that the technical and non-technical components were independent of a specific institutional setting, but the literature and case study research showed that the way information is organised has major implications on the technical and non-technical characteristics of a dataset. There is a relationship between the institutional setting and the consistency of the access policy, the physical access characteristics, and the technical characteristics of a dataset (see Figure 11.3).

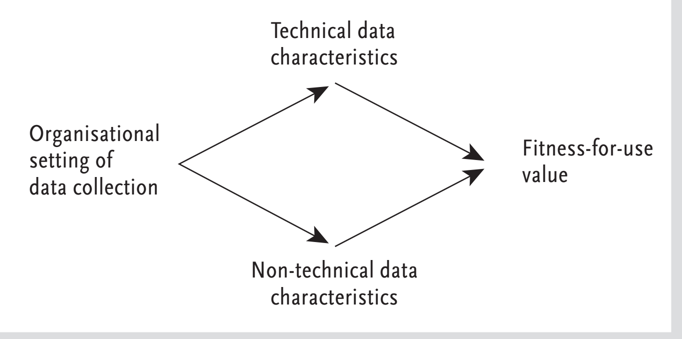
In instances where information collection was centralised in a single public organisation for a jurisdiction, datasets were more homogenous with respect to technical and non-technical data characteristics (including access policies) than datasets that were not controlled centrally, such as in local government. Examples of central control, and from a technical GII framework dataset view, successful datasets, are the parcel datasets of the Netherlands and Denmark.

If information collection is not centralised, the likelihood of heterogeneous technical and non-technical data characteristics increases, and their fitness-for-use value decreases. For example, if information collection in one country has been organised in 300 local entities, and each entity adheres to a different information model and policy, cross jurisdictional users (such as tertiary users) need to find 300 datasets, contact 300 organisations, explore 300 access policies, and ultimately integrate 300 datasets having different content, currency, accuracy, and formats. This would require significant investments, which may be difficult to recover economically. The 351 parcel datasets in Massachusetts, and to a lesser extent the 54 datasets in Northrhine Westphalia, and the 68 *Tekniske Korte* in Denmark are examples of decentralised heterogeneous datasets.

For the case studies, in most instances information collection was decentral, but for some datasets cooperative efforts among stakeholders resulted in a certain degree of harmonisation of datasets. The Dutch GBKN, the MetroGIS parcel dataset, and to some extent the *digitale Tekniske kort* in Denmark and the *Automatisierten Liegenschaftskarte* of Northrhine-Westphalia are examples of cooperative efforts aimed at harmonised datasets.

Further, centralising responsibility for a specific dataset may also have the advantage of having one point of contact with far-reaching authority for this dataset. The far-reaching authority is able to enforce implementation of a certain standard for the complete dataset quickly, and to execute agreements to exchange information with other organisations more efficiently and to improve the technical characteristics of the dataset according to a new GII standard. Moreover, a central organisation would allow for investment in re-

Figure 11.3 Factors determining the extent to which a framework dataset is used



search and development activities specifically aimed at improving the characteristics of the dataset and development of the GII. In addition to contributing to a product-based GII strategy, a central organisation is better able to appropriate all resources for GII development. If all framework information supply has been organised centrally, coordination among all activities may be more efficient and effective. Increased trust between the limited number of parties in a GII network may further increase the pace at which the GII can develop. This is especially true if the highest levels of the central organisation are willing to support GII investment.

Conversely, for decentralised efforts, necessary technical and non-technical changes to datasets to make them GII compliant will only be implemented in all individual datasets if all the responsible parties agree on the need to change. Coordination of change becomes more complex when several parties' interests need to be considered. Disagreement, or non-communication among the suppliers, or the inability of those representing an organisation to implement the agreed on actions results in inconsistent datasets and adherence to a wide variety of access policies. Further, resources that may be available within each individual organisation are more difficult to organise into single budgets promoting the GII.

The above assumes that centrally organised datasets are preferable to datasets that are managed decentrally. It should be noted, however, that even centrally managed datasets can block GII development. For example, centrally managed datasets that focus on internal dataset management may not readily adopt open standards or refuse to document the metadata. In a decentralised situation such practices may be corrected by best practices for several individual datasets. In a centrally managed situation, which in practice is a one-of-a-kind dataset, such best practices do not exist, and change may be even more difficult to accomplish. On the other hand, information societies increasingly communicate across borders, and organisations that operate centrally may learn from best practices from other jurisdictions.

It is possible to conclude that choices in institutional settings many years (or even centuries) ago have been decisive for the current stage of GII development as well as for future prospects. Jurisdictions having a central organisation for large-scale geographic framework data are preferable to decentralised authorities. Datasets with good GII technical characteristics are typically those that benefited from the institutional setting. But such instances often lack user-oriented access policies to promote tertiary use. Section 11.5 provides an alternative funding model that potentially benefits both users and producers, which ultimately may result in a user-oriented GII.

11.5 Local government access policies in the United States

One of the assumptions of this research was a possible link between the level of a dataset's detail and the access policy that applies to it.

The case study we used confirmed the situation presented in chapter 1 regarding the existence of restrictive access policies for large-scale topographic information in the US. Although US information policy at the federal level may be characterised as favouring "a strong freedom of information law, no government copyright, fees limited to recouping the cost of dissemination, and no restrictions on reuse" (Weiss and Backlund, 1997), this research confirms that this policy does not necessarily apply to large-scale topographic information in the US. Partly because private utilities were involved, none of the topographic datasets used in the research adhered to the open access principles. In addition, parcel information in the Metropolitan region of Minneapolis-St. Paul is provided on a cost recovery basis. The parcel datasets in Massachusetts were provided on open access principles, but they were rarely re-used because of their poor quality.

11.6 Ways forward: promoting GII development

The research encountered several barriers to GII development. These were directly related to the technical and non-technical characteristics of the datasets. While primary and secondary users regularly use the datasets, we found few value-added activities. The causes of the limited use are either restrictive access policies or poor technical data characteristics.

We also found several situations where framework datasets covered an entire jurisdiction with harmonised technical characteristics (in the Dutch, Danish, and MetroGIS parcel datasets, and to a lesser extent in the Dutch and Danish topographic datasets). Only the primary and secondary user groups use these datasets, however. Tertiary use of these datasets is limited because of the high price of access and restrictions on use. Thus, in instances where the technical characteristics of a dataset are assessed as advanced from a GII perspective, the full potential of a GII may only be reached if tertiary users take advantage of the facility. In those datasets that have poor technical data characteristics, the research showed that the reasons for this were largely the way in which framework information collection was organised. In this section both the technical and non-technical barriers are addressed and ways forward are suggested.

11.6.1 Decentralised information collection

The study found both centralised and decentralised information collection efforts. Generally, the centrally organised datasets had better technical data characteristics than the decentralised efforts. If the information collection is not centrally organised, information sharing and other cooperative efforts need to be initiated to meet GII requirements. Successful cooperation is likely when there is a common understanding of the needs of all primary and secondary users. Champions are key to the success of the effort (see Craig, 2001; Rietdijk, 2000, p. 222). Examples from the topographic dataset in the Netherlands and the integrated parcel dataset in the Metropolitan region are best practices of cooperative efforts that promote GII development. The cooperative efforts may further take advantage of developments in technology that allow organisations to exchange information and contribute to the GII without losing their autonomy (see also Onsrud, 1990).

Another option that addresses the disadvantages of decentralised information collection is institutional reform. But it is unlikely that state governments desire or are able to overcome the strong feelings of local independence to enforce institutional reform for the sake of GII development. In the Netherlands, however, municipalities have been forced to merge in order to address developments in society (Tweede Kamer, 1998-1999). In 2004 Denmark started a similar process of structural reform in local government. The 271 local authorities will be amalgamated to form approximately 100 large units. These units will take over tasks previously performed by the 14 counties, which will be amalgamated to form five new regions (Website DK AKF). It is likely that the GII will benefit from these reforms.

11.6.2 Alternative funding models

In many instances developing value-added products is outside the public tasks of government. Therefore, government agencies that bear the high cost of framework data collection cannot take advantage of the framework dataset commercially since they cannot enter the commercially interesting value-added products market. Government agencies attempt to recover their costs by selling their information against cost recovery prices. Not all users value a dataset at its production cost, however (see Krek and Frank, 2000). Tertiary users, for example, will not value the framework dataset at current cost recovery prices. They assess the price as too high to make it worthwhile to develop viable commercial value-added products based on the framework information. Therefore, tertiary users will not use the framework dataset. In addition, private interests in public-private partnerships may not allow others to create value-added products from the information collected by the partnership. Thus, in instances of sufficient technical data characteristics but insufficient non-technical data characteristics for tertiary use, tertiary users will not use the dataset: the value-added market that would be based on framework datasets will not develop.

It has been suggested that a change from cost recovery to open access policies would be beneficial, as it would encourage the information economy (Pira et al., 2000; Weiss and Pluimers, 2002). But it is unlikely that an organisation that has sacrificed some of its income to further the information economy would be financially compensated. This uncertainty is one of the reasons why public entities are reluctant to provide their information through open access (see, for example, the EU directive re-use of public sector information, EU, 2003). Since open policies make government entities fully dependent on national budgets, they are in a fragile position. This is what we call 'the dilemma of the public enterprise': although a policy change would benefit the public enterprise (society) macro-economically, micro-economically, a public information provider (such as a public enterprise) loses part of its income. Important value-added products and services are not developed because public information producers are not guaranteed benefits in creating these products, as there is a shift in policy from cost recovery towards open access. Continuing the battle between advocates of the two funding models will not abolish the status quo. A model that takes the best of both types may be a viable future option. Understanding the value particular information has for different users should be a critical ingredient in an alternative funding model.

Guaranteed public funding for information with infrastructural characteristics is one option for reaching the potential. Ideally, if legislation required collection of framework datasets, the open access model would be able to promote GII development and its macro-economic potential. It is difficult or impossible to guarantee public funding for the GII, however, or to obtain it; this is outside the control of the geographic information sector.

Two other alternatives to current practices for large-scale framework data may promote tertiary use. One example of a favourable access policy for large-scale topographic datasets collected through public-private partnerships may be that described in the US Federal Technology Transfer Act (FTTA), which allows the public sector to withhold datasets for five years from the public domain that were produced together with private companies (see also Pluijmers, 1998b, p. 54). The disadvantage of such an approach is that the dataset is relatively old before tertiary users can use it. Chapter 2 shows that large-scale information requires current information to be most useful. Therefore, this option may not be feasible for viable value-added products for large-scale geographic framework datasets. What should be investigated is the feasibility of such a policy at the local level.

Another option is an alternative funding model that respects the needs of the information provider but promotes tertiary use for the most current information.

The alternative funding model

The alternative funding model distinguishes between primary, secondary, and tertiary users in determining access policy. This model maintains current cost recovery policies for the primary and secondary users, but promotes tertiary use by providing free access to framework datasets for those willing to add value to the framework data, either in a product or a service. Free access implies only access at no cost. The value-adding company compensates the information provider through royalties based on a small percentage of the turnover of the new product or service (see Figure 11.4) or through the return of improved information quality. Intellectual property rights remain with the information provider, and additional use restrictions should guarantee that the dataset is only used for value-adding activities, and not for purposes of primary or secondary use.

The alternative funding model specifies access policies for specific user groups so that the quality of datasets can be ascertained over time. Current use by primary and secondary user groups remain constant, while tertiary user groups are encouraged, which results in a GII with high quality framework datasets that provide the basis for a wide variety of government and private tasks and on which a large variety of value-added products and services can be built. Through this hybrid access policy approach, the alternative funding model is a bridge between the open access and cost recovery models. If successful, this alternative model can resolve the 'dilemma of the public enterprise'. It will result in a win-win situation, with new products, new users, and ultimately a user-oriented geographic information infrastructure. This model may also generate new revenues for the information producers. National government benefits from increased employment in the value-added sector, and it collects more income tax, value-added tax, and company tax.

But there may be several roadblocks to the alternative model. For example, the European directive on re-use of public sector information states: "Any applicable conditions for the re-use of documents shall be non-discriminatory for comparable categories of re-use" (article 10.1). Re-use is defined as reasons for using the public sector information other than what the public sector bodies had in fulfilling their public tasks. It is not clear whether using framework datasets for tertiary use, for example, as a basis for value-added services, and using the framework datasets for secondary use as a background map are comparable categories of re-use. If the two re-uses are not considered comparable, the public information supplier can continue to enjoy significant payments from secondary users, while it promotes tertiary use that returns some income from royalties. If the two re-uses are considered comparable, however, then the alternative model disintegrates. The information supplier needs to keep its cost recovery model to maintain the income stream from secondary users, and consequently, the European directive requires the imposition of identical policies for tertiary use, which maintains the status quo and blocks further development of the GII.

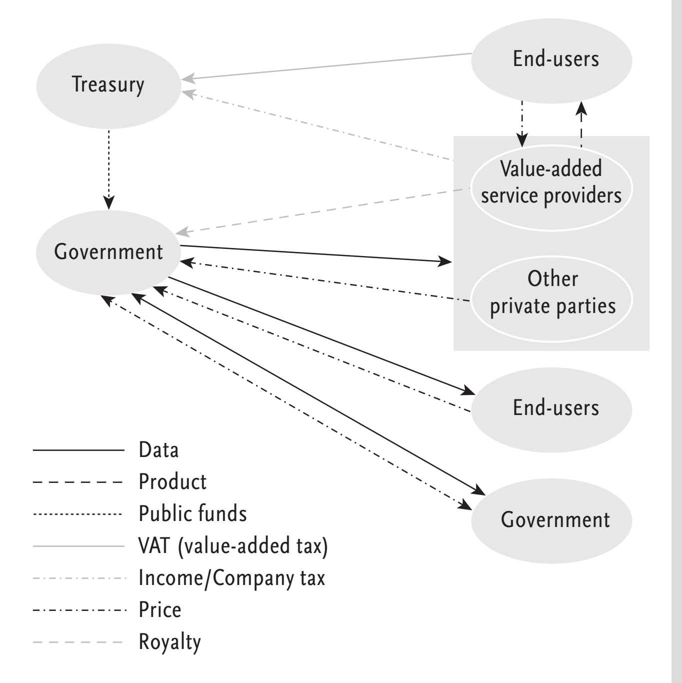
Further, the directive states that, “Where charges are made, the total income from supplying and allowing re-use of documents shall not exceed the cost of collection, production, reproduction and dissemination, together with a reasonable return on investment” (article 6). The article (and also the legislative history of the directive) does not address royalties generated on from company turnover. What happens if the model appears successful and income from the alternative model exceeds the cost of collection, processing, reproduction, and dissemination of the complete dataset, together with a reasonable return on investment? Probably setting a maximum for royalty income for a public agency will address issue.

Findings from the case study suggest that jurisdictions in Europe may be able to benefit from the alternative model, which advances technical geographic large-scale framework datasets by making guaranteed funding available for all, at almost no cost for tertiary and later users, with as few restrictions as possible.

11.6.3 Mandatory participation of primary users in framework dataset development

Involving semi-public and private utilities in topographic information collection is important, if not crucial, for GII development. The private nature of the utilities has resulted in restrictive access policies for topographic datasets, with limited uses. Since mapping is not the core business of the private utilities, however, it would be better for GII development if these groups cooperated and coordinated their activities, rather than competing on the information market. What would be most beneficial for society would be to involve all major beneficiaries in information collection. Newcomers in the utility market may be obliged to support information collection, or other ways may be found to prevent them from taking advantage of the investments made by the initiators. This is counter to free market principles, however, and would only be feasible if all stakeholders were public entities, or if there was legislation that outlined the position and role of primary users (utilities) in the development of a GII, or framework information collection and provision. Further research can investigate whether this direction would be feasible.

Figure 11.4 The alternative funding model



11.7 Further research

Researching access policies

One of the goals of this research was to assess the success or failure of access policies in jurisdictions of comparable socio-economic development, systems of government, and geography. We selected the cases on the basis of maximum variance in their access policy component for two framework datasets. The institutional setting for a framework dataset had no bearing on selection. Our research found that the way the collection, processing, maintenance, and dissemination of geographic framework was organised (whether it was decentralised or centralised) had a major impact on the technical characteristics of a GII dataset. Future research that compares the success of access policies through comparative analyses should include as one of the selection criteria the way information collection is organised. This will increase the likelihood of comparing similar entities, and would lead to research results that could contribute constructively to the ever-going access policy debate.

Other aspects that should be included are the extent of awareness in a jurisdiction for the value of geographic framework information. Some important questions are: can the level of awareness be assessed and promoted - and how to do this; how to break down the walls of the geo-information sector and open up the GII to other sectors?

Development of the GII maturity matrix

Developing a GII maturity matrix is another area of research increasingly demanded by GII developers. There are very few of these models, but they can be extremely useful for developing GII initiatives. What is especially needed are mechanisms to determine the level of information quality: at what point does access policy become more important than information quality for GII development. And what is the minimum quality and minimum access policy for value-added resellers to use framework information?

Further, our research has focused on jurisdictions that have an advanced level of socio-economic development. The extent to which the maturity matrix that was developed can be applied to situations in jurisdictions with different levels of socio-economic development is not clear. The applicability of these jurisdictions needs further investigation.

Comparing the geographic information market in Europe and the United States

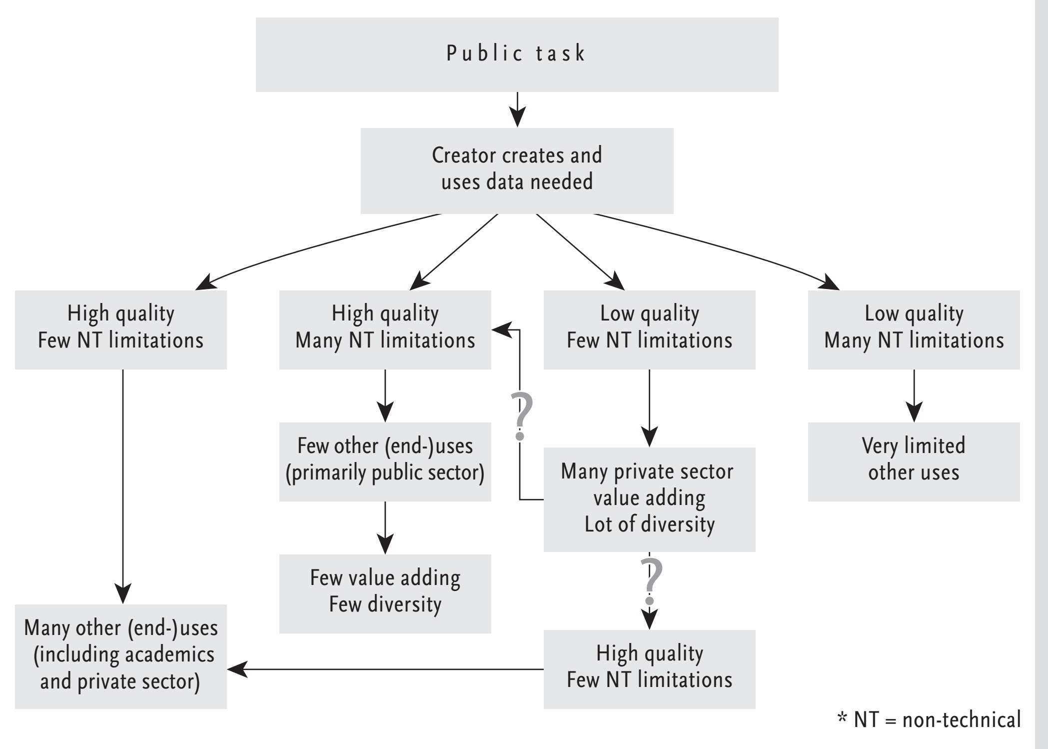
Although this study has shed some light on the differences between the US and European worlds of information collection, dissemination, and use, further research is required to explain the differences among these information markets with respect to quality of datasets, use, and benefits for society.

In the European cases, governments supply and use high-quality, large-scale datasets, while in the US, the government provides geographic information of less high quality. If the needs of users of large-scale geographic information are similar, it is reasonable to assume that the US public datasets will be upgraded by the private sector. This would result in datasets that compared in quality to the European ones (see Figure 11.5). In both instances these datasets are subject to restrictive use conditions, which do not promote tertiary use. In the European cases, however, governments control the high-quality datasets, while the private sector controls the US datasets.

In addition, groups that use the US government datasets to develop products and services are considered to be adding value that contributes to private sector benefits and turnover, which is the driver for the information economy. These private benefits have been measured and used to convince people in other countries of the need for open access policies: they are good for creating jobs in the private sector as well as other things. The jobs created in this way in Europe, however, are likely to be within the government sector, and remain less visible than they are in the US as private jobs. The difference in perception of the role of government and the private sector may explain why European governments have been reluctant to accept the research that recommends open access policies for government information.

While our research has not yielded any scientific evidence for the above speculations, if further research does show the suggested relationship, it will increase understanding of both the US and European situations.

Figure 11.5 Role of government and private sector in providing information



Government needs for large-scale information

The research found evidence that in local government in the US and in the European cases topographic datasets are used at different levels of detail and currency. In general, less detail was used in the US than was the case for the European counterparts, even though the population density, the overall population, and geographic size were of the same order of magnitude. It would be interesting to investigate whether European countries are working with datasets that have too much detail, or whether the local governments in the US do not use enough geographic detail, which can result in poorer decisions. Is the need for geographic information for the densely populated local levels in the US similar to the needs of densely populated areas in Europe? And is the role of local governments in the US as comprehensive as comparable levels of government in the European cases? Or are European government employees too demanding with respect to their information desires; is it possible that less comprehensive and less detailed datasets would be able to satisfy their needs? Or as we reasoned in the previous section, it may be that the (local) governments cannot afford to acquire the commercial value-added products, even though it is these organisations that have provided the basis for the commercial value-added products.

Further research should identify why local levels of government in the US use topographic datasets of different levels of detail and currency than the European cases.

Usage helps the GII

One of our hypotheses was that poor information quality goes hand-in-hand with open access policies. The example of MS VirtualEarth shows that even with open policies it is possible to improve information qualities quickly. MS VirtualEarth shows the Twin Towers in its recently launched service, and its dataset lacks the buildings of one of its competitors (Apple). Immediately after the launch, the developer was informed of this. Since it is likely that more than this piece of information was included in the feedback, MS may easily acquire information for areas that will need to be updated. Google/Earth has more current information available for the same two areas; it builds on other public sources. MS may well incorporate this information in its service, but even if they do not, they may address the issue with responsible governments to find ways to improve their information.

The Northrhine Westphalian service TIM-online has also been amazingly popular in the first months after its launch. The Topografisches Informationsmanagement online (Website: TIM-online) is freely available on the Internet and provides web-mapping services, including feedback from citizens about the quality of the information presented. It also provides the option of combining layers from any location, adhering to an open Web-mapping standard. The largest scale presented is 1:10,000. The feedback from citizens is expected to be useful for updating the information.

As people become more technology savvy, they will come to expect high quality information services. Ordinary users can contribute to the quality of the information by providing feedback to the information producing agencies. This will also increase awareness for geographic information, information maintenance will be more efficient, and if the feedback is able to detect misinformation, the information quality will be better than before. Whether involving ordinary users in the information updating process will make the GII efforts more successful is a question for further investigation.

One European mapping organisation

The difficulty of developing one topographic dataset through public-public and public-private partnerships for a jurisdiction as large as the Netherlands or Denmark raises the issue of whether such cooperative efforts would be efficient. Such cooperative efforts came about historically because it was not yet certain whether the investment in large-scale topographic datasets was really worth the money. Today few would question the need for ubiquitous topographic datasets for a single state or country. To achieve this, would it not be more efficient and effective for society to organise and fund the data collection centrally, and thereby develop topographic information with all the advantages of centrally managed datasets, including increased efficiency and effectiveness? In the Netherlands discussions about the GII framework datasets addressed the issue of whether to include the large-scale base map within the purview of the national government. Although this was a greatly appreciated effort that has found support in the research findings of this study, developments may well go beyond national boundaries to encompass a single European mapping organisation that would be responsible for large-scale topographic datasets.

INSPIRE (Infrastructure for spatial information) aims at linking existing datasets, putting significant effort in obtaining consensus about the most appropriate information model, with harmonised information specifications as well as other functions. But would it not be more efficient to gather all the budgets of topographical mapping agencies throughout Europe and use these resources for the collection, development, and maintenance of one large-scale topographic dataset for the whole of Europe?

The benefits are clear for both governments and the private sector: ubiquitous, consistent, accurate, and up-to-date topographic information that could provide the basis for European decision-making and the European market of value-added services. These benefits potentially represent billions of euros. Yet, if such an effort were to be considered useful, it would attract significant resistance from national mapping organisations, local governments, and other government organisations (e.g., Ministries of Defence) already involved in topographic information collection. Arguments against a single European-wide mapping organisation could focus on very special national or local needs for specific topographic elements, on relinquishing a certain degree of national autonomy, or even on the need to maintain the integrity of national identity in the European Union and other political arguments.

While it is possible to wonder if developing a European-wide GII is worth the battles around centralisation, the future of topographic mapping is likely to reside in one European mapping organisation. This, too, requires further investigation.

11.8 Further thoughts

Value-added services based on large-scale information

This research assumed that tertiary users needed large-scale parcel and topographic information, but so far no important application has been developed that promises to generate significant revenues for the value-adding company. Indeed, does such an application even exist for large-scale spatial framework data? Although at least one GII scholar has suggested that large-scale information has poor commercial value (Frank 2003), others foresee that “as society becomes more technically savvy, spatially aware and more demanding of services available through mobile devices, more detailed and more enhanced services are likely to be required” (Smith and Kealy, 2003). They envision a GII that could promote “Location Based Services development through the provision of high quality spatial data" (Smith and Kealy, 2003). The recent value-added services of GoogleEarth/maps and MS VirtualEarth are examples of services that increasingly include highly detailed satellite imagery with vector datasets of road centrelines and, if available, more detailed information such as buildings. It is probably only a matter of time before citizens start requiring detailed information for uses they now request irregularly but will soon use on a daily basis. The level of detail and currency that users will require is likely to be greater than current information timeliness.

Moreover, there are likely to be millions of mosquito applications rather than one major application; together these mosquito applications will build up the critical mass necessary for acquiring sustainable levels of awareness at decision-making levels.

Legislation requiring publication of a dataset in a clearinghouse

Generally, publication of a dataset in a clearinghouse is considered important because it allows users to find a dataset. Nevertheless, the success of the clearinghouses has been limited, and often not all available datasets are published. Is the concept of a sector specific clearinghouse at all useful? If it is valid, why not require that government information be published through a clearinghouse, or require that governments make their information available on the Internet. Would legislation that mandated this help? The European directive on re-use of public sector information recommends that member states facilitate making public sector information available for re-use through online lists (see EU 2003 article 9). Reviewing the directive should clarify how many member states introduced lists of public sector information and how successful they were compared to those that did not have these lists.

Similar to this is the documentation of metadata. A convincing rationale backed by academic research showing the benefits of metadata documentation has not yet led to government organisations documenting metadata. They continue to refuse to do this because they can use the information already, and do not need metadata for their internal processes. They have not considered what would happen when the brains of the organisation – its organisational memory – leaves: will they still be able to use the data in a knowledgeable way? Moreover, developments in technology will increasingly require metadata in order to exchange information. Web feature cannot do without metadata: no metadata, no service, which puts information societies that refuse to document metadata at a social and economic disadvantage. How much longer will information societies be able to afford to maintain geographic framework datasets without metadata documentation?

Summary

Developing geographic information infrastructures

by Bastiaan van Loenen

Within information societies, information availability is a key issue that affects the entire society's well being. The infrastructure underlying the foundation of the information society may be referred to as the information infrastructure. A geographic information infrastructure (GII) supports the information infrastructure with regard to geographic information. A GII facilitates the availability of and access to geographic information for all levels of government, the commercial sector, the non-profit sector, academia and citizens in general (see Onsrud, 1998b). It encompasses the policies, organisational remits, information, technologies, standards, delivery mechanisms and financial and human resources necessary to ensure that people who work with information at the local, national, regional or global scale are not impeded in meeting their objectives (GSDI, 1997). Access to government information policies are important for the availability and successful use of the information and the success of the GII itself. Yet there have been only a few investigations into access policy oriented towards GII development. This research is centred on the following question:

What role do access policies play in the development of a geographic information infrastructure (GII)?

Government has an important role in GII development: it is both provider and user of geographic information, and in many instances government agencies lead GII development. This is especially true for the government's role as provider of geographic information. It can decide what information is collected, and through its access policies, it can also determine the extent to which a dataset can be used.

Two access doctrines are dominant in the literature: open access policies and cost recovery policies. The open access approach assumes that government information is available for a price that does not exceed the cost of reproduction and distribution, with as few restrictions on use as possible. In the cost recovery approach, the price of government information covers the cost of development and dissemination at least, and may also include a return on investment. Use of the information is restricted, and government may even choose exclusive arrangements.

Many researchers have compared open access policies to the cost recovery model. Most studies compare the open information policies of the US federal government to the restrictive policies of European countries and conclude that the open access policies of the US federal government should be implemented in other countries because they may result in significant macroeconomic benefits. Previous research has not looked at the question from the

perspective of GII development, however. The research that has been done on government access policy has not (or has only briefly) addressed the impact of access policy on the quality of a dataset. Most research that compares access policies ignores differences in scale in both datasets and economies, nor does it distinguish between specific user groups. This renders such research less useful than is currently believed. Since it is crucial for the development of a GII to understand the role information policies have on information quality generally and on the GII more specifically, this study has researched access policies from the perspective of GII development. It provides guidelines to policy makers for a strategy for GII development, as well as information about which access policy would best promote the use of geographic information. Moreover, it provides guidelines that will help develop the GII so that it will be able to perform its appropriate infrastructure function in an information society.

Research strategy

The three objectives of the research are:

1. to develop a model that describes the different stages of development in geographic information infrastructures;
2. to provide a framework for researching access to geographic framework information policies in the context of the development of geographic information infrastructures, accounting for the level of development of such infrastructure; and
3. to assess the impact of access policies on the characteristics and use of large-scale geographic framework datasets.

This research focuses on parcel and large-scale topographic information (to a scale of approximately 1:1,000) because they are commonly considered core GII datasets. In addition, the high level of detail in these datasets enable them to be the basis for other hierarchal levels of GIIs. Moreover, while these datasets are relatively expensive to collect, process, and maintain, they have barely been addressed in research on assessing the success of access policies. We researched these datasets through a multiple case study in five jurisdictions: (1) the Netherlands, (2) Denmark, (3) the German state of Northrhine Westphalia, (4) the US state of Massachusetts, and (5) the US Metropolitan region of Minneapolis-St. Paul.

We used a study of the literature and the case study results to develop a GII maturity matrix and a GII framework dataset maturity matrix. Although all components of the GII maturity matrix were addressed in the case studies, the focus was on the access policy component. The case study provided input to assess the role of access policies in developing a GII.

Modelling GII development

Our research led to a model for describing four stages of development in geographic information infrastructures: the GII maturity matrix. We focused on an institutional perspective when developing the matrix.

The GII maturity matrix is comprised of four stages: a stand-alone stage, an exchange stage, an intermediary stage, and a network stage. For the most advanced or network stage, there is a common understanding about what the components of a GII are and what its objectives and ideals are. Further, leadership, open communication channels, and a proactive geographic information sector have allowed GIIs to enjoy broad support at all levels. This has resulted in sustainable funding for development.

We also developed a framework dataset maturity matrix in addition to the GII maturity matrix. The framework matrix accounts for the institutional, technical (quality), and non-technical characteristics (information policy, delivery mechanism) of a dataset. It also distinguishes among categories of users that are likely to use the dataset at particular stages in the development. The framework dataset maturity matrix models the development from a data oriented GII to a user oriented GII.

In an ideal situation the value of a framework dataset is well understood, and embedding it in legislation safeguards its future existence. The dataset should be technically excellent, including harmonised content, full jurisdictional coverage, and accurate, current information. Further, consistent, transparent, open information policies promote all uses. These attributes make it likely that the framework dataset will become the basis for a proactive geographic information sector that, with best practice solutions, will continue to enlarge support for the concept of the GII.

Both maturity matrices attempt to model GII development from an institutional perspective as well as framework data characteristics and an access policy perspective. The relation between these three components is not completely apparent. Full adherence to the institutional ideal may result, for example, in a high level of awareness for geographic information. There are no guarantees, however, that a high level of awareness will also result in high-quality framework datasets or open access policies. Therefore, the model presented should be regarded as a first attempt to show GII development.

Researching access policies for GIIs

The second objective centred on the research framework, which provides for assessing the value of geographic information. The framework distinguishes between a producer's side of the geographic information and a user's side, and consists of the non-technical and technical parts of framework data, as well as a use part. Technical characteristics include: type of information, scale of information, and quality of information. The non-technical characteristics are determined by the legal, financial, intellectual, and physical access characteristics of the dataset, and by the extras that come with the use of the dataset.

The technical and non-technical data characteristics determine the extent to which the dataset is used: the fitness-for-use value. Datasets in an advanced stage of GII framework dataset development have a high fitness-for-use value. The actual number of uses, users, and user satisfaction add to a use-value. An additional way to judge the value of a dataset is the number of alternative (identical or similar) datasets available.

Assessing the impact of access policies on the GII

The third objective provides the answer to the main research question:

What role do access policies play in the development of a geographic information infrastructure (GII)?

For two geographic framework datasets, parcel information and large-scale topography, this research confirms the important role of access policies for development of a GII. In assessing the success of specific access policies, however, the case studies suggest two conclusions: in some instances the cost recovery policies made a positive contribution to GII development, in other instances open access policies were needed to promote initial GII development.

Finding 1: Both technical and non-technical characteristics of a dataset are decisive for its use

The research findings confirm that the extent to which datasets are used is determined by both their technical and non-technical characteristics. Datasets with advanced non-technical characteristics (e.g., freely downloadable from a central clearinghouse, no use restrictions) were not used by value-adding users if the technical characteristics were limited. In such cases users needed to add significant effort and resources so the dataset would accommodate their needs. Similarly, datasets with advanced technical characteristics but restrictive access policies were not considered by value-adding users.

Finding 2: The relationship between access policy and data quality is not obvious

The research identified several datasets that had sufficient technical characteristics, but did not meet users' needs for advanced non-technical characteristics (e.g., topographic dataset in the Netherlands and the parcel datasets of Denmark, the Netherlands, and MetroGIS). On the other hand, the research also identified datasets that had insufficient technical data characteristics (the topographic datasets in Denmark, Northrhine Westphalia, Massachusetts, and Minnesota), yet imposed restrictive access policies. The information from the case study did not allow us to draw any firm conclusions with regard to the context of open access policies.

We were unable to find any definitive relationship between the quality and policy of the datasets. Although the links between policy and use and quality of information and use are apparent, the research did not find convincing evidence for directly linking access policy to the quality of a dataset.

Finding 3: Most appropriate access policy for GII development is related to the stage of GII development

The research shows that the most appropriate policy for a particular dataset is likely to be related to its stage of institutional, technical, and non-technical development. In the early stages, information collection is the driver for GII development; for advanced GIIs, however (including those with advanced technical dataset characteristics), use of the information and more open access policies are the drivers.

For earlier stages of GII development, the first priority in a GII is to satisfy the needs of the primary users of framework information (without taking the needs of other users into account): the dataset needs to exist, whatever the access policy. Cost recovery policies allow for cost-sharing arrangements in public-private partnerships and return on investment for the responsible entity, often the lower levels of government. The examples of public-private or public-public partnerships in the case studies (topographic datasets in the Netherlands, Denmark, Massachusetts, and the Metropolitan region), especially between local governments and utilities, show the success of cost recovery policies for GII development at modest levels of GII development.

After the dataset has acquired the status of sustainable technical characteristics that meet primary users' needs, questions of access need to be addressed. In these more advanced stages, GII development may be promoted by stimulating value-added use, without endangering the funding mechanism underlying information collection. This study confirms (at least theoretically) that when all levels are aware of the value of a dataset and a GII, funding for a framework dataset is likely to be sustainable, thus making an open access policy more beneficial for GII development. The case studies did not yield any definitive choices, however, for best practices with excellent technical and non-technical data characteristics that would ensure high levels of use in all user categories.

Ways forward: promoting GII development

Our research identified several barriers to GII development, which were directly related to the technical and non-technical characteristics of the datasets. The causes for the limited use were restrictive access policies or poor technical data characteristics. What follows are two ways that can help overcome these barriers.

Decentralised information collection

The study identified both centrally organised and decentralised information collection efforts. Generally, the centrally organised datasets had better technical data characteristics than the decentralised ones. If the information collection is not centrally organised, information sharing and other cooperative efforts need to be initiated to meet the GII requirements. The cooperative efforts can take advantage of technological developments that allow organisations to exchange information and contribute to the GII without losing their autonomy (see also Onsrud, 1990). Successful cooperation is likely in instances where there is a common understanding of the needs of primary and secondary users. Champions are key for the success of the effort. Examples from the topographic dataset in the Netherlands and the integrated parcel dataset in the Metropolitan region represent best practices of cooperative efforts that promote GII development.

Another option for decentralised information collection is institutional reform. But it is unlikely that state governments will desire or be able to overcome strong feelings of local independence to enforce institutional reform solely for GII development.

The alternative funding model

We found several cases in which framework datasets entirely covered a jurisdiction with harmonised technical characteristics (in the Dutch, Danish, and MetroGIS parcel datasets, and to a lesser extent in the Dutch and Danish topographic datasets). Nevertheless, value-added use of these datasets is limited because of price and use restrictions. Thus, in instances where the technical characteristics of a GII dataset are assessed as advanced, the full potential of the GII may only be achieved if the value-adding users use it.

An alternative funding model was introduced to stimulate value-added use. The alternative funding model is a bridge between the open access and cost recovery models. It distinguishes between user groups that add value to the information and those that do not.

The alternative funding model provides free access to framework datasets for those willing to add value to the framework information, while those that do not pay a fee for using the dataset. Free access implies only access at no cost. The entity that adds value compensates the information provider through royalties based on a small percentage of the turnover of the new product or service offered, or through improved information quality. Intellectual property rights remain with the information provider, and additional use restrictions should guarantee that the dataset is only used for value added activities and not for other purposes.

The alternative funding model specifies access policies for particular user groups, enabling the quality of datasets to be ascertained over time. In addition, use is promoted, which leads to a GII with high-quality framework datasets that provide the basis for a wide variety of government and private tasks. It also provides the basis for building a wide variety of value-added products and services. If successful, this alternative model can lead to new products and new users, taking the GII to the next level of development: the user oriented geographic information infrastructure.

Samenvatting

Het ontwikkelen van geografische informatie-infrastructuur

Bastiaan van Loenen

De beschikbaarheid van informatie is in onze informatiemaatschappij van groot belang voor het functioneren van de samenleving. De basis die ten grondslag ligt aan het succes van de informatiemaatschappij is de informatie-infrastructuur. Wanneer de informatie-infrastructuur betrekking heeft op geografische informatie spreken we van een geografische informatie infrastructuur (GII). Geografische informatie geeft informatie een plaats op het aardoppervlak. Een GII verzorgt de beschikbaarheid van en toegang tot geografische informatie voor iedereen, variërend van overheid, private sector, non-profit sector tot de burger. Een GII bestaat uit beleid, organisatorische aspecten, informatie, technologie, standaarden, financiële middelen en mensen die noodzakelijk zijn om gebruikers in staat te stellen hun doelen te bereiken (cf. GSDI 1997). Bij de ontwikkeling van een GII is het toegankelijkheidsbeleid voor geografische informatie in hoge mate bepalend voor de beschikbaarheid ervan, en daarmee een bepalende factor voor de succesvolle ontwikkeling van een GII. Hoewel in het algemeen een belangrijke rol wordt toegedicht aan het toegankelijkheidsbeleid van overheidsinformatie bij de ontwikkeling van een GII, is er nog weinig onderzoek dat het succes van een bepaald beleid heeft gekoppeld aan de ontwikkeling van zo'n GII. Dit onderzoek heeft zich daarom gericht op de volgende vraag:

Wat is de rol van toegankelijkheidsbeleid voor de ontwikkeling van een geografische informatie infrastructuur (GII)?

De overheid speelt een belangrijke rol in de ontwikkeling van een GII. Zij is zowel een belangrijke producent als gebruiker van geografische informatie. In veel gevallen is het ook een overheidsorganisatie die de GII-ontwikkeling in een land of regio stuurt. In haar rol als producent bepaalt de overheid veelal welke informatie wordt verzameld. Verder bepaalt zij door haar toegankelijkheidsbeleid de mate waarin anderen haar informatie kunnen gebruiken.

Twee toegankelijkheidsdoctrines zijn alom bekend: het open toegankelijkheidsmodel (open access) en het kostendekkende model (cost recovery). Het open model gaat er vanuit dat de overheidsinformatie beschikbaar is voor een prijs die de marginale verstrekkingskosten niet te boven gaat met zo min mogelijk beperkingen in het gebruik. In het kostendekkende model dekt de prijs van de informatie niet alleen de kosten van verstrekking, maar ook van de inwinning en verwerking van de informatie. Daarbovenop kan een winstpercentage berekend worden. Dit model beperkt het gebruik van de informatie en overheden kunnen er zelfs voor kiezen om exclusieve overeenkomsten aan te gaan.

Veel onderzoek op dit gebied heeft het open toegankelijkheidsbeleid van de federale overheid in de Verenigde Staten vergeleken met kostendekkend beleid in Europese landen. De meeste onderzoeken concluderen dat het open model van de federale Amerikaanse overheid moet worden geïmplementeerd in andere landen, omdat het zou leiden tot aanzienlijke macro-economische voordelen. Er is echter weinig onderzoek gedaan op het gebied van het toegankelijkheidsbeleid vanuit het perspectief van de GII-ontwikkeling. De bestaande onderzoeken hebben daarbij niet de impact van een bepaald toegankelijkheidsbeleid op de kwaliteit van de informatie in ogenschouw genomen. Verder zijn veelal verschillen in schaal van informatie en economie niet meegenomen en wordt er geen onderscheid gemaakt tussen verschillende gebruikersgroepen van geografische informatie. Deze beperkingen doen geen recht aan de claim die deze onderzoeken leggen op het succes van het open toegankelijkheidsmodel. Daardoor weten beleidsmakers niet welk toegankelijkheidsbeleid ze moeten aanhouden om de GII, en daarmee de informatiemaatschappij, verder te ontwikkelen. Het is daarom cruciaal voor de ontwikkeling van een GII dat er inzicht komt in de mogelijke invloed die het toegankelijkheidsbeleid heeft op de kwaliteit van de informatie en op de ontwikkeling van de GII. Dit onderzoek voegt deze dimensie toe aan bestaand onderzoek en geeft, waar nodig, richting aan noodzakelijke veranderingen van bestaand toegankelijkheidsbeleid.

De strategie van het onderzoek

De doelstelling van dit onderzoek is drieledig:

1. het ontwikkelen van een model dat de verschillende fasen van ontwikkeling van een geografische informatie infrastructuur beschrijft;
2. het ontwikkelen van een onderzoeksraamwerk voor onderzoek naar het succes van toegankelijksheidsbeleid in de context van een GII, en
3. het bepalen van de impact van toegankelijkheidsbeleid op de kenmerken en het gebruik van grootschalige geografische basisinformatie.

Het onderzoek heeft zich gericht op grootschalige geografische basisinformatie (vergelijkbaar met een schaal van ongeveer 1:1.000) voor dichtbevolkte gebieden. Het grote detailniveau en de uitgebreide inhoud maken grootschalige basisinformatie, vergeleken met informatie op andere schaalniveaus, kostbaar om in te winnen en te verwerken. Bovendien vormt grootschalige informatie in potentie de basis voor kleinschalige informatie. Het is daarom niet alleen de basis voor lokale GIIs maar ook belangrijk voor GIIs op een hoger abstractieniveau zoals nationale GIIs. Het succes van toegankelijkheidsbeleid voor grootschalige basisinformatie is echter nauwelijks onderzocht. Dit onderzoek heeft zich op kadastrale en grootschalige topografische informatie gericht, omdat kadastrale en topografische informatie alom worden beschouwd als basisinformatie voor een GII (zie bijvoorbeeld Rajabifard et al., 2000)

Het onderzoek bestond uit een literatuurstudie en een meervoudige case studie. Hieruit zijn een GII-groeimatrix en een GII-groeimatrix van de basisinformatie ontwikkeld. De case studie behelst vijf jurisdicties: (1) Nederland, (2) Denemarken, (3) de Duitse deelstaat Nordrhein-Westfalen, en in de Verenigde Staten (4) de staat Massachusetts, en (5) de Metro regio van Minneapolis en St. Paul (binnen de staat Minnesota). Hoewel alle componenten van de GII-groeimatrices in de case studie zijn behandeld, ligt de nadruk op het toegankelijkheidsbeleid. De case studies zijn gebruikt als input voor de beoordeling van de rol van toegankelijkheidsbeleid in de ontwikkeling van een GII.

De modellering van GII-ontwikkeling

In het onderzoek is een model ontwikkeld dat vier stadia van ontwikkeling van geografische informatie-infrastructuren beschrijft: de GII-groeimatrix. De GII-groeimatrix bestaat uit vier stadia van GII-ontwikkeling: de eilandfase, de uitwisselingsfase, de tussenfase en de netwerkfase. Uiteindelijk zal in het meest geavanceerde stadium, de netwerkfase, door iedereen worden begrepen wat een GII is, en wat de doelstellingen en het ideaal zijn. Verder, hebben de leiders, de open communicatiekanalen en een pro-actieve geografische informatiesector geresulteerd in brede steun op alle niveaus voor de GII met duurzame financiering voor de verdere ontwikkeling van de GII.

In aanvulling op de GII-groeimatrix is in dit onderzoek een GII-basisinformatie-groeimatrix ontwikkeld. De matrix bestaat uit een technische (kwaliteit van de informatie), niet-technische (onder andere toegankelijkheidsbeleid) en institutionele component van informatie. De matrix onderscheidt verder verschillende groepen gebruikers die in een bepaalde ontwikkelingsfase van de informatie bereid zijn om de betreffende informatie te gaan gebruiken. De GII-basisinformatie-groeimatrix modelleert de ontwikkeling van een GII van een aanbodgerichte GII naar een gebruikersgeoriënteerde GII. In een ideale situatie wordt de waarde van basisinformatie alom onderkend en heeft dit geleid tot (wettelijke) garanties voor de beschikbaarheid van de informatie. Verder heeft de basisinformatie idealiter uitstekende technische kenmerken; onder andere een geharmoniseerde, actuele en nauwkeurige inhoud, en volledige dekking over een jurisdictie. Verder wordt het gebruik gestimuleerd door consistent en transparant open toegankelijkheidsbeleid. Door deze eigenschappen zal de basisinformatie ook daadwerkelijk de basis vormen voor een pro-actieve geografische informatiesector. De best practices die hieruit voortvloeien zorgen voor de noodzakelijke erkenning van het belang van een GII voor de informatiemaatschappij.

De GII-groeimatrix en de GII-basisinformatie-groeimatrix vormen een eerste model om GII-ontwikkeling vanuit een institutioneel, technisch en niet-technisch informatie perspectief te beoordelen. De relatie tussen de individuele componenten is echter onbepaald gebleven. Het bereiken van het institutionele ideaal kan resulteren in een hoge mate van erkenning van de waarde van geografische informatie in het algemeen en de GII voor de informatiemaatschappij in het bijzonder. Zo'n institutionele onderkenning is echter geen garantie dat deze ook daadwerkelijk leidt tot technisch uitstekende informatie of een open toegankelijkheidsbeleid. De ontwikkelde modellen moeten dan ook worden gezien als een eerste poging om GII-ontwikkeling te modelleren.

Het onderzoeken van toegankelijkheidsbeleid vanuit het perspectief van een GII

De tweede doelstelling betrof het ontwerp van een onderzoeksmodel voor het onderzoeken van het toegankelijkheidsbeleid zelf. Het ontwikkelde onderzoeksmodel geeft aan op welke wijze het succes of falen van een bepaald toegankelijkheidsmodel kan worden onderzocht. Het model onderscheidt producenten van de geografische informatie en een gebruikersperspectief. Het producentendeel bestaat uit een technisch en niet-technisch deel van basisgegevens. De technische kenmerken zijn type van informatie, schaal van informatie en kwaliteit van informatie. De niet-technische kenmerken worden bepaald door de wettelijke, financiële, intellectuele en fysieke toegangskenmerken van de dataset en door extra's die met het gebruik van de dataset samenhangen. De technische en niet-technische gegevenskenmerken bepalen in welke mate de dataset wordt gebruikt: de geschiktheid-voor-gebruik waarde. De datasets in een geavanceerd stadium van GII-ontwikkeling hebben een hoge geschiktheid-voor-gebruik waarde. Het daadwerkelijke gebruik, aantallen gebruikers, en de tevredenheid met het gebruik vormen een gebruikswaarde. Een extra controlepost voor de schatting van de waarde van een dataset is het aantal alternatieve (identieke of vergelijkbare) datasets dat beschikbaar is.

De beoordeling van het effect van toegankelijkheidsbeleid op GII

De derde doelstelling geeft het antwoord aan de belangrijkste onderzoeksvraag:

Wat is de rol van toegankelijkheidsbeleid voor de ontwikkeling van een geografische informatie-infrastructuur (GII)?

Voor twee geografische basisinformatie verzamelingen, kadastrale informatie en grootschalige topografie, bevestigt dit onderzoek de belangrijke rol die het toegankelijkheidsbeleid voor basisinformatie heeft voor de ontwikkeling van een GII. Echter, in de beoordeling van het succes van specifiek toegankelijkheidsbeleid, zijn de bevindingen in de case studies tegenstrijdig: in sommige gevallen heeft het kostendekkende beleid positief bijgedragen tot GII-ontwikkeling, in andere gevallen is een open toegankelijkheidsbeleid nodig om na aanvankelijke ontwikkeling, de verdere GII-ontwikkeling te bevorderen. Hier worden de belangrijkste bevindingen weergegeven.

Bevinding 1: Zowel de technische als niet-technische kenmerken van een dataset zijn bepalend voor het gebruik

De bevindingen in dit onderzoek bevestigen dat de mate waarin de datasets worden gebruikt, door zowel hun technische als niet-technische kenmerken wordt bepaald. De datasets met geavanceerde niet-technische kenmerken (bijv. vrij downloadbaar vanuit een centraal clearinghouse, geen gebruiksbeperkingen), maar met technische kenmerken waardoor een gebruiker een grote inspanning moet leveren om de dataset geschikt te maken voor zijn gebruik, werden niet gebruikt door 'value-added' gebruikers. Op dezelfde manier werden de datasets met geavanceerde technische kenmerken, maar met een restrictieve toegang, door deze gebruikersgroep niet als bruikbaar beschouwd.

Bevinding 2: De relatie tussen toegankelijkheidsbeleid en gegevenskwaliteit is niet gevonden

In het onderzoek zijn verscheidene datasets gevonden met, vanuit een GII-perspectief, voldoende technische kenmerken, maar met minder geavanceerde niet-technische kenmerken (bijv. de topografische dataset in Nederland, en de kadastrale datasets van Denemarken, Nederland en MetroGIS). In het onderzoek zijn echter ook datasets gevonden met, vanuit een GII-perspectief, ontoereikende technische kenmerken (de topografische datasets in Denemarken, Massachusetts, Minnesota, en Nordrhein-Westfalen), maar met restrictieve toegang. Hoewel het verband tussen beleid en gebruik, en het verband tussen kwaliteit van informatie en gebruik duidelijk is, heeft het onderzoek geen direct verband kunnen leggen tussen het toegankelijkheidsbeleid en de kwaliteit van een dataset.

Bevinding 3: Het meest aangewezen toegankelijkheidsbeleid is gerelateerd aan de ontwikkelingsfase waarin een GII verkeert

Het onderzoek bevestigt dat het meest wenselijke toegankelijkheidsmodel afhankelijk is van de ontwikkelingsfase waarin een GII verkeert. In de beginstadia is de informatievergaring de drijvende kracht achter de GII-ontwikkeling. Voor geavanceerde GIIs, met inbegrip van geavanceerde technische dataset-kenmerken, zijn het gebruik van de informatie en bijbehorende meer open toegankelijkheidsbeleid de bepalende factoren.

In beginstadia van GII-ontwikkeling ligt de prioriteit op het vervullen van de behoeften van de primaire gebruikers van basisinformatie: de dataset moet er zijn, ongeacht het toegankelijkheidsbeleid. Het kostendekkend beleid biedt dan de mogelijkheid om publiek-private samenwerkingsverbanden aan te gaan en een deel van de investering terug te verdienen door de verkoop van informatie. De voorbeelden in de case studies van publiek-private of publiek-publieke samenwerkingsverbanden, vooral die tussen lokale overheden en nutsbedrijven (topografische datasets in Nederland, Denemarken, Metro regio en Massachusetts) zijn het bewijs van het succes van kostendekkend beleid voor GII-ontwikkeling in de beginnende fasen van GII-ontwikkeling.

Vanaf het moment dat de technische kenmerken van een dataset redelijk stabiel zijn en de primaire gebruikersbehoeften vervullen, kan de aandacht worden verplaatst naar vragen rondom de toegang van de informatie voor andere gebruikers. In deze gevorderde stadia van GII-ontwikkeling wordt het waardetoevoegend gebruik gestimuleerd, zonder dat het financieringsmechanisme, dat aan de informatievergaring ten grondslag ligt, in gevaar wordt gebracht. Theoretisch bevestigt dit onderzoek dat voor vergevorderde fasen van GII-ontwikkeling de financiering van basisinformatie waarschijnlijk duurzaam zal zijn. In zulke gevallen zal een open toegankelijkheidsbeleid de GII-ontwikkeling meer stimuleren dan ander beleid. De case studies in het onderzoek leverden echter geen voorbeelden op van basisinformatie met uitstekende technische en niet-technische gegevenskenmerken die veelvuldig werd gebruikt door alle gebruikerscategorieën.

Status van de onderzochte geografische informatie infrastructuren

Van de onderzochte cases en datasets vallen sommige vanuit een technisch datasetperspectief in beginfases van GII-ontwikkeling, terwijl andere datasets zich in een vergevorderd stadium bevinden. Vooral de Deense en Nederlandse kadastrale informatie voldoen op veel technische punten aan de eisen die een GII aan een dataset stelt. De datasets met percelen en grootschalige topografie in Massachusetts en de topografische datasets in Metro zijn datasets die zich in de beginfase van GII-ontwikkeling bevinden. In Massachusetts is de perceleninformatie zeer heterogeen van kwaliteit. Het zal (te) tijdrovend zijn om deze verschillende datasets in een jurisdictiedekkend bestand te integreren. In Metro is grootschalige topografische informatie slechts beschikbaar voor drie van de zeven counties. Volledige dekking kan dus voor de Metroregio niet worden verkregen.

In Nordrhein-Westfalen werkt het *Landesvermessungsamt* samen met locale kadasters aan een deelstaatdekkende topografische/kadastrale dataset met geharmoniseerde technische kenmerken. De huidige dataset dekt 87% van Nordrhein-Westfalen. De inhoud van de dataset, de juridische status en wettelijke inkadering van de inwinning en verwerking van grootschalige geografische informatie tezamen met toenemende druk om de huidige restrictieve toegang om te vormen naar meer open beleid maken de Nordrhein-Westfaalse GII potentieel de meest veelbelovende GII van dit onderzoek.

De Nederlandse GII is op dit moment in vergelijking tot de andere GII's toonaangevend. De realiteit noodzaakt echter te constateren dat het de afgelopen jaren voor wat betreft regie en organiserend vermogen aan kracht heeft ingeboet. Dit ondanks het programma Ruimte voor Geo-informatie, waar de sector, naast de subsidie van €20 miljoen, ruim €20 miljoen investeert in de ontwikkeling van de GII. De toegenomen onzekerheid over de mate waarin het Ministerie van VROM de regierol over de ontwikkeling van de Nederlandse

GII op zich wil nemen, en als gevolg daarvan de onzekere positie van de Ravi, die jarenlang succesvol de regie heeft gevoerd, dragen bij tot de vermindering van de institutionele GII-ontwikkeling in Nederland.

Het programma Ruimte voor Geo-informatie werkt als een stimulerende kracht achter diverse innoverende projecten. Na een lange aanlooptijd, die gepaard ging met de nodige bureaucratie en frustratie binnen de sector, lijkt het programma zich te hebben hervonden. De grote opkomst tijdens recente Makel- en Schakeldagen en het grote aantal ingediende projectvoorstellen bevestigen dit beeld.

Tenslotte moet worden opgemerkt dat de bestanden waarover Nederland beschikt en de inbedding van deze basisbestanden als basisregistratie in het nationale programma Stroomlijning Basisgegevens een uitstekende basis vormen voor de succesvolle verdere ontwikkeling van de Nederlandse GII. Standaarden, metadata en objectgerichtheid van de bestanden zijn de terreinen waar nog veel technische progressie geboekt moet worden. Voor het bereiken van een volgende fase van GII-ontwikkeling zal verder het huidige toegankelijkheidsbeleid voor geografische basisinformatie moeten worden omgevormd tot een beleid dat waardetoevoegend gebruik stimuleert.

Het bevorderen van GII-ontwikkeling

In het onderzoek zijn verscheidene barrières geïdentificeerd die GII-ontwikkeling blokkeren. De barrières hebben rechtstreeks betrekking op de technische en niet-technische kenmerken van de datasets. De oorzaken voor het beperkte gebruik zijn het restrictieve toegankelijkheidsbeleid en/of de niet toereikende technische gegevenskenmerken. Hier worden twee mogelijke oplossingsrichtingen voorgesteld die kunnen helpen deze barrières te overbruggen.

Decentrale informatie-inwinning

In de studie is gestuit op zowel centraal als decentraal georganiseerde informatie-inwinning. Over het algemeen hebben de centraal georganiseerde datasets betere technische gegevenskenmerken dan de decentrale datasets. Als de informatievergaring niet centraal wordt georganiseerd, zal informatie tussen decentraal opererende partijen moeten worden uitgewisseld en zullen er afspraken moeten worden gemaakt over inhoud, standaarden, afbakening van gebied, kwaliteitswaarborgen, vertrekking en toegankelijkheidsbeleid, en andere relevante factoren. De samenwerkingsverbanden kunnen uit technologische ontwikkelingen verder voordeel halen. Deze geven organisaties de mogelijkheid om informatie uit te wisselen en tot GII bij te dragen zonder hun autonomie te verliezen (zie ook Onsrud 1990).

Succesvolle samenwerking is waarschijnlijk in gevallen met gemeenschappelijk begrip van de behoeften van de (primaire en secundaire) gebruikers. 'Champions', individuen wier visie door alle betrokken partijen wordt geaccepteerd en gerespecteerd, zijn dan veelal de sleutel voor succes van de inspanning. De voorbeelden van de topografische dataset in Nederland, en de geïntegreerde kadastrale dataset in de Metro regio, zijn goede voorbeelden van samenwerkingsverbanden die GII-ontwikkeling bevorderen.

Een rigoureuzere methode om de nadelen van decentrale informatievergaring te verhelpen is institutionele hervorming. Het is echter onwaarschijnlijk dat een nationale overheid de autonomie van lokale overheden wil beperken omwille van de ontwikkeling van een GII.

Het alternatieve financieringsmodel

In situaties waarin de technische kenmerken van een dataset vanuit een perspectief van een GII als afdoende worden beoordeeld, kan het volledige potentieel van een GII slechts worden bereikt als de waardetoevoegende gebruikers worden geactiveerd. Het onderzoek leverde verscheidene situaties op waar de basisinformatie een jurisdictie volledig dekte met geharmoniseerde technische kenmerken (in het Nederlandse en Deense kadastrale bestand en de percelen in dataset van MetroGIS, en in mindere mate in de Nederlandse en Deense topografische datasets). Echter, het waardetoevoegende gebruik van deze datasets is beperkt gebleven door de hoge prijs en gebruiksbeperkingen.

Dit onderzoek heeft een alternatief financieringsmodel geïntroduceerd om waardetoevoegend gebruik te bevorderen. Het alternatieve financieringsmodel slaat bruggen tussen het open toegankelijkheidsmodel en het kostendekkende model. Bedrijven die op basis van publieke geografische gegevens een waardetoevoegende dienst of waardetoevoegend product willen aanbieden, zouden gratis toegang tot de gegevens moeten krijgen. Middels een klein percentage van de omzet van dat nieuwe product of door teruglevering van verbeterde informatie, kan de eigenaar van de gegevens (financieel) worden gecompenseerd. De intellectuele eigendomsrechten blijven bij de informatieleverancier en gebruiksbeperkingen moeten waarborgen dat de dataset slechts voor waardetoevoegende activiteiten en niet voor andere doeleinden wordt gebruikt. Gebruik voor andere doeleinden kan onder een kostendekkend beleid blijven vallen.

Het alternatieve financieringsmodel specificeert het toegankelijkheidsbeleid voor specifieke gebruikersgroepen. Hiermee kan de kwaliteit van datasets op lange termijn worden gegarandeerd. Verder wordt het waardetoevoegend gebruik bevorderd. Dit moet resulteren in een GII met basisinformatie van uitstekende kwaliteit die de basis vormt voor een grote verscheidenheid aan overheids- en private taken en waarop een grote verscheidenheid aan waardetoegevoegde producten en diensten kan bouwen.

Als dit alternatieve model succesvol blijkt, zal het leiden tot nieuwe producten en nieuwe gebruikers die GII op het volgende niveau van ontwikkeling zullen brengen: de gebruikergeoriënteerde geografische informatie-infrastructuur.

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AdV	http://www.adv-online.de/exteng/broker?uCon=a05602fa-117e-3afa-6d78-79f08a07b51a	19-08-2005
Alaska mortgage	www.alaskausamortgage.com/help/mtgterms.asp	19-08-2005
ALK Lexikon	http://www.igip.de/ALK-Lexikon/index-alk-lexikon.html	19-08-2005
ATKIS	www.atkis.de/metainfo/	19-08-2005
AUSLIG	www.auslig.gov.au/asdi/index.htm	19-08-2005
Boston Atlas	http://www.mapjunction.com/places/Boston_BRA/main.pl?ht=768	19-08-2005
Boundary Solutions	http://www.boundarysolutions.com/	19-08-2005
CeGI	www.cegi.de	19-08-2005
CeGI1	http://www.cegi.de/de/aktuelles/news/news-20041203-01.html	19-08-2005
Census	http://quickfacts.census.gov/qfd/states/27000.html	16-08-2005
City of BostonC	http://www.cityofboston.gov/assessing/search/default.asp	19-08-2005
clearinghouse	http://registry.gsdi.org/serverstatus/	16-08-2005
Conservation Commons	http://www.conservationcommons.org/	19-08-2005
Creative Commons	http://creativecommons.org/	19-08-2005

CSUN	http://library.csun.edu/mwoodley/dublincoreglossary.html	19-08-2005
Dakota County	http://207.171.98.200/plats/info.htm	19-08-2005
DK Aalborg	http://www.aalborg.dk/Vejviser/g_kort/oversigt.htm	19-08-2005
DK AKF	http://www.akf.dk/dk2005/summary/strukturreform.htm	19-08-2005
DK Bornholm	http://www.brk.dk/gisweb/mappage.asp?brugerid=9	19-08-2005
DK clearinghouse	http://www.geodata-info.dk/ds.asp?DS=176&LA=2	19-08-2005
DK Geodatahotel	www.geodatahotel.dk	19-08-2005
DK Grundkort Fyn	http://www.grundkortfyn.dk	
	http://www.grundkortfyn.dk/netgis/defaultframes.asp?KUNDEGRP=14&KUNDENR=473	19-08-2005
DK Grundkort Øst	http://www.gko.dk	19-08-2005
DK Kommunekort	http://www.kommunekort.dk/	19-08-2005
DK Kortcenter	www.kortcenter.dk	19-08-2005
DK Nykobing	http://194.192.218.98/nykf/webgis.htm	19-08-2005
DK Ringe Kommune	http://www.grundkortfyn.dk/netgis/ defaultframes.asp?KUNDEGRP=14&KUNDENR=473	19-08-2005
DK XYZ	http://www.xyz-geodata.dk	19-08-2005
Enschede	https://www.loket.enschede.nl/griffieren/p1009/13/schermen.asp?SchermID=4	19-08-2005
ESRI	http://www.esri.com/news/arcuser/1001/octdec2001.html	19-08-2005
FGDC	http://www.fgdc.gov/framework/overview.html	19-08-2005

GBKNa	http://www.gbkn.nl/html/loket.htm	19-08-2005
GCGI	http://www.gis.state.mn.us/standards.htm	16-08-2005
	http://geoserver.lds.nrw.de	–
Geocatalog	www.geocatalog.de	16-08-2005
Geocatalog1	http://www.geocatalog.de/frameset.html	
geodatenzentrum	http://www.lverma.nrw.de/aufgaben/geodatenzentrum/Geodatenzentrum.htm	16-08-2005
geogateway	http://geogateway.state.mn.us/documents/index.html	16-08-2005
geo-one-stop	http://www.geo-one-stop.gov/	16-08-2005
GoogelEarth	http://maps.google.com	16-08-2005
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HUNT	http://libinfo.uark.edu/GIS/us.asp	19-08-2005
IEEE	http://www.validationstation.com/glossary/glossaryd.htm	19-08-2005
IMAGI	http://www.imagi.de	16-08-2005
Justizministerium NRW	http://www.justiz.nrw.de/JM/organisation/gerichtsorganisation/index.html	19-08-2005
Kadaster	www.kadaster.nl	19-08-2005
Kadaster1	http://www.kadaster.nl/zakelijk/default.html	19-08-2005
KL	http://www.kl.dk/296091/	16-08-2005
KMS	www.kms.dk	19-08-2005
KMS1	http://kortforsyning.kms.dk	19-08-2005
Kommunekort	www.kommunekort.dk	16-08-2005
LMIC	http://www.lmic.state.mn.us/chouse/GLO/	19-08-2005
LMICa	http://www.lmic.state.mn.us/chouse/SPMI	19-08-2005

LMICb	http://www.lmic.state.mn.us/chouse/ land_own_property.html	19-08-2005
LVA	http://www.lverma.nrw.de/produkte/ druckschriften/verwaltungsvorschriften/ Verwaltungsvorschriften.htm	19-08-2005
LVA1	http://www.lverma.nrw.de/shop/ nutzungsrechte/Nutzungsrechte.htm	19-08-2005
MA City of Boston	http://www.cityofboston.gov/assessing/ search/ default.asp?mode=reval&pid=22 03719000&image1.x=20& image1.y=18_	19-08-2005
MA City of BostonA	http://www.cityofboston.gov/dnd/M_ Property_Inventory_Intro_Page.asp	19-08-2005
website MA City of BostonB	http://www.cityofboston.gov/assessing/ paymentinfo.asp?parcelid=0201071002	19-08-2005
MA City of Fitchburg	http://www.ci.fitchburg.ma.us/dataavail.html)	19-08-2005
MA City of Newton	http://www.ci.newton.ma.us/Assessors2003/ Interactivemap.asp?id=71037+0004	19-08-2005
MA counties	http://www.sec.state.ma.us/cis/ cispdf/ma_counties.pdf	19-08-2005
MA Town of Barnstable	http://www.town.barnstable.ma.us/ tob02/roadstatusweb.PDF	16-08-2005
MA Town of Brookline	http://www.town.brookline. ma.us/gis/req/req/mou.PDF	16-08-2005
MA Town of Dedham	http://host.appgeo.com/dedham_gis/ map.aspx?ParcelID=153-107	19-08-2005
MA Town of Groton	http://host.appgeo.com/groton/Search.asp	19-08-2005
MassGIS	http://www.state.ma.us/mgis/laylist.htm	16-08-2005
MassGIS1	http://www.state.ma.us/mgis/maps.htm/	

MassGov	http://www.mass.gov/legis/laws/mgl/21a-4b.htm	16-08-2005
Masslandrecords	http://www.masslandrecords.com/malr/controller	
Middlesex County	http://www.lowelldeeds.com/RODFAQ.htm#reg%20ld	19-08-2005
Minneapolis Chambre of Commerce	http://www.minneapolischamber.org/la_center/Met_council.htm	16-08-2005
Minnesota GIS	http://www.gis.state.mn.us/iisac/imp.html	19-08-2005
MMA (Massachusetts Municipal Association	http://www.mma.org/local_government/facts_and_stats.html	16-08-2005
MN Admin	http://www.admin.state.mn.us/data_practices_ii.html	DOC
MN Anoka County	http://www.co.anoka.mn.us/services-res-txt.asp#PROPERTYTAX	16-08-2005
MN Carver County	http://156.99.124.167/website/gishome/ (http://www.co.carver.mn.us/)	16-08-2005
MN Clay County	http://www.co.clay.mn.us/Depts/GIS/GISDatDl.htm	19-08-2005
MN Dakota County1	http://www.co.dakota.mn.us/gis/maps/aerial.htm	19-08-2005
MN Dakota County2	http://www.co.dakota.mn.us/gis/data/dcphysic.htm	19-08-2005
MN Dakota County3	http://www.co.dakota.mn.us/gis/data/map_fees.htm	19-08-2005
MN DataFinder	www.datafinder.org	19-08-2005
MN DataFinder Parcel	http://www.datafinder.org/metadata/metrogis_regional_parcels.htm	19-08-2005

MN DataFinder Ramsey	http://www.datafinder.org/metadata/rams_buildings.htm	19-08-2005
MN GISLIS	http://www.mngislis.org/newsletter/issue36/Maintaining%20the%20Parcel%20Database.htm	19-08-2005
MN Hennepin County	http://www.co.hennepin.mn.us/vgn/portal/internet/hcdetailmaster/0,2300,1273_83329_100591773,00.html	19-08-2005
MN IPAD	http://www.ipad.state.mn.us/modeldocs.html	19-08-2005
MN MetroGIS	http://www.metrogis.org	16-08-2005
MN MetroGIS1	http://www.metrogis.org/dta/datasets/parcels/private/index.shtml	16-08-2005
MN Minneapolis	http://www.minneapolis.org/mapsanddirections/index.asp http://apps.ci.minneapolis.mn.us/pi.app/address_selection/address.asp http://www.ci.minneapolis.mn.us/about/maps/streets.pdf	16-08-2005
MN MGMG	http://www.gis.state.mn.us/stds/metadata.htm	16-08-2005
MN Ramsey County GIS User Group	http://maps.metro-inet.us/ http://www.ramseygis.com/Webpages/	16-08-2005
MN Scott County	www.co.scott.mn.us/gis/help/gisdata/gisdata.htm	16-08-2005
MN Scott County1	http://www.co.scott.mn.us/gis/common/html/propertysearchindex.html	16-08-2005
MN Washington County	http://www.co.washington.mn.us/info_for_residents/survey_and_land_management_division/faq/	16-08-2005
nationmaster	http://www.nationmaster.com/encyclopedia/North-Rhine_Westphalia	16-08-2005
netstate	http://www.netstate.com/states/geography/ma_geography.htm	16-08-2005

Newsfactor	http://www.newsfactor.com/perl/story/18172.html	16-08-2005
NL clearinghouse	www.ncgi.nl	1-06-2005
NL GBKN	www.gbkn.nl	16-08-2005
OGC	http://www.opengeospatial.org/about/	16-08-2005
Opensource	www.opensource.org	16-08-2005
OSOSS	http://www.ososs.nl/index.jsp?alias=watisos	16-08-2005
Princeton	http://www.cogsci.princeton.edu/cgi-bin/webwn?stage=1&word=topography	16-08-2005
Roger Clarke	http://www.anu.edu.au/people/Roger.Clarke/II/	16-08-2005
Stand ALK	http://www.adv-online.de/extdeu/broker.jsp?uMen=ea510328-46de-1afa-6d78-79f08a07b51a.	19-08-2005
Suffolk	www.suffolkdeeds.com	16-08-2005
Terralink	http://www.terralink.co.nz/profile/glossary/	16-08-2005
The World Factbook	http://www.cia.gov/cia/publications/factbook/	16-08-2005
TIM-online	http://www.tim-online.nrw.de/tim/LVermA/index.html	16-08-2005
U.S. land use	http://www.landuse.com	16-08-2005
USGSa	http://rockyweb.cr.usgs.gov/nmpstds/nmas647.html	16-08-2005
UTexas	http://www.ar.utexas.edu/Courses/parmenter/gis/nmas.html	16-08-2005
VirtualEarth		
Vision Appraisal	http://www.visionappraisal.com/databases/mass/index.htm	June 2005

Washington County	http://www.co.washington.mn.us/info_for_residents/recorder__registrar_of_titles/abstract__torrens/	19-08-2005
Webster	http://www.websters-online-dictionary.org/	16-08-2005
Wikipedia	www.wikipedia.com	16-08-2005
Woonomgeving	www.dewoonomgeving.nl	16-08-2005

Appendix 1 Interviewees

Case The Netherlands

Gijs	Boekelo	Grontmij Geo Informatie
Erik	Dolle	Gemeente Den Haag, Dienst Stedelijke Ontwikkeling, afdeling Landmeten en Vastgoed
Cees	Guijkers	Directeur Bridgis B.V.
Leen	Murre	Directeur-secretaris LSV GBKN
Wiebe	Tamminga	Kadaster
Bart	Versteegh	Secretaris Bedrijvenplatform geo-informatie
Anton	Vogels	Provincie Gelderland, dienst Milieu en Water, afd. GEO-informatie, Landmeten en Vastgoed

E-mail:

Hans	van Eekelen	Adviseur techniek en beleid LSV GBKN
Lex	ten Veen	Geoscape

Case Denmark

Hanne	Brande-Lavridsen	Associate professor, Aalborg University Department of Development and Planning
Lars	Buhl	National Survey and Cadastre
Paul	Daugbjerg	National Survey and Cadastre, strategy and development
Inge	Flensted	Herning Kommune
Jens	Hollaender	National Survey and Cadastre
Vagn G.	Hyldgaard	KortCenter.dk
Erik	Jeppesen	NESA A/S, Netplanlægning
Vagn	Laursen	Geoforum Danmark
Anne	Revald	Amtsrådsforeningen
Erik	Stubkjaer	Professor, Aalborg University Department of Development and Planning
Knud	Villemoes Hansen	National Survey and Cadastre

Case Northrhine Westphalia

Jens	Riecken	Landesvermessungsamt Nordrhein-Westfalen

E-mail:

Norbert	Dephoff	Stadt Münster, Vermessungs- und Katasteramt
Herbert	Kruel	Kreis Lippe, Der Landrat, Vermessung und Kataster
Ralf	Riemer	Stadt Bottrop
Markus	Stein	Stadt Bornheim - Der Bürgermeister, Stadtplanung
Karl-Wilhelm	Wilke	Stadt Köln - Der Oberbürgermeister, Abteilung für Kataster und Geobasisdaten

Case MetroGIS

William	Brown	Hennepin County Surveyor
Larry	Charboneau	President/CEO The Lawrence Group
David	Claypool	Ramsey County Surveyor
Carla	Coates	Ramsey County GIS Group, GIS analyst
William	Craig	University of Minnesota, Center for Urban and Regional Affairs (CURA)
Brad	Henry	Senior associate, URS Corporation, Create Imaging
Randall	Johnson	MetroGIS Staff Coordinator, Metropolitan Council
Randy	Knippel	GIS Manager, Dakota County Office of GIS
Kent	Lee	President/CEO, East View Cartographic, Inc.
Matthew	McGuire	Metropolitan Council (Dakota County)
David	Windle	GIS Coordinator City of Roseville, MN Ramsey County

E-mail:

Tianhong	Zhang	City of Plymouth, Minnesota
Alan D.	Laumeyer	CenterPoint Energy Minnegasco

Case Massachusetts

Richard	Grady	President, Applied Geographics, Inc.
Glenn	Hazelton	Massachusetts Water Resources Authority
Claire	Lane	City of Boston Assessing Department
Lucia	Lovinson	Harvard University
Neil	MacGaffey	Assistant Director, Office of Geographic and Environmental Information (MassGIS), Executive Office of Environmental Affairs
Wayne L.	Mory	General Manager, The BSC/Cullinan Associates, Engineering Surveys & GeoSpatial Data Consultants
Michael	Terner	Applied Geographics, Inc.
Martin	von Wyss	Boston Redevelopment Authority

E-mail:

Dave	Beck	Town of Hull, Massachusetts
Ben	Binger	National Grid
Douglas	Greenfield	GIS Administrator, City of Newton, Massachusetts
Clarence	Young	Project Manager, Energy & Telecommunications, James W. Sewall Company

Appendix 2 Glossary

Acronym	Short for	Explanation
AKR	GeAutomatiseerde Kadastrale Registratie	Digital automated administrative cadastral database of the Netherlands
ALB	Automatisierten Liegenschaftsbuch	Digital automated administrative cadastral database in Germany
ALK	Automatisierten Liegenschaftskarte	Digital parcel map in Germany
CDPWG	MetroGIS' County Data Producers Working Group	
CEN	The European Committee for Standardization	
CGDI	Canadian Geospatial Data Infrastructure	Canadian GII
DK	Denmark	
DKK	Danish krone	
DSFL	Dansk Selskab for Fotogrammetri og Landmåling et Forslag	Danish exchange standard
EDBS	Einheitliche Datenbankschnittstelle	German exchange standard for ALK
EOEA	Massachusetts' Executive Office of Environmental Affairs	
EULIS	European Land Information Service	
FGDC	Federal Geographic Data Committee	U.S. federal agency responsible for the coordination of the NSDI
FTTA	U.S. Federal Technology Transfer Act	
GBKN	Grootschalige Basiskaart Nederland	Large-scale base map of the Netherlands

GCGI	Minnesota Governor's Council on Geographic Information	
GDI.NRW	Geodateninfrastruktur Nordrhein-Westfalen	Northrhine Westphalian GII
GII	Geographic Information Infrastructure	a framework continuously facilitating the efficient and effective generation, dissemination, and use of needed geographic information within a community or between communities
GIS	Geographic Information System	
GITA	Geospatial Information & Technology Association	a nonprofit educational association serving the global geospatial community
GML	Geography Markup Language	XML grammar written in XML Schema for the modeling, transport, and storage of geographic information (OGC, 2005a)
GPS	Global Positioning System	
GSDI	Global Spatial Data Infrastructure Association	organisation promoting international cooperation and collaboration in support of local, national and international spatial data infrastructure developments (website GSDI)
IMAGI	Interministerielle Ausschuss für Geoinformationswesen	German Agency and Co-ordination Centre of the Interministerial Committee for Geoinformation
INSPIRE	Infrastructure for Spatial information in Europe	EU initiative to come to an European GII

IPAD	Minnesota's Information Policy Analysis Division	Government organisation providing technical assistance and consultation about Minnesota's data practices act and other information policy laws
ISO	International Standardization Organisation	
KMS	Kort & Matrikelstyrelsen	Danish National Survey and Cadastre
LBS	Location Based Service	
LKI	Landmeetkundig Kartografisch Informatiesysteem	Digital parcel map of the Netherlands
LMIC	Land Management Information Center	Coordinating agency of the Minnesotan GII
MA	Massachusetts	
Metro	The Metropolitan region of Minneapolis and St. Paul (Minnesota, U.S.A.)	
MGIC	Massachusetts Geographic Information Council	
MGMG	Minnesota Geographic Metadata Guidelines	
NAPA	U.S. National Academy of Public Administration	
NGDF	National Geospatial Data Framework	The GII initiative of the U.K.
NIMSA	National Interest Mapping Services Agreement	
NL	The Netherlands	

NRC	National Research Council	A U.S. non-profit institution that provide science, technology and health policy advice under a congressional charter (http://www.nationalacademies.org/nrc/)
NRW	Northrhein Westphalia	One of the 16 German states
NSDI	National spatial data infrastructure	See GII
NSGIC	National States Geographic Information Council	Organisation committed to efficient and effective (state) government through the prudent adoption of geospatial information technologies
OGC	Open Geospatial Consortium	The Open Geospatial Consortium, Inc (OGC) is an international industry consortium of 282 companies, government agencies and universities participating in a consensus process to develop publicly available interface specifications http://www.opengeospatial.org
OMB	U.S. Office of Management and Budget	Organisation assisting the U.S. President in overseeing the preparation of the federal budget and to supervise its administration in Executive Branch agencies (http://www.whitehouse.gov/omb/organization/role.html)
OS	Ordnance Survey	British national mapping agency
OSOSS	programma Open Standaarden en Open Source Software voor de overheid	Progam of Dutch government to stimulate the use of open standard within government (http://www.ososs.nl/)

PDA	Personal Digital Assistant	
PPP	Public-private-partnership	
PRA	U.S. Paperwork Reduction Act	
RLS	Registered Land Survey	
SDI	Spatial data infrastructure	See GII
STIA	Spatial Technologies Industry Association	A U.S. geographic information industry advocate on legislative and regulatory issues providing strategic business development information on public sector policies, programs, and funding (www.fgdc.gov/fgdc/coorwg/2002/fgdc_coordination.htm)
TK	Tekniske Kort	Large-scale topographic dataset in Denmark
U.S.C.	United States Code	the codification by subject matter of the general and permanent laws of the United States (http://www.gpoaccess.gov/uscode/)
USGS	United States Geological Survey	U.S. federal agency providing information to describe and understand the Earth (focus on biology, geography, geology, geospatial information, and water) (http://www.usgs.gov/aboutusgs/)
VAR	Value-added reseller	
VAT	Value-added tax	
WTO	World Trade Organisation	
XML	Extensible Markup Language	An open standard for exchanging structured data

Curriculum vitae

Bastiaan van Loenen was born on July 11, 1974 in Hoorn, the Netherlands. He attended Delft University of Technology in 1992 and graduated in 1998 with a M.Sc. degree in Geodetic Engineering. After his study he worked as a researcher at the Department of Geodetic Engineering. In August 1998, he went to the United States to write his thesis with professor Harlan Onsrud and to work for a Master's degree at The University of Maine. Bastiaan graduated from The University of Maine in 2001 with a M.Sc. degree in Spatial Information Science and Engineering. In 2000, he returned to the Department of Geodetic Engineering of Delft University of Technology where he started his PhD project in the beginning of 2001.
Bastiaan is co-editor of the GSDI publication Spatial data infrastructure and policy development in Europe and the United States, and has published and presented on a variety of legal and policy related to geographic information infrastructures and land administration. For several MSc courses in the Netherlands, he teaches on Funding mechanisms for GII. He participates the GSDI legal and economic working group and has created a searchable database with GII-related and freely accessible literature (see http://www.otb.tudelft.nl/NGII).
Bastiaan has the privilege to live together with three most enjoyable women: his wife Saskia and their daughters Iris and Femke.
A comprehensive curriculum vitae may be found at http:///www.bastiaanvanloenen.nl.

Within information societies, information availability is a key issue affecting society's well being. A geographic information infrastructure (GII) is the underlying foundation of such a society with regard to geographic information. Access to government information policies are important for the availability and successful use of the information and the success of the GII itself. Yet there have been only a few investigations into access policy oriented towards GII development. This book adds this perspective. Through the creation of a GII maturity matrix describing the development in GIIs, it presents new insights in the role access policies may play in the development of GIIs. The book provides policy makers with strategy guidelines for GII development, as well as information about which access policy would best promote the use of geographic information. This should result in a GII that is able to perform its appropriate infrastructure function in an information society.

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