Geographical Information Systems and Public Accountability

Towards a better understanding of long-term public accountability in an information age

Albert Jacob Meijer (*Information Polity*, Vol. 7, No. 1, 2002, pp. 39 - 47)

Abstract. This paper explores the question which consequences the use of geographical information systems (GISs) may have for public accountability. Empirical data from a Delphi-survey were used for this exploration. Respondents were asked to reflect on the consequences of GISs for the availability of data for accountability. Based on their answers four hypotheses were formulated. The first hypothesis states that the use of a GIS leads to an increased focus on up-to-date data at the expense of historical data. Important data for accountability will sometimes not be retained. The second hypothesis states that the use of a GIS leads to an increased need to maintain about how, when and by whom data have been generated. This need may not be sufficiently met. In a process of accountability, data from a GIS may then be difficult to interpret or cannot be trusted. The third hypothesis states that a GIS increases the possibility to look at the data in different ways. In processes of accountability fora may ask governmental organizations to substantiate the choice fora certain perspective. The last hypothesis states that the use of a GIS leads to better access to the data. Therefore, data from a GIS may play a more important role in a process of accountability. These hypotheses require further attention to gain a better understanding of long-term public accountability in an information age.

0. Introduction

Geographical information systems[1] (GISs) are used by many government organizations. These systems are extremely useful for supporting various tasks (spatial planning, environmental policy, traffic control, etc.). The use of GISs, however, may have important consequences for long-term public accountability. These consequences are illustrated in the following fictitious example:

A planning agency draws up a plan to build a road through a forest. Before this road is built, however, there is much discussion about the road. Environmentalists argue that the forest is special and needs to be protected. The agency disagrees. According to officials at the agency, the maps, based on data about animal and plant populations and generated with a GIS, show clearly that the forest is of little ecological value. After much heated discussion, Parliament agrees with the plan and the road is built. Five years later discussions start again. A university research team investigates the consequences of the road and concludes that the road has had disastrous consequences for a unique forest. This research gets extensive media coverage. Environmentalist groups demand an explanation. Parliament starts to investigate the planning process to find out what had happened. Officials at the planning agency argue that they had heavily relied on the data from the GIS about the ecological value of the forest. The GIS had, according to them, clearly shown that the forest had little ecological value. However, it is not possible to check this argument because the GIS had been updated: no one can show what data were in the system five years ago. Therefore, Parliament can not find out what has happened and why the road was built through a unique forest.

The planning agency in the fictitious example decided to build a road because it 'knew' that area was of little ecological value because that is what the GIS told them. As GISs make increasingly sophisticated maps, they also seem to become more important for policy makers. Eventually they might even become more important than a visit to the area. The example shows that this may have important consequences for long-term public accountability. Parliament could not retrieve the data that had supported the decision. In this paper the consequences of the use of GISs for accountability are explored. The consequences of the use of GISs for long-term accountability have not yet become

[1] A Geographical Information System or G.I.S. can be regarded as the high-tech equivalent of an atlas (collection of maps) with a calculator attached to it. A G.I.S. enables the user to analyze and model spatial data.

apparent since information, which may be important for accountability, is generally still written down in paper documents. It seems likely, however, that this will change in the near future and digital data will become crucial for public accountability. This leaves us with the question whether, in the near future, GISs will enhance or hinder public accountability. In this paper I will start to explore this question using empirical data from an expert consultation.

1. Accountability

Before discussing the consequences of the use of GISs, we need to get a clear idea of what accountability is and how government organizations anticipate accountability. Accountability is an important feature of democratic societies. “Democracy and accountability are strongly connected. One could say that the defining characteristic of democracy is not that officials are elected but that they have to explain and justify their conduct in public continuously. (...) From this perspective, it is precisely day-by-day accountability, in which the rulers explain and justify their actions directly to the ruled, which distinguishes a democratic society from an elective tyranny.” [1, pp. 6, 7] In spite of its significance for democratic societies, accountability is not a well-defined term. Day and Klein show how the word accountability has passed into the ordinary language only relatively recently [1, p. 26]. Accountability can be called a form of ‘argumentative communication’ [2]. In general one can say that accountability has to do with having to tell another person about something one did or did not do and why. But this definition is too general for a discussion of accountability within public administration. Day and Klein define political accountability in the following way: “Political accountability is about those with delegated authority being answerable for their actions to the people, whether directly in simpler societies or indirectly in complex societies. Here the criteria of judgment are, themselves, contestable and reasons, justification, and explanation have to be provided.” [1, pp. 26, 27] Based on this definition, five elements of accountability can be distinguished: a person or organization that is accountable, an action or situation for which the person or organization is accountable, a forum to which the person or organization is accountable, criteria to judge the action or situation, and, if necessary, sanctions imposed on the person or organizations.

In the fictitious example the minister of spatial planning (accountable person) has to explain what has happened. He or she has to explain why a road was built through a certain area (action). The minister is held accountable by Parliament (forum). Parliament judges the decision according to accuracy, effectiveness and legitimacy (criteria). Eventually, the minister could be forced to resign (sanction).

These five elements provide a first conceptualization of accountability. Further understanding of accountability can be gained by looking at the different phases of accountability. In his discussion of ministerial accountability Elzinga distinguishes three phases: the information phase, the discussion phase and the sanction phase [3]. In the first phase the forum reconstructs what has happened. Therefore data are gathered from various sources. In the second phase the actions are discussed and judged according to certain criteria. In the third phase sanctions can be applied.[2]

In this paper the consequences of the use of GISs for public accountability are explored. Therefore, the first phase in a process of accountability, the information phase, receives most emphasis. A change in the information phase may influence the discussion phase and the sanction phase but these further consequences are not explicitly dealt with in this paper. The central question is not whether the transition from paper documents to GISs will change the judgment of a forum; it is whether this transition will change the ability to reconstruct what happened. Other research will have to show what consequences a change in the information phase will bring to the other phases. In this paper accountability refers to the 'answerability' of governmental organizations.

2. Anticipating accountability

As I have indicated, in the information phase a forum needs to reconstruct what the governmental organization did to be able to judge their actions. Data from various sources is gathered. Records of

[2] It might be better to speak of "aspects" instead of phases, because there doesn't seem to be a fixed sequence in these phases. Based on discussions new information is gathered and even during the sanction phase new information might be gathered and this could start a new discussion.

government organizations are an important source of information for accountability fora. Therefore, laws and rules have been imposed on governmental organizations to make them keep records of what they do. Apart from these rules and laws, keeping data for accountability is also in the interest of governmental organizations themselves. They need the data to legitimize their actions and to maintain the trust of citizens. Also, it could be in the interest of governmental organizations to expose themselves to external criticism so they can learn from others. Furthermore, in conflict situations they could need the data to prove that their actions were justifiable.

A fundamental problem with keeping data for reasons of accountability concerns the question: what data should be kept? [4] Decisions about what data should be kept for accountability have to be taken before and during work processes. However only later, during the process of accountability, one will know what data are needed for accountability. Therefore, organizations have to anticipate the demand for data. Generally in organizations institutional arrangements have been made to take care of these demands. This is the 'record keeping function'.[3]

The record keeping function consists of policies, procedures, methodologies, departments, experts, etc. This function has been structured to deal with data in a paper form. Increasingly, data are no longer contained in paper documents but dealt with in a digital form. Sometimes these digital data are eventually printed on paper, but certainly not all digital data are converted to paper documents. This transition can have a serious impact on organizations [5]. In many organizations, the record keeping function does not seem to be adjusted to these technical and organizational changes [6]. Therefore, the fact that many data are not converted to a paper form and are handled exclusively in a digital form can have an important impact on the availability (content and quality) of data for accountability.

The use of information and communication technologies has important consequences for the way people and organizations deal with data. A few examples can illustrate this. Most people seem to find it easier to delete an electronic document on their computer with one stroke on the keyboard then to throw a paper document in the garbage can. Use of e-mail seems to lead to a mix of formal and

[3] Record keeping does not only serve accountability. Other reasons to keep records include knowledge management, future research and cultural heritage.

informal communication. Databases can lead to increased cooperation between different departments and even to restructuring the organization. These personal and organizational changes could have serious impacts on the availability of data for accountability. What these impacts will be, however, is not yet clear.

There has been a lot of discussion about the consequences of the use of information and communication technologies for record keeping [6, 7, 8]. Most research has a strong normative orientation. It tries to answer the question: what should be done to safeguard record keeping in the information age? This research has led to important findings. Bearman [7] emphasizes that records should be conceptualized as evidence of business transactions. He argues that electronic record keeping should focus on capturing and preserving this evidence. Another interesting research project is the research at the School of Library, Archival & Information Studies of the University of British Colombia. In this project the old science of diplomatics has been promoted to warrant the evidential value of documents [8]. The importance of completeness, reliability and authenticity of records is emphasized.

In research on electronic record keeping, however, there has been little attention for a more descriptive approach. This would deal with the question: what are the consequences of the use of information and communication technologies for accountability? It is not possible to give a general answer to this question because different applications seem to have different consequences for accountability. A few examples illustrate this point. Use of expert systems seems to lead to a greater urge to store documentation about the software (e.g. according to what rules does an Expert System function). Use of databases can lead to an extreme form of transparency (if every change in the database is maintained). Use of office software seems to lead to less control and therefore a lot of important data might not be saved. Use of e-mail seems to lead to discussion about the status of formal and informal communication. A GIS is also one of these applications. Before discussing the consequences of the use of GISs for accountability, I will describe what a GIS is and how it is used in public administration.

3. Geographical Information Systems

GISs are widely used in governmental organizations.[4] They are used to plan railways, to develop environmental policies, to monitor population growth, to manage rural areas, etc. In the Netherlands 70,000 people work in policy formulation, development, management and registration of geo-data. 3,000 public and 3,500 private organizations are involved. GISs are used by the national government but also by provincial governments, local governments, electricity companies, police, etc. So it is save to say that GISs are important for public administration.[10]

Different kinds of spatial information systems can be distinguished. Firstly, there are systems to draw, design and construct objects (e.g. Computer Aided Design systems). A second type is systems to generate geo-data sets (e.g. Earth Image Processing and Remote Sensing, Global Positioning Systems and Coordinate Geometry systems). Then there are systems for registration and management (e.g. Automated mapping, Facility Management Systems, Land Information Systems). Finally, there are systems to support policy-making and decision-making (e.g. GISs linked with Management Information Systems, Decision Support Systems or Executive Information Systems). The last category can be referred to as a narrow definition of GISs. [10] This paper refers to the narrowly defined GIS, i.e. the GIS used to support policy-making and decision-making.

GISs are based on different geo-data sets[5] ('thematic layers'). In general, some of the geo-data sets in a GIS are specific for a certain organization (reflecting the administrative task of the organization), whereas other data sets are more general and are acquired from other organizations. Three main tasks of a GIS can be defined: to input, order, manage and integrate large quantities of spatial data; to analyze spatial data; and, to present data by means of maps [10]. Different GISs can concentrate on different functions. Some GISs are basically just meant for registration and presentation of spatial data. For other GISs analysis of these data are more important. This analysis seems to be especially

[4] See [9] for a general description of GISs.

[5] The data in these geo-data sets refer to 'real' and 'virtual' objects. A real object might be a house, a bridge or a pipeline. Examples of virtual objects are administrative territories, land-ownership or functional destination of areas.

important for policy development and decision making. The fictitious example can show what the three different functions (manage, analyze and present spatial data) mean.

The planning agency wants to construct a road. Therefore it will have to assess the impact of different trajectories of the road on the environment. It uses a GIS to generate maps that can present possible consequences. The GIS contains data sets with data about, for example, plant and animal populations. Managing these data sets comprises the 'data-management function' of the GIS Then, the agency uses a program to calculate the effects of different trajectories on plant and animal population. These calculations are an example of the 'analysis function' of the GIS The results of this analysis can be presented in a map that shows the impact of different trajectories of the road on plant and animal population. This is the 'presentation function'.

4. GISs and accountability: a Delphi-survey

The empirical results from a Delphi-survey will be used in this paper to further explore the consequences of the use of GISs for accountability. In this Delphi-survey a panel of 30 international experts on electronic recordkeeping were asked to reflect on the consequences (risks and opportunities) of the use of different information and communication technologies in public administration for the availability of data for accountability. 21 respondents answered the questionnaire. Seven of the respondents stated that they knew enough about GISs to answer the questions about risks and opportunities a GIS might create. Their opinions provided a wide overview of the possible consequences of the use of GISs for accountability.[6]

[6] This Delphi-survey actually consisted of two rounds. In the first round, the experts could state their opinions. In the second round of the Delphi-survey these results were presented to all experts and they were asked to react to and reflect on the results. Based on the results of the first round, GISs were grouped under the general category databases. The respondents approved this grouping. The second round did not yield specific results for GISs. Reports with the full methodology and results of the two rounds of the Delphi-survey can be retrieved from http://www.archief.nl/digiduur/05-prod_diensten/bibliotheek.htm.

4.1. GISs and accountability: risks

In the Delphi-survey, the respondents were asked to indicate what risks that GISs could create for accountability, they thought were most important. Possible risks were categorized according to the four questions about the availability of data for accountability that are important from the point of view of the forum: are the data present, are the data accessible, can the data be interpreted, and, can the data be trusted? The first question concerns the content of the data, the other three questions relate to the quality of the data. To be able to value the risks of content and quality independently, I will apply the first question (content) to the specific data needed for accountability, whereas the other three questions (quality) concern similar data that are kept in the same information system.[7] For each application, the respondents were asked to rank those four risks (1: most important risk, 4: least important risk). For GISs this yielded the following results:

Data are not present	2,0	(St. Dev. = 1,3)
Data cannot be interpreted	2,4	(St. Dev. = 0,8)
Data cannot be trusted	2,6	(St. Dev. = 1,1)
Data cannot be accessed	3,0	(St. Dev. = 1,0)

Table 1: Risks GISs might create for accountability

[7] Two examples can show how quality and content can be valued independently:

- An organization saves e-mail-messages on a central server. Through a simple application all these e-mail messages are accessible. However, a certain e-mail message may not be present because someone deleted the message. In that situation data of this type are accessible but the specific data are not present.
- An organization uses a customized information system to support a work process. Certain data are saved in this information system, but the software to read these data is not available. Then the data are present but not accessible.

The respondents indicated that the risk that data are not present is most important and the risk that data cannot be accessed is least important. In view of the standard deviation, however, all scores are fairly close. More insight in the expected risks can be gained from the explanations the respondents gave for their scores. Two respondents pointed to the problem that data are updated:

"(...) in most of the applications GIS represent only the actual situation and don't have any historical dimension. In consequence you can not reconstruct the state of the GIS-database at a given time in the past."

"Databases seldom have historical components. That means that information is constantly overwritten, especially in 'living' databases."

It is important to realize that to update data means that, if no special precautions have been taken, the old data are deleted.[8] This is a difference between paper and digital data. For paper data deletion and update are two different actions, for digital data, from a user's point of view, these two actions can be integrated. The lack of historical dimension also refers to the fact that analyses on databases are often not retained. The result of the analysis (often a map) is saved but the specific query that was used to analyze the data are generally not saved. Furthermore, data about the context in which a map was generated might be lacking. Think of a situation in which someone generates a map for a specific question. Later the map might also be used for other issues. Then it is important to know the context in which the map was generated.

A second risk concerns the access to data. Although the risk of not being able to access the data got a lower ranking than the other risks, some respondents did point at problems of maintaining the data.[9] Especially the layer-structure of GISs seems to make this complicated:

[8] If digital data are preserved, there is an additional problem. For digital data, it is difficult to prove that the data have not been changed later. Changing digital data is much easier than changing paper data. How can you know for sure that someone has deleted or mutated data?

[9] An example in literature about GISs confirms problems of long-term access in GISs. For the Land Use and Natural Resources Inventory Project (LUNR) a primitive GIS was developed by the New York State

"As far as I understand, GIS are extremely [difficult] to maintain, because of the various software and data layers. In particular the interfaces between the layers have the risk to become corrupt, with the result that the information cannot be interpreted properly."

A third risk concerns the trustworthiness of data. One respondent pointed to questions concerning the origins of the data in the GIS:

"A GIS is only a collection of geographical information. It does not show how, when, and in what functional context a specific information element has been generated. (...) The trustworthiness of the information is closely related to interpretation: if you don't know anything about the creation context of the information you can hardly trust it."

Compared to other data, this problem seems to be of special relevance for geodata. These data are often acquired from other organizations because building up a geodata set is often very expensive.

In summary, based on the experts' answers three main risks for GISs can be distinguished. The first risk is that geo-data, data about the analyses and data about the context are lost because databases lack a historical dimension: databases are updated and queries and context data are not saved. The second risk is that data cannot be read anymore because the software is no longer available. The third risk is

---

Department of Commerce and the Cornell University in the late sixties. Data from this GIS were used for city planning, economic development and environmental policies. For the LUNR-project special software was developed. And, while the data were kept in hard copies, this software wasn't retained. Therefore, the functionalities of digital access (selection, aggregation, etc.) were lost. In the eighties it was only possible to access the data on paper (or digitally at the very high cost of redeveloping the software).[11]

that there are no data available about how, when and by whom the data in the GIS have been generated.[10]

4.2. GISs and accountability: opportunities

In the Delphi-survey, the respondents were also asked to indicate what opportunities that GISs could create for accountability, they thought were most important. For a first analysis of these possible positive consequences of the use of a GIS for accountability basically the same procedure was followed as for a first analysis of the risks. The respondents were asked to rank the following four opportunities (1 = most important opportunity, 4 = least important opportunity). For GISs this gave the following results:

Better access to data	1,6	(St. Dev. = 1,0)
Data can be interpreted better	2,6	(St. Dev. = 1,0)
More data are present	2,7	(St. Dev. = 0,5)
Data can be trusted better	3,1	(St. Dev. = 1,1)

Table 2: Opportunities GISs might create for accountability

This ranking is more differentiated than the ranking for the risks: 'better access to data' gets the highest ranking and 'data can be trusted better' gets the lowest ranking. 'Better interpretation' and 'more data present' are in between these two. A quote can illustrate why the respondents seem to believe that better access to data is an opportunity the use of GISs offers.

[10] Data about data are often called "metadata". Metadata, however, is a very broad term. For GISs the word metadata is mainly used for those data that are needed to find, access and exchange data. The metadata in this paper are metadata that are needed to evaluate and interpret data. Since this might be confusing, I have chosen to refrain from using the word metadata.

"GIS provide on-line access to a wide range of spatial information. They offer many easy functionalities to combine information from different layers. So, you have better access and more information than with non digital media."

This means that fora have easier access to the spatial data that a governmental organization has used.

5. GISs and accountability: hypotheses

In the previous sections I have described possible consequences of the use of a GIS for accountability. In this section, I will aggregate the results and formulate four hypotheses[11] concerning the consequences of GISs for accountability. All these hypotheses stress changes compared to the 'paper situation'.

The first hypothesis concerns the focus on up-to-date data and insufficient attention for further use of the data for accountability. This concerns the risks that data are updated, queries are not saved, data about the context are not retained and software can become obsolete. In terms of archival scientist Bearman [7] this would mean that evidence of business transactions is not preserved. If you go by what is written in magazines about information and communication technologies this seems to be a general trend in database-technology. Software becomes obsolete within a few years and access to old files becomes problematic. Also, the importance of up-to-date data is stressed. Very few software manufacturers tend to be aware of the importance of historical data. Data tend to be volatile. "If it is not new, it is no value," seems to be the credo. Thus, I can formulate a first hypothesis:

1. Use of a GIS leads to an increased focus on up-to-date data at the expense of historical data. Therefore important data (and queries and context data) for accountability will sometimes not be retained.

[11] I use 'hypothesis' in a broad sense. The hypotheses are statements of expected relations between the use of GISs and accountability. They should be seen as indications of possible consequences that can help to focus further research.

Another risk is that there would be insufficient data about how, when and by whom data in the GIS have been generated. Archival scientist Duranti [7] would conclude that these records are not complete, reliable and authentic. If you go by discussions in ICT-magazines this seems to be a general issue. Data are assumed to have value on their own account. There is a lot of emphasis on ways to recombine data and thus create new information (e.g. data mining). There is little attention, though, for maintaining data about data (e.g. who gathered the data, for what purpose, according to what procedures, etc.). The data seem to become 'footloose'. Thus, I would like to formulate a second hypothesis:

2. Use of a GIS leads to an increased need to maintain about how, when and by whom data have been generated. This need may not be sufficiently met. Therefore, in a process of accountability, these data may be difficult to interpret or cannot be trusted.

A third point is that a GIS offers possibilities to look at the data in different ways. Different queries yield different maps. During a process of accountability, fora might want to know not only what data were used by the governmental organization but also what data could have been used. Therefore, it seems to become more important for governmental organizations to substantiate why they have chosen to use a certain map. A third hypothesis, therefore, concerns this demand for substantiation of perspective:

3. A GIS increases the possibility to look at the data in different ways. Therefore, in processes of accountability fora will probably ask governmental organizations to substantiate the choice for a certain perspective.

A last point is that the use of GISs is expected to lead to better access to data. A forum could use the GIS to make different selections and aggregations of the data which a governmental organization has used for its plans or decisions. Also, a forum could for example access the data through the Internet. Thus, I formulate a fourth hypothesis:

4. Use of a GIS leads to better access to the data. Therefore, these data could play a more important role in a process of accountability.

This exploration has not resulted in definite answers to the question what the consequences of the use of GISs for accountability may be. It has, however, resulted in four hypotheses, which require further attention to gain a better understanding of long-term public accountability in an information age.

References

[1] P. Day & R. Klein, *Accountabilities, Five public services*, Tavistock Publications, London, 1987

[2] A.J.M. van Weers, *Publieke verantwoording*, Eburon, Delft, 1990 (in Dutch).

[3] M.A.P. Bovens , *The Quest for Responsibility: Accountability and Citizenship in Complex Organisations*, Cambridge, Cambridge University Press, 1998.

[4] A. Meijer, Anticipating Accountability Processes, *Archives and Manuscripts* **28**(1) (May 2000), pp. 52-63.

[5] S. Zuboff, *In the age of the smart machine. The future of work and power*, BasicBooks, New York, 1988.

[6] A. Erlandsson, *Electronic Records Management, A Literature Review*, International Council on Archives, Paris, 1997.

[7] D. Bearman, *Electronic Evidence. Strategies for Managing Records in Contemporary Organizations*, Archives and Museum Informatics, Pittsburgh, 1994.

[8] L. Duranti, *Diplomatics : New Uses for an Old Science*, Scarecrow Press, Lanham (Maryland), 1998.

[9] D. Maguire D & D. Rhind (eds.) *Geographical Information Systems: Principles, Techniques, Management and Applications*, Wiley, New York, 1998.

[10] M. Grothe & H.J. Scholten, *GIS in de publieke sector. Een inventarisatie naar gebruik van geo-informatie en GIS bij de Nederlandse overheid*, Koninklijk Nederlands Aardrijkskundig Genootschap/Vakgroep Ruimtelijke Economie, Vrije Universiteit Amsterdam, Utrecht/Amsterdam, 1996 (in Dutch).

[11] R.F Tomlinson, D.F. Marble & H.W. Calkins, *Computer Handling of Spatial Data*, UNESCO Press, Paris, 1976.