Developing geographic information infrastructures; the role of access policies

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Abstract
Within societies, information availability is a key issue affecting society's well-being. For geographic information, a geographic information infrastructure (GII) facilitates availability and access to geographic information for all levels of government, the commercial sector, the non-profit sector, academia, and ordinary citizens. Although the importance of access policies in the development of a GII is commonly understood, research that has assessed the impact of access policies on this development is scant. This article adds this perspective. Based on information acquired from case-study and literature research, the author argues that open access policies do not always promote GII development and in specific instances are counter productive. These findings may explain why many nations still adhere to cost recovery policies instead of following access policies recommended by research. The article provides alternatives for changing current policies into new access policies that promote GII development.

Keywords: Geographic information infrastructure, SDI, access policy, development;

1 Introduction

In the information age access to information has become of vital importance to the economic and social development of a country. Information technology has increased the availability of and improved 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 "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). 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 and distributed efficiently to a wide range of users, and provides reliable information for effective use in decision-making processes at all levels.

Within the information infrastructure, geographic information is a special type of information. The linkage of information to the earth gives general information extra value (BDO 1998). It makes the object or subject easy to identify, and as a result easy to reach. Another specialty is that geographic information is multidimensional (x,y), voluminous (large databases), and often represents a 3D world on a flat (2D) surface (Longley et al. 2001, p. 6). Further, to integrate and analyse the many varied types may be time-consuming, and the

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process of updating is complex (Longley et al., 2001). Another specialty of geographic information is the costly collection and processing of geographic information. 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. Also, the creation of geographic products or services from geographic information typically requires advanced human and computer skills (see also Longley et al. 2001). This speciality has resulted in the emerging of geographic information infrastructures (GII) within or outside the concept of an information infrastructure.

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 (Onsrud 1998a). Although the importance of access policies in the development of a GII is commonly understood (see STIA 2001, Borgman 2000, Masser 1999, Tosta 1999, McLaughlin and Nichols 1994), research assessing the impact of access policies to GII development is scant. Consequently, the question of which funding model allows ready access to high-quality information and low-cost geographic information necessary to advance GII development (Lopez 1998) remains unanswered.

Based on a literature study and case studies research (Van Loenen *et al*. 2007 and Van Loenen 2006), this article assesses the impact access policies may have on geographic information quality in general and on the GII itself, and provides alternatives for changing current policies to more beneficial access policies. The article argues that an appropriate access policy for GII development is linked to the stage of GII development.

The outline of the article is as follows. First two common access policies are provided and their positives and negatives described. This is followed by the section on stages of GII development and the role of users in GII development. Then, stages of GII development, user needs, and access policies are linked and recommendations made. The final part introduces an alternative policy option that overcomes barriers of currently utilised access policies. This alternative access policy promotes ready access for all users to high-quality low-cost geographic information, which is the necessary foundation for our information society.

2 Two common access policies

Although in practice a wide variety of access policies exist ranging from open access to cost recovery policies, in the literature discussions have focused on the poles of open access and cost recovery (see, for example, Weiss and Pluijmers 2002, Onsrud 1992a and 1992b). 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 to use as possible. In the cost recovery approach, the price of government information covers at least the cost of creation and dissemination, and may include a return on investment. The use of the information is restricted, and government may choose to have exclusive arrangements.

2.1 Open access

In the open access model, information within governments is 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. 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.

The economic reasoning behind the open access model is presented in figure 1. Government agencies, responsible for collecting government geographic information, are

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funded with public funds to accomplish their public tasks. The use of these government data sets 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. The 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 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. In this way, "an open access policy fosters a process for adding value to raw government information resources" (Lopez 1998). This spin-off effect promotes the use of the information, which results in higher quantities of (income, company, or value-added) taxes flowing into government.

It has been argued that all leading economic studies indicate that current open access policies should remain in place to take full advantage of the potentials of a GII (Onsrud 2004, cf. Perritt 1995). Open access fosters academic and scientific research and effective public sector planning, as well as stimulating potential commercial development (KPMG 2001, Onsrud 1998b).

On the other hand, the open access model is continually under discussion with its precepts changing and being challenged as technology and society change overtime (Van Loenen and Kok 2004). An open access policy may make government entities fully (financially) dependent of high-level bureaucrats outside the geographic information sector, which are not necessarily aware of the value geographic information has for society. In a US context, Joffe (2005) has found: "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 for funding their GIS operations."

[Insert figure 1 about here]

2.2 Cost recovery

Cost recovery approaches seek profits from the sale of information to support the development and maintenance of the data sets (Lopez 1998, Onsrud 1992b). Information collection, maintenance, and dissemination are not fully provided by public funds and the costs must be covered through other means. The government agency is forced to generate income from the sales of information or products or through the provision of services. As a consequence, access to information is restricted 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 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). 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); it allows for tailor-made solutions for individual end-users.

Some of the drawbacks of the cost recovery model include net losses in hidden costs, such as extra administrative cost in managing such a policy (to cash the checks and to enforce

the use restrictions) (see, for example, in the UK: HM Treasury 2000). Further, the result of cost recovery policies may be that other parties decide to collect identical information themselves, to use substitutes, or to use inferior information from others. In an extreme situation, the user will do without the required data. Another potential major drawback is when government agencies that have a monopoly or near monopoly of some information product act also as commercial players and thus distort competition (see Statskontoret 2005).

Figure 2 shows the economic reasoning behind the cost recovery model. Government agencies creating geographic data sets 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. In many 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). The cost recovery model may provide sustainable funding to individual government agencies, allowing them to maintain their information collection activities overtime (Onsrud 1992b). It thus may allow for the advantage of having (access to) accurate, consistent, standardised databases that provide national coverage (Lopez 1998, Aslesen 2002, GITA 2005).

[Insert figure 2 about here]

3 Geographic information infrastructure development

A GII may be defined as 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 and provides its components, and the focus on needed geographic information presupposes interaction between users and suppliers, addressing the dynamic nature of the GII. The framework consist of five interdepending components: (framework) data sets, policy (including institutional framework and financial resources), technology, standards, and people (see also Rajabifard and Williamson 2002, GSDI 1997, McLaughlin and Nichols 1994). These components interact, which is a condition for the further development of the infrastructure.

Although ultimately all GIIs should strive to contribute significantly to economic growth and the establishment of preferred social and environmental objectives (see Masser 1999), the objectives of today's GIIs differ. The differences may be explained by the stage of development of a GII. In their assessment of currently evolving GIIs, Masser (2000 and 2007) and also Rajabifard *et al.* (2002) found two distinguishing types of GIIs: the first generation and second generation GIIs. Here, we confine ourselves with a description of the key characteristics of these two GII generations.

3.1 First generation GII

First generation GIIs are typically resulting from government organisations starting to think more strategically about information needs, collection and the resources needed to deliver information to a wider group of users (see Masser 1998). Due to increased pressures to operate efficiently and the development of new technology, government organisations realise 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 build on other organisations for the subordinate information.

In addition, society's challenges require solutions that go beyond specific organisations' focus and capabilities. 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 [….] – 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). Cooperation between departments, and between organisations is required to provide the necessary multidisciplinary or interorganisational solutions. Awareness among professionals in the geographic information sector grows that together they can make a difference. The concept of a GII may be an answer to the issues that need to be resolved: the first generation GIIs has come into being (see Masser 1999).

The dominant role of the public information producers in these GIIs, results in GII strategies that focus primarily on standardisation, digitisation (see Graafland 1993), information integration, and reducing duplication: the product-based strategies (see Rajabifard *et al.* 2003, Rajabifard *et al.* 2002). Significant investments are made to create a framework data set for an entire jurisdiction, either by integrating existing data sets, or through new information collection. Data set development and continuation of the existence of the data set are the key driver for GII development (cf. Rajabifard *et al.* 2003, Rajabifard *et al.* 2002, Masser 2000, Masser 1999).

3.2 Second generation GII

In the second generation the islands of organisations are becoming a network of organisations. The key organisations in this stage have changed from internally centred towards organisations open to external developments, and the individual organisations' strategies increasingly align with the GII vision (cf. Graafland 1997). Government, private sector and academia increasingly cooperate in the GII network.

Participants in the GII start to realise the potential of the network now information is available for and is used in multiple subject areas. Issues of use are addressed, such as barriers for using framework data sets. These barriers may be technical of nature, but awareness grows that policy issues need to be resolved to meet the needs of users.

Consequently, the GII strategy is not only focusing on information creation and exchange, but also aims to address the GII from a broader society perspective. Capacity building, coordination, and *meeting user needs* are central to these GIIs: the so-called process model (Rajabifard *et al.* 2002). Identifying and understanding different user groups and their specific needs has become critical.

The main driving forces behind the process model are the desire to reuse data collected by a wide range of agencies for a great diversity of purposes and a shift from centralised structures to the distributed networks of the internet (Masser 2007, p. 80, Masser *et al.* 2007, Van Loenen 2006). Especially the existence of web services and other information applications are regarded as one of the main technological drivers or indicators because "such services are partly able to fulfil the needs of users and improve the use of data" (Crompvoets *et al.* 2004, see also Rajabifard *et al.* 2003).

In specific instances, also other drivers may be found. In the European Union, for example, the process towards acceptance of the Infrastructure for Spatial Information in Europe (INSPIRE) (since 2002) and the implementation of the INSPIRE Directive (since 2007) has been and is a major driver for GII development in EU Member States. Through INSPIRE, GII development has gained significant awareness and commitment at high-levels of national governments.

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4 Role of users in GII development

Linking users to geographic information is at the core of GII development (see, for example, Masser *et al.* 2007). Users of the GII, however, "will probably be the most mentioned group and yet actually the least considered" (McLaughlin and Nichols 1994). Discussions on access policy often focus on *the* user without specifying different types of users and use. In practice, this has resulted often in a single access policy for a data set. Obviously, a wide variety of policies can be applied to a specific data set depending on needs of a user, the type of use, the number of users, the frequency of use, among others. In Sweden, as in many other countries, citizens can access geographic information through a model that can be categorised as open, as the model for private sector GI users is restrictive.

From a GII perspective it is important to acknowledge that within a GII different types of users exists, which may require a user group specific policy. We distinguish between four user groups:

(1) primary users, which are users that use the data set 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.
(2) secondary users are incidental users for similar purposes as the primary user.
(3) tertiary users are those that add value to the framework data set. Tertiary use may be integrating several data sets into one layer for a jurisdiction, the linkage of a framework geographic data set with several thematic layers, or providing user-friendly access to the data set (adding search facilities, explanation, or a help desk functionality), or simply intermediaries that help information resources in distributing the data set without adding anything other than providing distribution channels. Tertiary use may also be referred to as value-added use or re-use.
(4) end-users consist 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. Each of these groups, and even users within a group, may have unique needs, in terms of both data quality and access policy.

Figure 3 shows some insight in the relation between user groups and the value of geographic information. Primary users would typically value a data set at its production cost. Not all users value a data set at its production cost, however (see Krek and Frank 2000). Tertiary users, for example, will not value the framework data set at cost recovery prices. End-users might be willing to pay a few euros for a specific aspect of a data set, or otherwise turn to alternatives.

[Insert figure 3 about here]

Figure 3 also shows that the commercially interesting market is in value-adding products. Often, government cannot develop such value-added products, since this is outside its public task. Therefore, government agencies that bear the high cost of framework data collection often cannot take advantage of the framework data set commercially through value-added products. If government agencies then attempt to recover their costs by selling their information to value-adding resellers (VARs) against cost recovery prices they will fail, since the VARs do not value a data set at its cost recovery prices. The ‘one policy fits all’ principle will not work.

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5 How access policies may promote GII development

Section 3 has described two generations GII with distinguishing characteristics. The product-based strategies in the first generation focus on data set development and continuation of the existence of the data. These strategies are typically addressing primary and secondary users' needs. In the second generation, the process model, fulfilling the needs of tertiary users are at the core of GII strategies.

In this section, we will link the different objectives of the two GII generations to the characteristics of the access policies as described in section 2. Findings from case studies performed in Van Loenen (2006) and Van Loenen *et al.* (2007) are used to support the arguments.

5.3 First generation GII

In the first generation, users of geographic information are typically primary and secondary users; users that use the information in harmony with purposes for which it was collected. Tertiary use is limited primarily due to the insufficient quality of the data for value-adding purposes. New public sector objectives require further data set development, and also private sector needs require this (although this may not be recognised at this point).

Guaranteed public funding for improving the data set is one option to meet the needs. However, for most data sets such a guarantee would be unattainable: the awareness at the decision-making levels for a specific data set is insufficient for guaranteed public funding. Consequently, general budgets dedicated to costly data set development may not always be sufficient. In these instances, government can satisfy its needs through cooperation with other parties. Substantial gains may be found in public-private or public-public cooperation, for example for information collection.

5.3.1 Public-private partnerships. Cost recovery policies for public sector information may promote cooperation with the private sector to share the cost of information collection. Private entities are only willing to partner with the public entity if their investments are not flowing towards their competitor(s): they will require restrictive policies in exchange for their investment. 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 data set under an open records request (cf. Holland 1994). Cost recovery policies may lead to the availability of geographic information to a limited group of users (those in the private and government entities involved), whereas the information otherwise may not have been available at all.

Examples of successful partnerships are found in the public-private partnerships in collecting topographic information in the Netherlands, Norway, Denmark, the US Metropolitan region of Minneapolis of St. Paul, and to a smaller extent in the US state Massachusetts and the German state Northrhine Westphalia. Utilities play in these jurisdictions a critical role in the collection, creation, and maintenance of large-scale topographic information (see Van Loenen 2005). Through public-private partnerships, or independent of government, they support the respective GIIs through collecting, creating and maintaining digital large-scale topographic information. In the instances of no partnerships, the public party in the mentioned cases often lacked current and accurate large-scale topographic information.

In the Netherlands, the status of the large-scale topographic base map (GBKN), developed through a public-private partnership, has become such that it was considered to become part of the core of the Dutch Information Infrastructure (Besemer *et al.* 2006). Government was to

compensate the private partners for their investments in exchange for full public sector control over the data set. Such an opportunity would not have been there without private sector involvement.

5.3.2 Public-public cooperation. In instances where the quality of data sets is sufficient for primary users, but where other categories of use require a higher quality, public-public partnerships using cost recovery policies may also promote GII development. For example, in the German state Northrhine Westphalia, information collection is largely decentralised and carried out mostly on the regional and local levels. The processing and maintenance of information is mostly tailored to these local and regional requirements. Use of the *'Automatisierten Liegenschaftskarte' (*ALK, the parcel and topographic data set) is primarily with the primary users in the public sector. 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 value-added market will develop geographic information products and services (Micus, 2001b, p. 8). As a result, the state authority and the local authorities started to work together towards a single parcel and topographic layer for Northrhine Westphalia. In the beginning of 2007, this harmonised ALK data set had 96% digital coverage (LVA 2007). Through a cost recovery policy, the revenues generated are being shared between the participating authorities.

Another example stems from Massachusetts (US). The parcel data sets in Massachusetts are locally managed in the 351 towns and cities. Despite the open access policies, mainly primary users use the data sets. The heterogeneous quality of the 351 local parcel data sets at the state level is a major cause for this limited use (see Van Loenen 2006). Public-public cooperation in Massachusetts may result in harmonised parcel quality at the state level; the use of harmonised data models, and adherence to the same standards.

However, individual local government may not be willing to invest in a statewide harmonised data set which it does not need, but from which other levels of government and private sector may benefit significantly. Open access policies do not allow for recovering the cost of the integration and harmonisation of data sets. It is, in these instances, questionable whether local governments bound to open access policies will invest in harmonising their data set with state standards since the (tax) benefits will be received by the state or federal budget and not by the town bearing the cost. Potentially, the beneficiaries (i.e. state or federal treasury) may compensate local government. However, the likelihood of compensation decreases with the extent to which the value of geographic information is understood at the decision-making levels. With a cost recovery policy in place, local government will control the use (and revenues) of its data set. Cost recovery policies may provide some financial relief and help justify the investment with the local decision-makers. Therefore, local government is, with cost recovery policies in place, more likely to be willing to invest in integrating its data sets in jurisdiction-wide harmonised data sets.

5.4 Second generation GII

In the second generation, the use of framework data sets is in the primary and secondary user groups. Contrary to the previous stages, the cause for the limited tertiary use is not in the quality of the framework data sets, but rather in the restrictive access policies that are associated with the data set (see Brox *et al.* 2002). Such a situation has been found in several European GIIs (see Van Loenen *et al.* 2007, Van Loenen 2006). Potential tertiary users assess the restrictive use conditions including cost recovery prices as insufficient to develop viable commercial value-added products based on the framework information: the value-added

market that would be based on framework data sets does not develop. Maintaining full cost recovery policies for all user groups may be against the interest of the GII.

5.4.1 Promoting value-added use. It has been suggested that a change from cost recovery to open access policies would be beneficial for a society, as it would stimulate the information economy (e.g., Weiss and Pluijmers 2002, KPMG 2001, Berenschot *et al.* 2001, Pira *et al.* 2000, Ravi bedrijvenplatform 2000, Lopez 1998, Onsrud *et al.* 1996).

Still, the vast majority of public geographic information suppliers stick to cost recovery policies. The reluctance of these public data providers 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 (see EU 2002). Research has assessed that a price change for the Dutch 1:10 000 topographic data set 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. A change to completely free access was assessed to 'cost' €3.36 million per year (Berenschot *et al.* 2001). These numbers are small from a macroeconomic perspective. However, from a microeconomic perspective a policy change is likely to have a major impact on the national mapping agency, and the information it provides. For example, in the US, USGS suffered from significant real budget reductions that have caused USGS to scale back updates of the 1:24 000 map series (NRC 2003, p. 22).

This is what may be called 'the dilemma of the public enterprise'. A policy change would benefit the public enterprise (society) macroeconomically through promoting the development of value added services, including creating new jobs and generating tax income from these new products. However, 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 unavailable, the public sector entity (as a public enterprise) may be forced to collect less comprehensive information with lower frequencies; the existence of information currently available can no longer be guaranteed (see van Loenen *et al.* 2006). The quality may then become insufficient as a basis for value added products (see first generation GII). In these instances of uncertain resources, also open access policies may be counter-productive for GII development.

Both cost recovery and open access policies do not seem to be the panacea for further GII development in this stage. Policy makers still struggle to develop an appropriate policy (see Van Loenen *et al.* 2007). Continuing the battle between advocates of the two funding models will not abolish the status quo, however. Alternative approaches may help overcome the dilemma of the public enterprise by addressing the deficiencies of both the cost recovery and open access model.

5.4.2 Overcoming the dilemma of the public enterprise. Three alternative options to address the dilemma of the public enterprise are presented. All of them assume user group specific policies. One option is described in the US Federal Technology Transfer Act (FTTA), which allows the public sector to withhold data sets for five years from the public domain that were produced together with private companies (see also Pluijmers 1998, p. 54). The disadvantage of such an approach is that the data set is relatively old before value-added users can use it. Large-scale information products require current information to be most useful (see Van Loenen 2006). Therefore, this option may not be feasible for most value-added products for large-scale geographic framework data sets.

A more promising model may be found in the Data Lending Facility in Finland (see Toivonen *et al.* 2006). After subscribing to the facility (and agreeing to the terms of use),

users can freely download data for a one year period. After this one year in which the user can test the data, they are asked to buy the data, delete the data, or to extend the subscription for another year. This model allows value adding companies to use the data without cost, for example, to test the software and to assess the data set. A similar approach is found in Northrhine Westphalia where a new law allows government to provide private sector companies free access to geobasisdaten to explore the commercial opportunities (Van Loenen *et al.* 2007). If the value adding of these companies appears to be successful, a contract between state authority and the private partner will be negotiated.

The third alternative acknowledges that different users value identical information differently (Van Loenen *et al.* 2006). This alternative model maintains current cost recovery policies for the primary and secondary users, but promotes tertiary use by providing free *access* to framework data sets for those willing to add value to the framework information. Free access implies only access at no start-up 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 4) or through returning improved information quality. Intellectual property rights remain with the information provider, and additional use restrictions should guarantee that the data set is only used for value-adding activities, and not for purposes of primary or secondary use.

[Insert figure 4 about here]

Current use by primary and secondary user groups remain constant under the model, while it encourages tertiary use. This results in a GII with high-quality framework data sets that provide the basis for a wide variety of government and private tasks. In addition, the GII functions as the foundation for a large variety of value-added products and services. Through this hybrid access policy approach, the alternative funding model bridges the open access and cost recovery models. In this way this alternative model resolves the 'dilemma of the public enterprise'. It will result in a win-win situation, with new products, and new users. 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.

An example of the third alternative is in the UK's Ordnance Survey (OS) where primary users are bound to a collective licensing agreement and VARs can enter into a partnership program with VAR specific licenses. This has allowed OS to go into partnerships with over 140 VARs. The overall principle of market segmentation is very well understood, but the implementation by OS seems to be over-restrictive with respect to sharing and displaying data; that is, sharing of data is only possible with agencies with similar licensing agreement, which has resulted in dissatisfied primary users in government (Van Loenen *et al.* 2007). In addition, not all value-added resellers are satisfied with OS' policies. Some claim unfair discriminating practices of OS in the terms upon which basic (raw) information is made available to different entities within the public and private sectors (see APPSI 2007).

5.4.3 Barriers for implementation. Although the third alternative model looks promising, there may be several roadblocks to the alternative model. In Europe, for example, the European directive on re-use of public sector information (EU 2003) states: "Any applicable conditions for the reuse of documents shall be non-discriminatory for comparable categories of reuse" (article 10.1). Reuse is defined as reasons for using the public sector information other than the public sector bodies had in fulfilling their public tasks. It is not clear whether using framework data sets for tertiary use, for example, as a basis for value-added services,

and using the framework data sets for secondary use as a background map are comparable categories of reuse. If the two reuses are not 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 reuses are 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. A feasible, but fragile, way to promote value-added use is then to organise guaranteed funding with primary and secondary users and provide open access to the information to all users.

6 Future generation GII

In future generations GII, the GII may be a true network with players that operate pro-actively (Van Kerkhoff et al. 1999). The organisations involved may depend on each other because of shared responsibilities for the GII. The GII may become a 'multi-purpose system' with well-integrated information from multiple systems and sources (Masser 2005, Watson *et al.* 2001). Information is maintained at the source. This implies that information is only collected at the largest scale needed and generalised to smaller scales. Further, the dependencies require comprehensive metadata documentation (Watson *et al.* 2001). Standardisation has shifted from supplier or product specific to adherence to international standards that are supplier independent (Bemelmans and Matthijsse 1995). The value of a framework data set is well understood, and embedding it in legislation safeguards its future existence. The legislation is conceptual in its wording since framework data sets conceptual qualities are relatively constant (they exist, are complete, current, accurate, and interoperable with other data sets), but the technical requirements may change overtime. Further, it is commonly understood that the value of information comes from its use (see Onsrud and Rushton 1995).

In future generations GII awareness for the value of a geographic framework data set is present at the decision-making levels, which may result in sufficient financial resources ensuring that framework information will be collected and maintained. Open access policies support the development of GII 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. The open policies allow for a proactive geographic information sector that, with best practice solutions, continue to enlarge support for the concept of the GII.

Although some may argue that the approach of ubiquitous open access may be naïve or unlikely to happen, trends in Europe and Canada suggest that in the near future access policies are more likely to be more open or adjusted to specific user needs than most of today's policies for geographic information. Geographic information from the Dutch provinces and water boards can be freely reused (Van Berkel 2006), and the Dutch Ministry of Transport, Public Works and Water Management has announced to introduce a similar policy in 2009 (TK 2007). Also in Ireland (see Ryan 2007) and Canada (see, for example, http://www.geogratis.ca/) a similar trend evolves. In other countries, free access within government is emerging. For example, in Catalunya (Spain) but also in Northrhine Westphalia, access to public geographic framework data for government use has since 2005 been without cost. In Norway, open access for public data sets for public sector participating in Norge Digitalt has resulted in increased use of these data sets (Van Loenen *et al.* 2007).

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7 Conclusions

This article has aimed to provide a balanced view on the role access policies may play in developing geographic information infrastructures. Two stages of GII development were utilised to assess the role of access policies.

An appropriate policy for a particular framework data set is likely to relate to the stage of GII development. 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. In the first generation GIIs, information collection is the driver for GII development. 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 (topographic data sets in the Netherlands, Denmark, Massachusetts, and the Metropolitan region of Minneapolis and St. Paul), especially between local governments and utilities, show the success of cost recovery policies for GII development.

In more advanced stages, GII development aims at promoting use, without endangering the funding mechanism underlying information collection. Open access policies are in these instances expected to address the objectives of the GII better than cost recovery policies. However, in instances where guaranteed public funding for the GII is unattainable, which is likely for many geographic data sets, this article recommends to adopt relatively open policies for value-added use, but to maintain restrictive policies for those that do not intend to add value to the data set.

What Masser noticed in 1998, still holds today: the success of the GII strategies is likely to be closely coupled with the extent to which they meet the requirements of users (Masser 1998). Only user group specific access policies will meet this requirement of currently developing and future GIIs. Recent developments towards open access in Europe and Canada suggest that the next generation of GIIs with open access policies for high quality information may be much closer than many recognise.

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7 Literature

APPSI (ADVISORY PANEL ON PUBLIC SECTOR INFORMATION), 2007, Report in relation to requests by Intelligent Addressing Limited and Ordnance Survey to review certain recommendations made in the Report of the Office of Public Sector Information of 13 July 2006 relating to a complaint by Intelligent Addressing Limited (SO 42/8/4), 30 April.

ASLESEN, L., 2002, The US Experience, In *Data Policy & Legal Issues Position Paper*, Infrastructure for Spatial Information in Europe (INSPIRE). Available online at: http://inspire.jrc.it/reports/position_papers/inspire_dpli_pp_v12_2_en.pdf (accessed September 2007).

BDO CONSULTANTS, 1998, Elektronische bestanden van het bestuur. Report prepared for the Dutch Ministery of the Interior. (Electronic files of government)

BESEMER, J.W.J., LAARAKKER, P.M., MURRE, L, KROODE, R.B.M. TEN, & ZUIDERVEEN, BORGESIUS, N.W., 2006, *Basic registers for Geo-Information*. In Shaping the Change, T. Gollwitzer, K Hillinger & M Villikka (Eds.), XXIII international FIG congress

BEMELMANS, T.M.A. and MATTHIJSSE, R.P.H.M., 1995, Informatie-Infrastructuren. *Informatie en informatiebeleid,* **13**, pp. 57-66.

BERENSCHOT and NEDERLANDS ECONOMISCH INSTITUUT, 2001, Welvaartseffecten van verschillende financieringsmethoden van elektronische gegevensbestanden. Report prepared for the Ministerie van Binnenlandse Zaken en Koninkrijksrelaties. (Prosperity effects of different funding models of electronic data sets).

BORGMAN, C.L., 2000, *From Gutenberg to the Global Information Infrastructure; Access to Information in the Networked World* (Cambridge, Massachusetts: The MIT Press).

BROX, C., Y. BISHR, K. SENKLER, K. ZENS, AND W. KUHN, 2002, Toward a geospatial data infrastructure for Northrhine-Westphalia, *Computers, Environment and Urban Systems*, **26** (1), pp. 19-37.

COOPERS LYBRAND, 1996, Economic aspects of the collection, dissemination and integration of government's geospatial information. A report arising from work carried out for Ordnance Survey by Coopers and Lybrand. Available online at: http://www.ordnancesurvey.co.uk/oswebsite/aboutus/reports/coopers/index.html (accessed September 2007).

CROMPVOETS, J., BREGT, A., RAJABIFARD, A., and WILLIAMSON, I., 2004, Assessing the worldwide status of national spatial data clearinghouses. *International Journal of Geographical Information Science*, **18**, pp. 665-689.

EU, EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION, 2002, Proposal for a Directive Proposal for a Directive of the European Parliament and of the Council on the re-use and commercial exploitation of public sector documents, COM(2002) 207 final 2002/0123 (COD).

EU, EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION, 2003, Directive 2003/98/EC of the European Parliament and of the Council of 17 November 2003 on the re-use of public sector information, *2*003/98/EC.

GITA, 2005, Free or Fee: The Governmental Data Ownership Debate. Available online at: http://www.gita.org/resources/whitepapers/Free_or_fee.pdf (accessed September 2007).

GRAAFLAND, A., 1993, Geo-informatievoorziening in Nederlandse gemeenten. PhD thesis, Delft University of Technology). (Geographic information supply in Dutch Municipalities).

GRAAFLAND, A., 1997, *Gemeentelijke geo-informatievoorziening* (Delft: Technische Universiteit Delft). (Geographic information supply in local government).

GSDI, 1997, Global Spatial Data Infrastructure Conference Findings and Resolutions, Chapel Hill, North Carolina. Available online at: http://www.gsdi.org/docs1997/97_gsdi97r.html (accessed September 2007).

HM TREASURY, 2000, Cross Cutting Review of the Knowledge Economy Review of Government Information, final report, Available online at: http://www.hm-treasury.gov.uk/spending_review/spending_review_2000/associated_documents/spend_sr00_ad_ccrcontents.cfm (accessed 10 September 2007).

HOLLAND, W.S., 1994, Copyright, Licensing and Cost Recovery for Geographic and Land Information Systems Data: A Legal, Economic and Policy Analysis, In *Proceedings of the Conference on Law and Information Policy for Spatial Databases*, October 28-29 1994, Tempe, AZ.

JOFFE, B, 2005, Ten Ways to Support GIS Without Selling Data. *URISA Journal*, **16** (2), pp. 27-33, Available online at: http://www.urisa.org/files/Joffevol16no2-3.pdf (accessed 15 January 2006).

KELLEY, P.C., 1993, A National Spatial Information Infrastructure, In *Proceedings of the 1993 Conference of the Australasian Urban and Regional Information Systems Association (AURISA)*, Adelaide, South Australia, Australia.

KPMG CONSULTING (GARRY SEARS) 2001, Canadian Geospatial Data Policy Study (executive summary), report prepared for GeoConnections. Available online at: http://www.geoconnections.org/programsCommittees/proCom_policy/keyDocs/KPMG/KPMG_E.pdf (accessed September 2007).

KREK, A. and FRANK, A.U., 2000, The Production of Geographic Information – The Value Tree. *Geo-Informations-Systeme - Journal for Spatial Information and Decision Making*, **13,** pp. 10-12. Available online at: ftp://ftp.geoinfo.tuwien.ac.at/krek/3226_value-tree.pdf (accessed September 2007).

LAYNE, K. and LEE, J., 2001, Developing fully functional E-government: A four stage model. *Government Information Quarterly*, **18,** pp. 122-136.

LONGLEY, P.A., GOODCHILD, M.F., MAGUIRE, D.J., and RHIND, D.W., 2001, *Geographic information Systems and Science* (Chicester: John Wiley and Sons Ltd).

LOPEZ, X.R., 1998, *The dissemination of spatial data: A North American - European comparative study on the impact of government information policy* (London: Ablex Publishing Corporation).

LVA (Landesvermessungsamt), 2007, Erfassungsstand der ALK in NRW (Stand: 01.01.2007). Available online at:

http://www.lverma.nrw.de/produkte/liegenschaftsinformation/katasterinfo/alk/images/erfassungsstand.pdf (accessed 10 September 2007).

MASSER, I., 1998, The First Generation of National Geographic Information Strategies, In *Proceedings of the GSDI Conference*, Canberra, November.

MASSER, I., 1999, All shapes and sizes: the first generation of national spatial data infrastructures. *International Journal of Geographical Science*, **3**, pp. 67-84.

MASSER, I., 2000, What is a spatial data infrastructure? In *4th Global Spatial Data Infrastructure conference*, Cape Town, South Africa.

MASSER, I. 2005, *GIS Worlds; Creating Spatial Data Infrastructures* (Redlands, California: ESRI Press).

MASSER, I., 2007, *Building European Spatial Data Infrastructures*, (Redlands, California: ESRI Press).

MASSER, I., RAJABIFARD, A., AND WILLIAMSON, I.P., 2007, Spatially Enabling Governments through SDI Implementation, *International Journal of Geographical Information Science*, **21**, July, pp. 1-16.

MCLAUGHLIN, J. AND NICHOLS, S., 1994, Developing a National Spatial Data Infrastructure. *Journal of Surveying Engineering*, **120**, pp. 62-76.

MICUS MANAGEMENT CONSULTING GMBH, 2001a, Market survey: Boosting of the geospatial market in North Rhine Westphalia, (Media NRW), 33. Available online at: http://www.micus.de/pdf/micus_marktstudie_nrw_en.pdf (accessed September 2007).

MICUS MANAGEMENT CONSULTING GMBH 2001b, Aktivierung des Geodatenmarktes in Nordrhein-Westfalen Marktstudie. (Media NRW). Available online at: http://www.micus.de/pdf/micus_marktstudie_nrw.pdf (accessed September 2007).

NRC (NATIONAL RESEARCH COUNCIL), 2003, *Weaving a National Map: Review of the U.S. Geological Survey Concept of The National Map* (Washington D.C.: The National Academies Press).

ONSRUD, H.J., 1992a, In support of open access for publicly held geographic information, *GIS Law*, **1** (1), pp. 3-6. Available online at: http://www.spatial.maine.edu/~onsrud/pubs/In_Support_OA.htm (accessed 10 September, 2007)

ONSRUD, H.J., 1992b, In support of cost recovery for publicly held geographic information. *GIS Law*, **1** (2), pp. 1-7. Available online at: http://www.spatial.maine.edu/~onsrud/pubs/Cost_Recovery_for_GIS.html (accessed September 2007).

ONSRUD H.J. AND G. RUSHTON, 1995, Sharing *Geographic Information* (Rutgers: CUPR Press).

ONSRUD, H.J., 1998a, Survey of national and regional spatial data infrastructures activities around the globe. In *Third Global Spatial Data Infrastructure Conference*, 17-19 November 1998, Canberra, Australia. Available online at: http://www.spatial.maine.edu/~onsrud/GSDI.htm (accessed September 2007).

ONSRUD, H.J., 1998b, The Tragedy of the Information Commons. In *Policy Issues in Modern Cartography*, D.R.F. Taylor (Ed.), pp. 141-158 (Oxford: Elsevier Science Ltd.).

ONSRUD, H.J., 2004, The US spatial data infrastructure; Legal & economic issues and developments. In *Spatial data infrastructure and policy development in Europe and the United States*, B. van Loenen and B.C. Kok (Eds.), pp. 87-100 (Delft: Delft University Press).

ONSRUD, H.J., J.P. JOHNSON AND J. WINNECKI, 1996, GIS Dissemination Policy: Two Surveys and a Suggested Approach. *Journal of Urban and Regional Information Systems*, **8**, pp. 8-23.

PERRITT, H.H., 1995, Should local governments sell local spatial databases through state monopolies? *Jurimetrics, Journal of Law, Science and Technology*, **35**, pp. 449-469.

PIRA INTERNATIONAL LTD, UNIVERSITY OF EAST ANGLIA, and KNOWLEDGE VIEW LTD., 2000, Commercial exploitation of Europe's public sector information. Final Report For the European Commission Directorate General for the Information Society. Available online at: ftp://ftp.cordis.lu/pub/econtent/docs/commercial_final_report.pdf (accessed September 2007).

PLUIJMERS, Y., 1998, Legal protection of geo-information in the United States and the Netherlands, Zevenbergen, J.A. (ed.), *Free accessibility of geo-information in the Netherlands, the United States and the European Community*, Delft (Delft University Press). pp. 49-57.

RAJABIFARD, A. and WILLIAMSON, I.P., 2002, Spatial Data Infrastructures: an initiative to facilitate spatial data sharing. In *Global Environmental Databases- Present Situation and Future Directions. Volume 2*, Hong Kong: International Society for Photogrammetry and Remote Sensing (ISPRS-WG IV/8), GeoCarto International Centre (Eds.).

RAJABIFARD, A., FEENEY, M.-E.F., and WILLIAMSON, I.P., 2002, Directions for the Future of SDI development. *International Journal of Applied Earth Observation and Geoinformation*, **4,** pp.11-22.

RAJABIFARD, A., FEENEY, M.-E.F., WILLIAMSON, I.P., and MASSER, I., 2003, National SDI Initiatives. In *Developing Spatial Data Infrastructures: From Concept to Reality*, I. Williamson, A. Rajabifard and M.-E.F. Feeney (Eds.) pp. 95-110 (London: Taylor and Francis, 2003).

This article was published in International Journal of Geographical Information Science Vol.23 No.2 February 2009, 195-212

RAVI BEDRIJVENPLATFORM, 2000, Economische effecten van laagdrempelige beschikbaarstelling van overheidsinformatie. Ravi publicatie 00-02. (Economic impact of readily available of government information).

RYAN, E., 2007, Natural resource deposit locations, licence areas & groundwater information now available online. Press release of the Irish Department of Communications, Energy and Natural Resources. Available online at: http://www.dcmnr.gov.ie/Press+Releases/Ryan+announces+free+online+access+to+Departmental+spatial+data.htm (accessed 18 October 2007).

STATSKONTORET, 2005, Competition at the Public/Private Interface (Stockholm: The Swedish Agency for Public Management). Available online at: http://www.statskontoret.se/upload/Publikationer/2005/200519A.pdf (accessed 10 September 2007).

STIA (SPATIAL TECHNOLOGIES INDUSTRY ASSOCIATION), 2001, *PHASE I REPORT; Increase private sector awareness of, and enthusiastic participation in the National Spatial Data Infrastructure (NSDI).*

TK, 2007, Vragen gesteld door de leden der Kamer aan de minister van Verkeer en Waterstaat over *navigatiesystemen*, Aanhangsel der Handelingen 997, Tweede Kamer vergaderjaar 2006-2007. (Parliamentary questions to the Minister on navigation systems).

TOIVONEN, T., R. KALLIOLA, AND E. ENNOLA, 2006, Data Lending Facility – the Innovative Download Service of the Finnish NSDI, Karen Fullerton and Katalin Tóth (eds.), *Proceedings of the 12th EC-GI&GIS Workshop*, Innsbruck, Austria, 21-23 June 2006, pp. 110-112.

TOSTA, N., 1999, NSDI was supposed to be a verb; A personal perspective on progress in the evolution of the U.S. National Spatial Data Infrastructure, In *Integrating Information Infrastructures with GI Technology*, B. Gittings (Ed.), pp. 13-24 (Philadelphia: Taylor & Francis Inc., 1999).

VAN BERKEL, F., 2006, Geen drempels meer voor hergebruik provinciale geodata (Ook waterschappen geven geo-info vrij), *VI Matrix* **103**, pp. 6-8. (No barriers left for reuse of provincial geo-data (also water boards provide free access to their information)

VAN KERKHOFF, J., GROOTELAAR, H.B.A., and WIELENGA, R., 1999, *Sturen, besturen en gestuurd worden.* (Zeist: A-D Druk).

VAN LOENEN, B. AND B.C. KOK, 2004, Spatial data infrastructures; Legal and economic issues. In *Spatial data infrastructure and policy development in Europe and the United States*, B. van Loenen and B.C. Kok (Eds.), pp. 1-14. (Delft: Delft University Press, 2004).

VAN LOENEN, B., 2005, The Impact of Access Policies on the Development of Local SDIs: The Special Role of Utilities, In *Proceedings of the FIG Working Week 2005 and 8th International Conference on the Global Spatial Data Infrastructure (GSDI-8)*, Cairo,

Egypt. Available online at: http://www.fig.net/pub/cairo/papers/ts_50/ts50_01_vanloenen.pdf (accessed September 2007).

VAN LOENEN, B., ZEVENBERGEN, J., AND DE JONG, J., 2006, Access to Government Information Unnecessary Remains a Case of Professional Elite, In Conference proceedings Shaping the Change XXIII FIG Congress, Munich, Germany, October 8-13, 2006

VAN LOENEN, B., 2006, Developing geographic information infrastructures; the role of information policies. (Delft: DUP Science).

VAN LOENEN, BASTIAAN, JAAP ZEVENBERGEN, GARFIELD GIFF & JOEP CROMPVOETS, Open toegankelijkheidsbeleid voor geo-informatie vergeleken: het gras leek groener dan het was, Ministry of the Interior and Kingdom Relations, (Executive summary & country reports in English). Available online at: http://www.minbzk.nl/aspx/download.aspx?file=/contents/pages/87285/opentoegankelijkheidsbeleidvooroverheidvergeleken.pdf (accessed 10 September 2007). (Open access policies for geo-information compared).

WATSON, H., ARIYACHANDRA, T., and ROBERT J. MATYSKA, J., 2001, Data Warehousing Stages Of Growth. *Information Systems Management*, Summer 2001, pp. 42-50.

WEISS, P. and PLUIJMERS, Y., 2002, Borders in Cyberspace: Conflicting Public Sector Information Policies and their Economic Impacts. Available online at: http://www.spatial.maine.edu/GovtRecords/cache/Final%20Papers%20and%20Presentations/bordersII.htm (accessed September 2007).

WILLIAMSON, O.E., 1975, *Markets and Hierarchies, analysis and Antitrust Implications: A study in the Economics of Internal Organization* (New York: Free Press).

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Figure 1

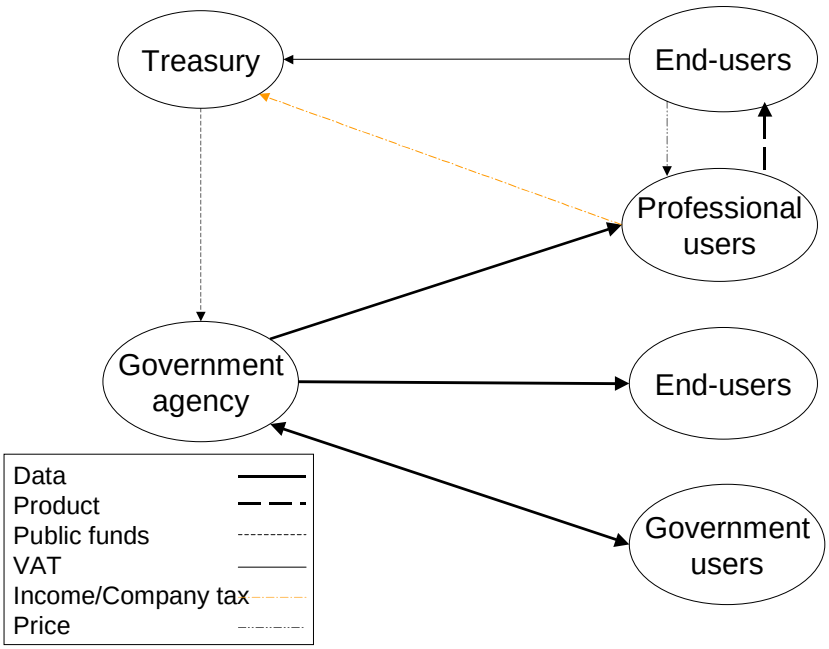

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Figure 2

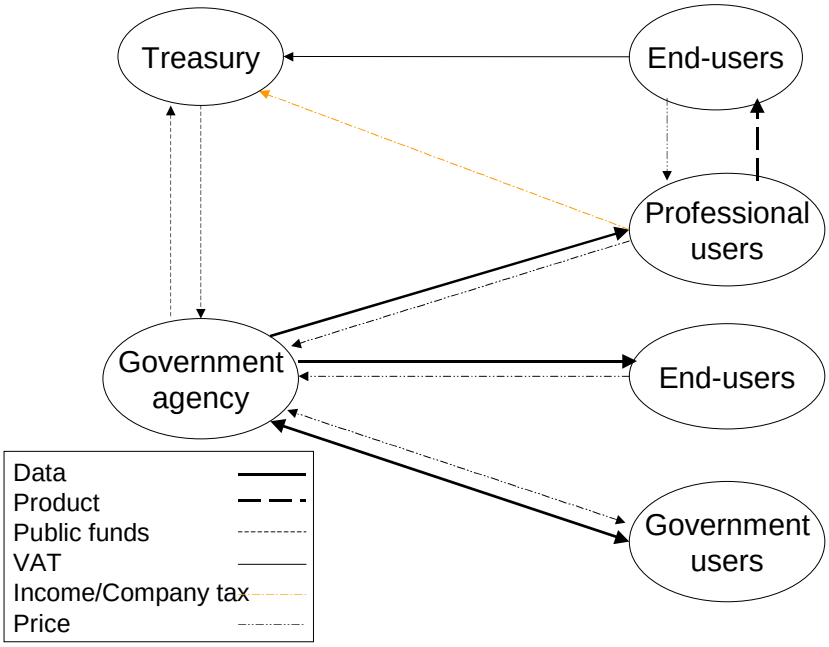

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Figure 3

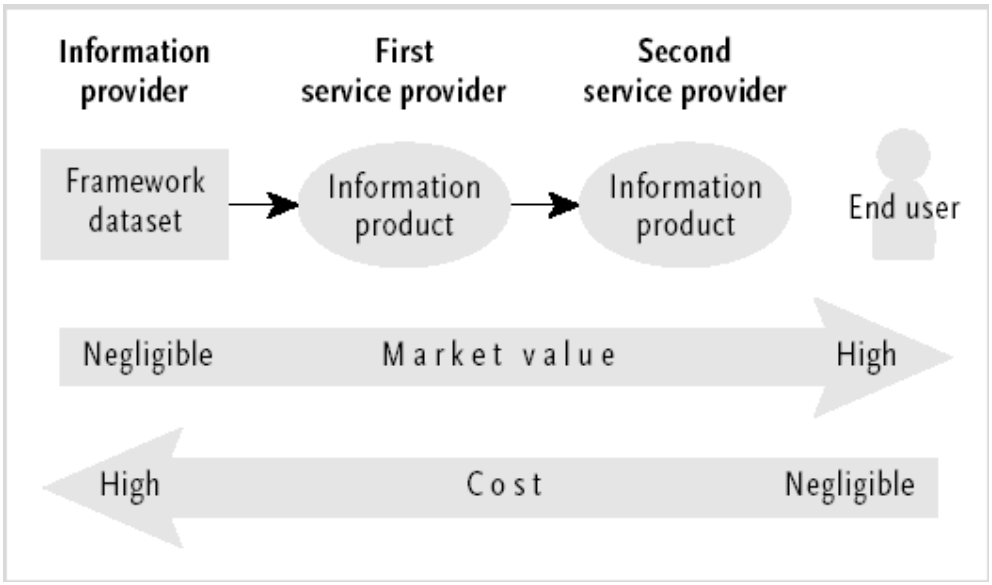

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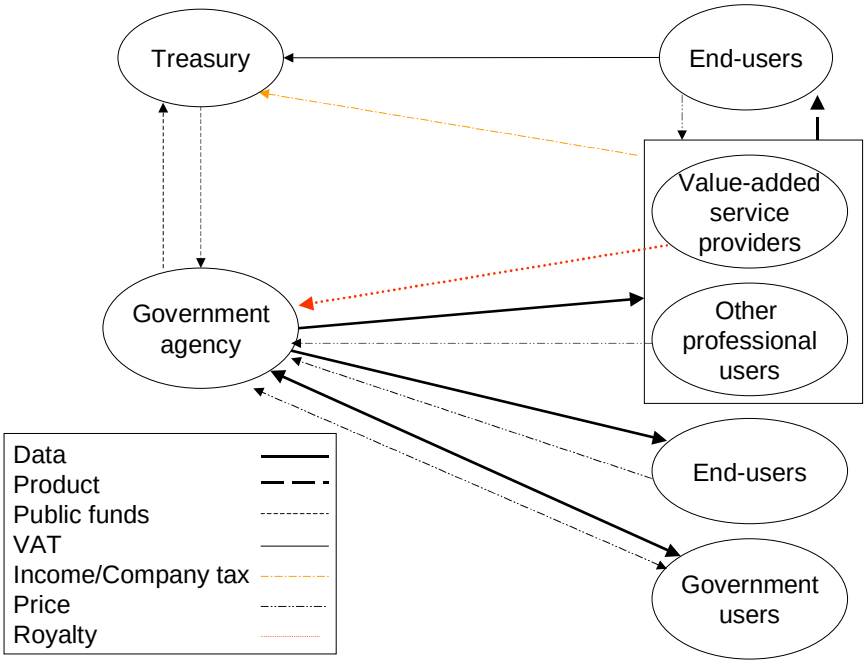
Figure 4



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