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One Access Policy for High-quality Geographic Information: Results From a US - EU Comparative Study

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Abstract

Geographic information is an important element in the decision-making process at many levels. The quality of the geographic information influences the quality of these decisions. Each decision will have its own geographic information needs. Generally, a decision at the local levels will need a higher level of detail and more comprehensive information than decisions at a regional or national level. It may be reasoned that the geographic information needs at corresponding levels are similar throughout different jurisdictions. However, research exploring the data quality of two framework data sets in five densely populated areas in the EU and the US has found major differences in the quality of the *public* data sets at the local level. Especially there appeared to be differences between the US and the EU cases. In general, less detail, content and currency was found in the US public data sets, even though the population density, the overall population, and geographic size of the areas studied were of the same order of magnitude. The research also found some evidence that the improved data qualities, comparable to the European public data sets are in the US available through the private sector. These data sets with improved quality are thus both in the US and EU subject to restrictive use conditions, which do not promote re-use. Therefore, if apples and apples are compared both European and US access policies for comparable data qualities are not that different. Through an analysis of the information chain, we closely look at the value added to a data set. We found that it is the extent to which value has been added that appears to explain the different access policies in the EU and US. Therefore, research assessing the success of access policies should incorporate the qualities of the data set involved. Finally, this paper assesses the potential impact of our findings for geographic information infrastructure development in the US and Europe.

1. Introduction

Geographic information is an important element in the decision-making process at many levels. It has been assessed that eighty percent of all decision have a geographic component. The quality of the geographic information influences the quality of these decisions. Each decision will have its own geographic information needs. Generally, a decision at the local levels will need a higher level of detail and more comprehensive information than decisions at a regional or national level. It may be reasoned that the geographic information needs at corresponding levels are similar throughout different jurisdictions. However, research exploring the data quality of two framework data sets in five densely populated areas in the EU and the US has found major differences in the quality of the public data sets at the local level. Especially there appeared to be differences between the US and the EU cases. The research presented in this paper found evidence that in local government in the US and in the European cases topographic data sets are used at different levels of detail, content and currency. In general, less detail was used in the US than in the European counterparts, even though the population density, the overall population, and geographic size of the areas studied were of the same order of magnitude.

2. Access Policies

Throughout the world a wide variety of access policies exist. Their fundamental difference is in the funding mechanism, and as a result the extent access and use of a data set is restricted. Two doctrines for the public sector are commonly discussed: open access policies and cost recovery policies. In addition, a third policy is commonplace in the private sector: the return on investment.

2.1 Open access

The open access approach assumes that government agencies, responsible for the collection and creation of government spatial data, are fully funded with public funds to accomplish their public tasks. Data within government are accessible for others for a price not exceeding the cost of reproduction and distribution (marginal cost of dissemination), with as few restrictions in the use as possible. The data are available to all (non-exclusive) on a nondiscriminatory basis (see also NRC 1997). Accepted restrictions include data concerning national security, trade secrets, and data relating to an individual's privacy.

2.2 Cost recovery policies

Cost recovery approaches seek income from the sale of data to support the development and maintenance of the data sets (Lopez 1998, Onsrud 1992). The public agency is forced to generate income from the sale of data, or products, or from service providing activities. In practice this implies a charge for the data higher than the marginal costs of dissemination, and restrictions in the use through copyright, and database rights. Further use restrictions may be imposed through contractual or licensing provisions. These restrictions protect the data provider against free-riders, but at the same time make it difficult to use the data as a base for value adding.

2.3 Return on investment

Return on investment policies seek income from the sale of data to cover the cost of the development and maintenance of the data sets and include on top of that a return on the investment. Typically, the return on investment margins are based on the demand and supply of the information product. The price may also be known as the market price. The use restrictions are similar to those imposed with a cost recovery policy.

3. Europe versus United States

3.1 Simplified view and critique

It is often mentioned that in the US government operates an open access policy, whereas in the EU cost recovery policies are the norm. At the same time it is said that more value adding by value adding resellers (VARs)[1] is taking place in the US than in the EU. Therefore, the EU should also move to an open access policy.

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[1] VARs are "integrators that take pieces and parts of many systems, technologies and data sets to form specialised solutions. They 'resell' all of these solutions and their value to their clients" (STIA, 2001, p. 9-4).

However, the above is based on several simplifications and misunderstandings. Firstly, within US government not one access policy exists. The often-quoted open access policy of the US federal government is much less prevalent at state and local levels. At these levels any policy varying from open to cost recovery policies are found (see Pira 2000, Van Loenen 2002 and 2006, Tulloch and Harvey 2006). Secondly, the available literature focuses on small to medium scale data sets, covering national or at least regional jurisdictions, and not so much the large-scale framework data sets, which we are treating here. Finally, the quality of the data sets available is usually not taken into account.
In the comparison of different access policies in different legal systems one should compare apples with apples and not apples with oranges to arrive at usable and fair conclusions.

3.2 Value adding market

In 2000, Pira (2000, p.47) estimated the economic value of public sector information (PSI) in the European Union (15 countries at that time) at €68.5 billion per annum, of which the geographical information industry accounted for €36bn (Pira 2000, p.16). This was still limited compared to the US and Canada (Pira 2000, p.17), where they estimated that the market is five times the size of the EU market (Pira 2000, p.17). The US the information industry contributes significantly to the American economy, employing over 3.2 million individuals and generating sales of over €641 million (Pira 2000, p.50). To arrive at similar figures, Europe should change its cost recovery policies for PSI into open access policies.
However, Pira acknowledges that there are some flaws in their research data. There was, for example, considerable uncertainty about the true value of PSI in EU (Pira 2000, p.48), which makes a truly reliable comparison treacherous (Pira 2000, p.53). For example, the jobs in the US information industry are jobs in the private sector. We argue that in Europe these jobs are in the public sector, are relatively invisible and therefore difficult to quantify.
One interesting finding of the Pira study is that the US federal government is investing more in the production of high quality PSI compared to its European competitors (Pira 2000, p.52). GITA (2005, p. 3), however, disagrees with the latter statement if it would apply to geographical information: “Digital and hardcopy mapping products created and sold by Ordnance Survey far exceed the quality, in terms of accuracy and timeliness, of most products given away in the United States”.
In the EU, the issue of access policies for all PSI continues to be debated. In the EU Directive 2003/98/EG on Re-use of public sector information a “fuzzy” compromise of access policies was agreed upon. Furthermore, a controversy between an open access oriented approach from the European Parliament and Commission, and a cost recovery approach by the European Council (comprised of the relevant ministers of the Members States) delays the progress of the INSPIRE-directive.

4. Value Adding

How should we in general describe adding value? There is a chain from the very raw (geo-) data to the most advanced (geo-) product or service (see figure 1). The product or service a VAR is selling, is one step in this chain. It can be the final step, but another product or service can be built on it by another VAR as well.

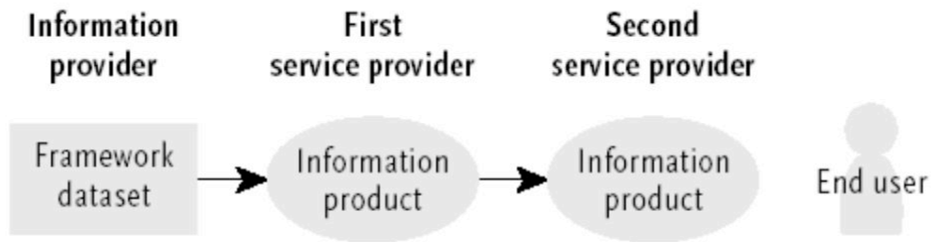

Figure 1: The information chain (extracted from Micus 2001, p.12)

The primary base for dividing the chain of a certain product or service into steps is derived from the sub processes of the (geo) data processing. Raw data is collected, a data model is applied, quality control in undertaken, the outcome is integrated in the existing dataset, etc. (see, for example, figure 2 for the creation of topographic data sets).

It is clear that in an abstract way each step provided in figure 2 'adds value' to the data from the previous step. But if all steps are going to be undertaken within one organization (company, agency, other), we would normally not use the term 'value adding'. Such a term we would reserve for the cases were a (geo) data product of a certain independent use value, is passed on from one organization to another. Each organization in the chain adds value, and makes a new (geo) data product or service that satisfies the needs of another group of users. The value adding may consist of improving the quality of the data set, integrating several topographic data sets into one layer for a jurisdiction, linking a framework geographic data set with several thematic layers, and preparing the readiness for combining (like in a geographic information infrastructure, GII)). Other value adding may include providing user-friendly access to the data set (e.g. adding search facilities, explanation, help desk), or intermediary services that help information resources in distributing the data set.

At the end of the value chain, the end-users (citizens, decision-makers, and others using an end-product) are being served by the end-product of geographic information, for example, an animation, a map or a plain answer, mostly through services provided by these value-adding resellers (Van Loenen 2006, p.40).

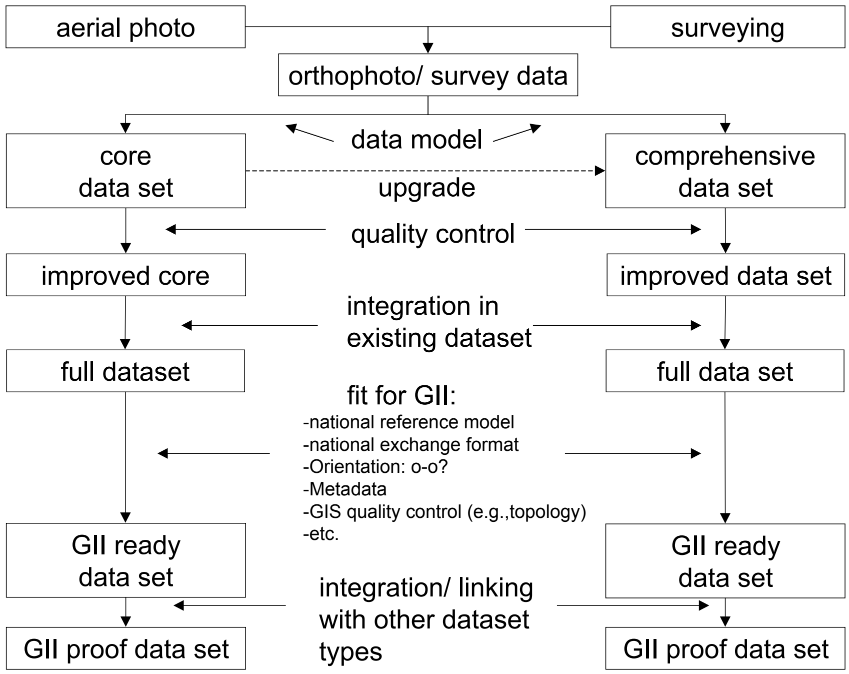

Figure 2: The information chain unravelled for topographic information (extracted from HTW 1996)

4.1 Who adds value?

Part of the confusion described in section 3, is caused by the general concept one associates with adding value. Focus is generally on the value adding step performed by *private companies* based on the (geo) data set they acquire from a public sector organization (including agencies), without realizing how for in the chain a data set has progressed.

A simple example may clarify this. Assume two cases A and B and a simple value chain of five steps. In case A an agency has performed two steps and provides the data set at that point for free to anyone including VARs. In case B an agency performs four of the five steps and sells the resulting data set to anyone including the VARs. Assuming that the end-user of the final product (after 5 steps) is willing to the pay the same price in both cases, it is very well possible that the work remaining to satisfy the needs of the end-user will cost much less in case B than in case A. In case A the private VAR has to work on three steps, while in case B only one step remains from meeting the needs of the end-user. When the VAR in case A has reached step four, he will ask a price that will cover his cost of the value adding process of step two to four. Therefore, at step four and five a cost recovery policy is likely to be found in both case A and B (see figure 3).

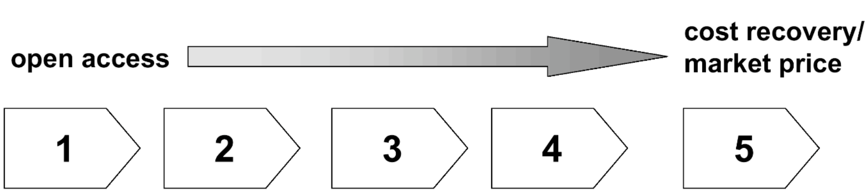

Figure 3: Access policies in the information chain?

In the next sections we will present several examples of large-scale framework data sets for which the first step(s) are set by government agencies to meet their immediate (legal) mandates, but with a very different approach in setting several consecutive steps (including making them digital, and combining data from several smaller areas into one data set of the next jurisdictional tier).

5. Large scale framework data sets and value adding

As figure 1 shows, framework data sets are data sets that are commonly used as a base data set upon which other data sets build (Groot and McLaughlin 2000). Without reference to a framework data set the wider use of other information is often limited. The US National Research Council (NRC) has provided the following criteria for framework data sets (NRC 1995, p.26):
_ 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 detail should be included in a framework data set. For the purpose of this paper, data quality includes positional accuracy, completeness, data structure, currency (including update frequency), coverage, and interoperability level. Additional information required for specific applications can be integrated with the framework layer, but the data quality requirements may differ from the framework and accordingly these data may be better acquired separately.
Onsrud (1998) provides an overview of a wide variety of core layers used among different national and regional initiatives. Among the most frequently mentioned data sets are topography (elevation), cadastral data, geodetic control, and government/ administrative boundaries. Among the typical framework data sets at the local GII levels are topographic and parcel data.
With respect to value-added use, Micus (2001, p.12) noted that the value of framework 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 data set is expensive (see figure 4). For framework data sets without any services a limited market exists. They are, however, an important basis for added value products (beginning of the value chain).

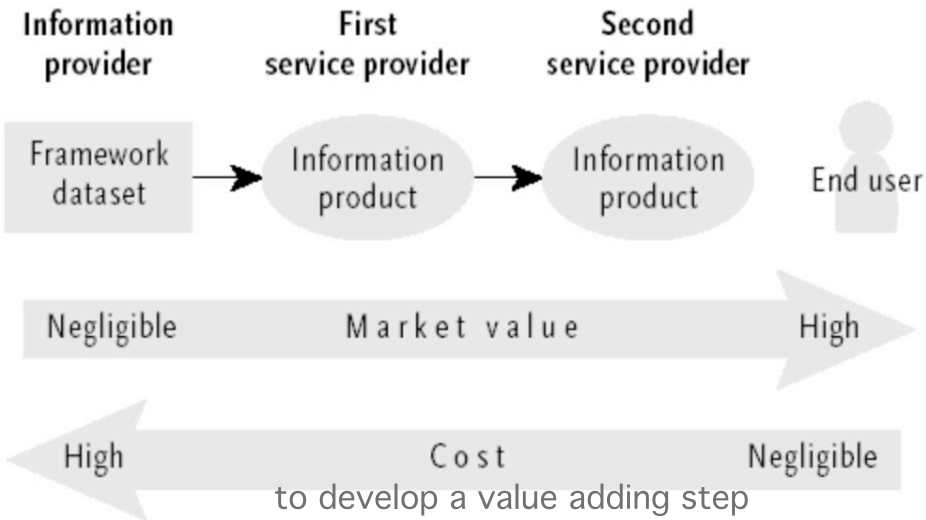

Figure 4: The paradox of the value creation (based on Micus 2001, p. 12)

6. Case study results

For this paper we took another look at the case study results of the five jurisdictions described in Van Loenen, 2006. In that study we compared similar jurisdictions with regard to socio-economic development, system of government, and geography (size of the country/ population density). The five jurisdictions selected were the Netherlands, Denmark, Northrhine-Westphalia (Germany), Massachusetts (US) and the Metropolitan Region of Minneapolis and St. Paul (US). The two framework data sets studied were large-scale topographic (or planimetric) data sets (1:500-1:1,500), and the parcel (or cadastral) data sets. Here we concentrate on the first one, with some additional examples related to road centre lines and parcel information.

6.1 Topographic information

A topographic data set may be defined as: a data set 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. This may be commonly referred to as planimetric information in US terminology.

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 data qualities. The case study research, however, found different data qualities for the large-scale topographic data sets in the different jurisdictions (see table 1 and Van Loenen 2006, p. 230 and further). Generally, the European jurisdictions seem to be occupied with better quality large-scale topographic information in the public sector. For example, 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 or a special need (i.e. some special project requiring geographic information) and therefore it is not surprisingly that public sector entities sometimes are using more than 10-year-old topographic information. In the Metropolitan region of Minneapolis (US), the update frequency of more than 10 years may be explained by the dynamics of a certain area. For several parts of Massachusetts, more current information is available, against a cost recovery price and policy, from the semi-public sector (utilities), which, however, did not built on the freely available data sets, but started from scratch.

Quality	**Denmark**	**Netherlands**	**Northrhine Westphalia**	**Massachusetts (public)**	**Minnesota (MetroGIS area)**
Digital coverage	100%	100%	87%	unknown	appr. 40%
Currency (years)	1-6	1-2	1	1-10	1-10
Content	core	core-comprehensive	comprehensive	none-comprehensive	none-comprehensive
Update frequency	periodic	periodic	periodic	ad hoc	periodic
Pos. accuracy	cm-m	cm-dm	cm-dm	dm-meters	dm-meters
Data model	jurisdiction wide harmonized	jurisdiction wide harmonized	jurisdiction wide harmonized	stand alone	stand alone
Metadata	none-comprehensive	poor	none-comprehensive	none-comprehensive	none-comprehensive
Quality consistency throughout (integrated) data sets	poor	sufficient	reasonable	none	none
Access policy	restrictive	restrictive	restrictive	open	restrictive

Table 1: Core topographic data qualities found in case studies

Open access in Massachusetts did not necessarily apply to all data. In one instance, we asked for better quality data than the data freely available from the website of a municipality for publication in the dissertation. Since this was considered a service not bound by the open access legislation, a fee was asked and only after several e-mails, and submitting a formal request form for the data with specification of purpose, user's name, agreeing to a liability waiver, fax this form to the local government, send several reminders and finally over a month after the initial request date, the data was provided for free for the sole purpose of publication in an academic work. Also here it is confirmed that in principle the basic data is available for free, but for improved quality (literally in this instance) the data set is only available after signing a license and paying a cost recovery fee.

6.2 Road centre line data sets

Road centre line data sets available in the public sector in both the United States and Europe may be another example for our suggestions.

United States

In the US, thé road centre line data set is the freely available TIGER (Topologically Integrated Geographic Encoding and Referencing system) data set. The TIGER data comes from a variety of sources, mainly the US Geological Survey (USGS)'s 1:100,000 topographic maps. The positional accuracy varies with the source materials used, but generally the information is no better than the established national map (a maximum positional error of 167 ft (i.e. 51 meter)) (http://www.census.gov/cgi-bin/geo/tigerfaq?). Update frequency varies heavily throughout the country. It is assessed that the TIGER files are not suitable for high-precision measurement applications such as engineering problems, property transfers, or other uses that might require highly accurate measurements of the earth's surface (Source: metadata TIGER files).

In several instances better road centerlines are developed at a local level. For example, in the Metropolitan region of Minneapolis and St. Paul (US), The Lawrence Group (www.lawrencegroup.com) builds on the data sets provided by local government, among others. 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 in these public data sets. The Lawrence Group (www.lawrencegroup.com) either digitizes street centre line data from paper maps from local government or obtains it in digital format through a partnership arrangement. They adjust the data to match coordinate geometry information from the counties. The private company further improves these data sets, aligning them and adding addresses (geo-coding). Updates are available every three months. The private company's goal is to have 95% of roads located within the approximate center of digital right-of-way data or pavement centerlines provided from counties, where such digital data is available. In other areas, 95% of roads are intended to be within ten meters of the road or right-of-way center.

The private company provides this value added product to local government and others against a cost recovery price and use restrictions.

Europe

In Europe, no public road centre line data set covers Europe entirely. However, many countries have their own road centerline data set available for the entire jurisdiction. In Denmark, public sector developed it based on the *Tekniske korte* (1:1,000-1:25,000) and provides it with a restrictive policy. In the Netherlands, the *Top10NL* (1:10,000) of the Dutch *Kadaster* (and also the National Road Data set (NWB-roads) of the Ministry of Transport, Public Works and Water Management) provide road centerlines for the entire Netherlands. Both data sets are public data sets. The *TOP10NL* is provided with a restrictive policy. The NWB-roads is at this moment only, but freely available within government. In the UK, the Integrated Transport Network Layer of Ordnance Survey (OS) MasterMap provides road centrelines for the complete road network of Great Britain, complete with Road Routing Information (RRI)[2] (1,1250). OS is well known for its restrictive access policy.

In Europe, the value adding of creating a high quality road centerline for an entire country has been in the public sector. In Minnesota, the activities of The Lawrence Group are considered value adding on the core public datasets.

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2 http://www.ordnancesurvey.co.uk/oswebsite/products/osmastermap/userguides/docs/userguidepart1.pdf, p156.

Private sector
Two dominant players on the private market for road centerlines are TeleAtlas and NAVTEQ. Here a summary of comparisons by users on a bulletin board (www.gpspassion.com) is provided. For the US, the NAVTEQ dataset "is very accurate in major cities and surrounding areas, outside this area the quality varies greatly including a good number of errors in omission, spatially geometry, and routing errors on major roads. For a lot of the areas outside cities it looks like a regurgitation of current available US Census Tiger line files." Another user found that "In certain areas the NAVTEQ data not only doesn't have developments that have been there for 6-8 years but also has a lot of errors. It appears that they are letting the US Census bureau and their Tiger modernization project do most of the updating and then they just incorporate the updates". Also TeleAtlas has "errors throughout but overall much more current than NAVTEQ outside the cities. Most areas around my house the TeleAtlas is much better than NAVTEQ including when looking at routing. Not as dependant on US Census TIGER files." One may conclude that NAVTEQ is using the TIGER files as a basis and adds value for the urban areas. However, apparently these data sets still do not meet the quality provided in the European data sets: "in Western Europe it seems that both mapsets are pretty comparable and have a high level of quality" (www.gpspassion.com).
Although it concerns a very brief summary based on a very limited number of user's experiences, it confirms to some extent the relationship we suggest between access policy and value added to a data set.

6.3 Parcel information
Another example of private sector value adding in the US for a product that is available under cost recovery policy in the public sector in Europe, deals with the parcel (cadastral) information. Both in the US and Europe, parcel information is considered a framework data set (see FGDC 2006; annex II of INSPIRE 2004). This may imply that the needs for parcel information in Europe and the US are similar.
Table 2 shows some core data qualities found in the five cases (see for detailed information Van Loenen 2006). Again, it seems that in the European cases higher quality datasets are available. Especially concerning the consistency in the data sets the European data sets score very well. The MetroGIS' data sets compares on many aspects (except for content) very well with the European data sets. However, this data set comes with a cost recovery policy.

Quality	Denmark	Netherlands	Northrhine Westphalia	Massachu-setts (public)	Minnesota (MetroGIS area)
Digital coverage	100%	100%	87%	66%	100%
Currency (years)	1-2	1	1	varies from non-existent to 1 year	0-2
Content	core-comprehensive	core-comprehensive	comprehensive	limited- core	limited
Coordinate system	national	national	national	local/ state	state
Pos. accuracy	cm-m	cm-dm	cm-dm	meters	dm-meters
Data model	jurisdiction wide harmonized	jurisdiction wide harmonized	jurisdiction wide harmonized	state/ none	jurisdiction wide harmonized
Metadata	comprehensive	none	none-comprehensive	none-comprehensive	comprehensive
Quality consistency throughout (integrated) data sets	high	high	high	none	reasonable
Access policy	restrictive	restrictive	restrictive	open	restrictive

Table 2: Core data qualities for parcel data in case studies

Value adding top parcel data sets

In the US at least one company, Boundarysolutions (www.boundarysolutions.com), sells 60 million parcels, of 400 jurisdictions in the US for $0.005–$1.00/parcel per year (specified in a license). The private company has normalized the government parcel data sets to a single national spatial configuration. Another private company brings together many local government parcel information in New England (6 US states). Most of them are freely available through http://www.visionappraisal.com/databases/mass/index.htm. Some of these states have their own access point for the land registry (see http://www.masslandrecords.com/malr/index.htm).

In Europe, these US private activities are typical public tasks. The European cadastres are the only access point for an entire country, and provide standardized ubiquitous parcel data. In addition, it is the public sector in Europe that has initiated to bring together the cadastres and land registrations within Europe through one portal (see the European Union Land Information Service, EULIS). Such initiatives are unknown for the US (except for the general geo spatial one stop shop).

6.4 Case study findings summarized

The information provided above is a small sub-set of available geographic information in Europe and the US. And within the sub-set, we have only looked at a very small number of cases, which may not represent the entire US or European situation concerning value added to framework data sets. However, the findings in the sections 6.1-6.3 provide us with the indication that it is the data sets available in the US private sector rather than those in the US public sector that compare with

European public data sets with respect to added value to framework data sets. Both are available for a cost recovery or a market price, and with restrictions on the re-use.
Figure 5 and 6 may be preliminary results summarizing this suggested relationship between value-adding and access policies found in the case-studies.

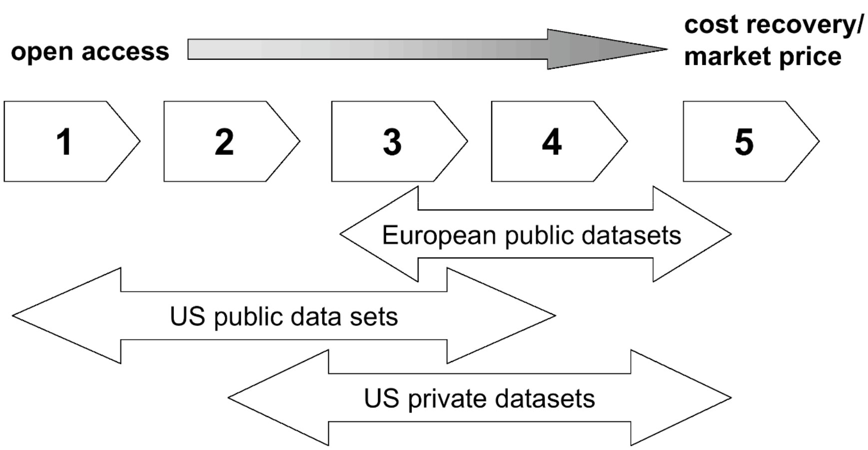

Figure 5: A preliminary summary of case study findings

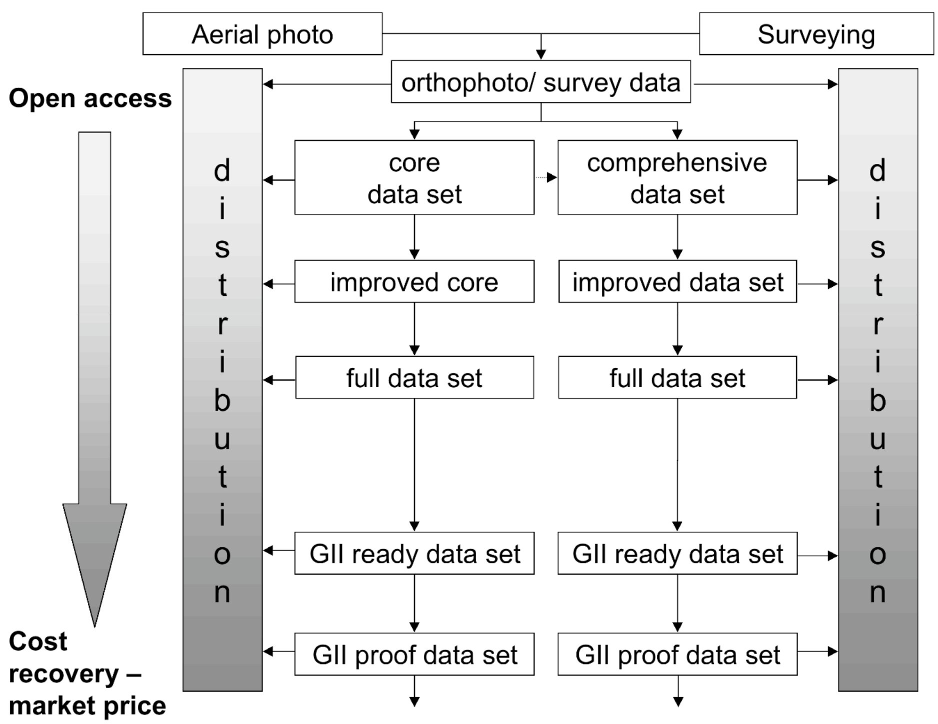

Figure 6: A preliminary suggested relation between value-adding and access policy

7. Conclusion

This paper provides a first attempt to link the access policies for public sector information to the value added to a data set. Through a re-evaluation of case-study research for large-scale topographic data and parcel data sets in the US and five countries or areas in the European Union, we found preliminary evidence for the assumed relation.

In the European cases, governments supply and use high-quality, large scale data sets, while in the US, the government provides geographic information of less high quality. The case-studies showed some evidence that the US public data sets are improved (value-added) by the private sector. This has resulted in data sets that compared in quality to the European ones. In both instances these data sets are subject to restrictive use conditions.

In the European cases, government control the high quality data sets, while the private sector controls the US data sets. Therefore, the prospects for the geographic information infrastructure(S) in Europe may be promising with potentially open access for high-quality geographic information (through the democratic process), while in the US the NSDI relies for a major extent on the quality adding activities of the private sector, which in return allows access only at restrictive conditions.

The preliminary findings raise the question of the validity of research that has assessed the impact of geographic information market in Europe and the US. Users that use the US government data sets 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. However, the preliminary results of our case study suggest that in Europe these jobs can to a major extent already be found within the public sector, and remain less visible than they are in the US as private jobs. This may explain why many European governments have been reluctant to accept research that recommends open access policies for government information.

8. Further Research

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 data sets, use, and benefits for society.

Further research may also involve the differences in public tasks in the US and Europe. It may be due to this different role or tasks the public sector in the US and Europe have that in the instances researched the US government lacks European quality data. It may be that US government relies on privately owned data sets, such as government in the Metropolitan region of Minneapolis and St. Paul (US) for road centre line data. Further research could concern the government needs for large-scale information in relation to its' public task. Are local governments in the US using insufficient geographic detail in their data sets, which can result in poorer decisions? Or are European government employees too demanding with respect to their information desires; is it possible that less comprehensive and less detailed data sets would be able to satisfy their needs?

Furthermore there is room for a comparison and discussion on the question what the market and what the government should see as their respective roles. Equally interesting is the potential impact of what we found on the development of GII. The prospects for the GIIs in Europe look more promising with potentially open access for high-quality geographic information, while in the US the NSDI relies for a major extent on the quality adding activities of the private sector, which in return allows access only at restrictive conditions.

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