Organizational and cultural assessment of GIIs: the introduction of a new model

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Abstract

A geographic information infrastructure (GII) develops gradually. Several development stages may be identified each with unique characteristics. Also the organisational characteristics are likely to vary per stage. This knowledge was used to develop an SDI maturity matrix as presented by Kok and Van Loenen (2005), further developed in Van Loenen (2006). Although the model has been subject of study of several Master students and has been successfully applied in several case studies, it is still in its early development stages. This paper further develops the model by including the cultural dimension as presented by Hofstede (1980). The paper draws on the research accomplished by and presented in Huisman van Zijp (2008).

Keywords: Assessment, organisation, culture, spatial data infrastructure (SDI)

1. INTRODUCTION

The organisation of a GII is increasingly considered to be an important factor that should be addressed in GII strategies. As GIIs develop due to external and internal developments, also the organisation of the GII develops to keep pace with these developments. This process was framed into an organisational maturity matrix by Kok and Van Loenen (2005). The ultimate purpose of the matrix was to provide policy makers a tool to improve their GII strategy by having some transparency in the organisational aspects of their GII.

Although the model has been subject of study of several Master students (De Graaf, 2006; Visser, 2008; Kurvers, 2007; Huisman van Zijp, 2008; Eelderink 2006) and has been successfully applied in several case studies (Grus et al., 2008), it is still in its early development stages.

One criticism was the conceptual level of the model. It does only provide some sense of the situation, but is not detailed enough to provide clear guidance to policy makers. For example, the culture of an organisation may have great impact on the performance of the organisation within a GII. This paper further develops the model by including the cultural dimension as presented by Hofstede (1980). The paper draws on the research accomplished by and presented in Huisman van Zijp (2008). First, the GII maturity matrix is explained. Then the cultural dimensions as explained by Hofstede. In the fourth section we combine the two models

2. ORGANISATIONAL DIMENSION: GII MATURITY MATRIX

The GII maturity matrix was first published in Kok and Van Loenen (2005) and further developed in van Loenen (2006) and Van Loenen and Van Rij (2008). Here, we briefly describe the key aspects of the model. For detailed information, we refer to other publications.

The matrix consists of four different stages of GII development from an organisational perspective: stand alone- exchange/standardisation - intermediary –network. Together with four key factors for the organisational GII development they present a

GII maturity matrix (see also Van Loenen, 2006; Kok and Van Loenen, 2005). This matrix describes the way a vision, leadership, communication channels, and the ability of the geographic information community for self-organisation are present or perform in a GII depends on the stage of development (see Table 1).

The GII maturity matrix consists of four stages of GII development. In the ultimate, most advanced stage, the network stage, it is commonly understood what a GII consists of, and what its objectives and ideal are. In this idealistic view, leadership, open communication channels and a pro-active geographic information sector have resulted in capacity that is such that the GII enjoys broad support at all levels which resulted in sustainable funding for GII development.

Table 1: Maturity of GII from an organisational perspective

Stage / Aspect	Stand alone	Exchange/ standardisation	Intermediary	Network
Vision	Focus on individual organisation	Developed with all stakeholders	Implementation	Commonly shared, and frequently reviewed
Leadership	Focus on individual organisation	Questioned	Accepted	Respected by all stakeholders
Communication	Focus on individual organisation	Open between public parties	Open between all stakeholders	Open and interactive between all
Self-organising ability	Passive problem recognition	Neutral problem recognition	Actively helping to solve identified problems	Actively working on innovation

When the phase of GII development is determined the development strategy of the GII can be formulated.

The categorisation of a GII in the matrix is not fully developed, however. It is sometimes unclear where to fit a GII. Sometimes it would be best to classify a GII in a stage between two stages. Also a GII might be assessed to be within a certain stage but in the beginning while another GII might be in the same stage but more closer to the next stage. It is unclear how these uncertainties would impact a GII strategy. At least from an scientific perspective it is a challenge to further develop the matrix so that it will more accurately assess the status of a GII from an organisational perspective.

One part of the organisation concerns culture. In the next section we will address culture in the context of the further development of the maturity matrix.

3.   CULTURAL DIMENSION AND GII: MODEL OF HOFSTEDE

To be able to observe and describe the differences in culture in an organisation, indicators of culture are necessary. Hofstede (1980) has developed a set of four indicators which characterises the culture in an organisation. He has formulated a 4-dimensionaal model that reflects the differences in culture by a score on each of the four indicators. This allows to obtain some insights in the concept of culture.

3.1 The four dimensions

Hofstede defines the following four dimensions (van der Toorn and De Man, 2000): Power distance (PD), Avoidance of uncertainty (AU), Male versus female culture (MF), and Individualism versus collectivism (IDV/COL).

Power distance (PD)
Power distance can be defined as the way a community handles differences in power and wealth. Cultures with large power distance are hierarchical, authoritarian and elitist, this means the higher in the hierarchy the more one profits from the power and wealth. The lower in the hierarchy, the less one profits. In cultures with small power distance one is likely to find flat organisations and participation, and a partitioning of the benefits and negatives.

Avoidance of uncertainty (AU)
Avoidance of uncertainty concerns the way a community handles uncertainty and risk. Cultures in which uncertainty is avoided, and show little innovation. These cultures are typically found in large institutes with a stable conservative nature that plan thoroughly. Cultures that do not avoid uncertainty are innovative and creative and tolerate diverging opinions and behaviour. Such cultures value risk and enthusiasm higher than security and stability.

Male versus female culture (MF)
Male versus female culture concerns the way a community handles male and female values in culture. Male cultures focus on result and success, are aggressive, winners win and losers lose, and pursue visible success. Female cultures on the other hand emphasise the quality of living, networks, and relations as social values, equivalently and show compassion.

Individualism versus collectivism (IDV/COL)
This dimension concerns how a community approaches an individual and a group. Individualistic cultures exist from calculating citizens: what can be obtained there for me, individual opinions are more important than those of a group. In collective cultures the group values dominate: your value is stipulated your contribution to common good. A link between PD and IDV/COL exists.

Hofstede (1980) has established this model for cultural difference between countries. The model is used here to analyse a culture of an organisation. In that case especially the dimensions power distance and avoiding uncertainty are important (Van der Toorn and De Man, 2000). Two questions are relevant: (1) who can decide that? and (2) which rules and procedures have be followed?
For the first question is the power distance important and for the second question avoiding uncertainty. The other two dimensions, individualism and masculinity, are more related to individual people in the organisation and their motivation. It is the organisation that determines the success of the implementation of a new concept such as GII (Van der Toorn and De Man, 2000).

3.2 Applying the cultural dimension theory to GII

According to Van der Toorn and De Man (2000) influence the four cultural dimensions of Hofstede the success of (geo-) information technologies and GII.

Power distance (PD)
Large power distance involves little participation in leadership and centralisation of authority. GII and GIS are especially from the top imposed, resulting in opposition against management visible in opposing the new concept. Cultures with large power distance frequently work on a need-to-know basis, instead of on a transparent and

sharing basis. Cultures with small power distance welcome the properties of transparency and sharing of a GIS or GII. They will try to incorporate these properties in the organisational structure and in management of their organisation. It is a culture in which individuals play an important role as part of whole, and for this reason they are involved. In cultures with small power distance the culture of sharing of everything is welcomed. GII concerns by nature sharing information, for this reason is small power distance most optimum for the implementation of GII.

Avoidance of uncertainty (AU)
When the culture of an organisation tends to avoid uncertainty, recourse is frequently sought to strict rules and formal procedures. This is frequently found in companies with conservative strategies. The checking and conservative functionalities of the GII or GIS will be especially appreciated. They can contribute to the certainty and stability of the organisation. Cultures that welcome uncertainty, undergo changes as they come. The organisation is curious for new technologies and concepts and will experiment also in new situations. This stimulates innovation.
Although GII can contribute after a successful implementation to certainty and stability of an organisation and therefore is appropriate in a culture which avoids uncertainty, in the beginning nevertheless a major change will occur for the manner of work in the organisation. Avoiding uncertainty is no optimum cultural condition for the implementation of GII. Curiosity and experiments are necessary and that brings uncertainty. Each organisation handles uncertainty differently and therefore this factor needs to be examined further.

Male versus female culture (MV)
Male cultures use new technologies especially for visible successes, but will tend as a result, also to only use the well-known successes of GIS. These will typically not use GIS in other unknown application areas because these are likely to be less successful.
Female cultures appreciate especially the networking and relational properties of GIS and GII. For GII a balance concerning masculinity and femininity most optimum culture should be sought. The male properties will ensure that fast successes are booked, whereas the female properties can broaden success stories.

Individualism versus collectivism (IDV/COL)
This factor influences especially the style of control used in the organisation. In a culture of individualism the participation in planning and developing computer systems and the level of parts of information will be low. This factor influences also how the success of the GII is experienced, as individual or as a group success. For successful implementation of GII, participation is necessary at planning and development levels. For this reason a culture of collectivism is likely to be optimal. In many organisations both individualism and collectivism characteristics exist. Sometimes there is a clear collective notion in the development of policy and the success of it, but sometimes an organisation is too large to speak of full collectivism.

Linking the cultural dimension to the maturity matrix results in Table 2.

Table 2: Maturity of GII from a cultural perspective

Stage \\ Aspect	Stand alone	Exchange/ standardisation	Intermediary	Network
Power distance (PD)	Large PD	Reasonably large PD	Reasonably small PD	Small PD
Avoiding Uncertainty (AU)	Much AU	Relatively much AU	Less AU	Little AU
Male (M)/ Female (F)	M	M	M/F	M/F
Individualism (IDV)/ Collectivism (COL)	IDV	IDV/COL	COL/IDV	COL

4. COMBINED MODEL

Combining the organisational and cultural dimension results in the Matrix presented in Table 3. The phase of the GII development and the organisational and cultural characteristics of an organisation can be determined with this maturity matrix. When the phase is determined the development strategy of the GII can be formulated.

Table 3: Maturity of GII from an organisational and cultural perspective combined.

Stage \\ Aspect	Stand alone	Exchange/ standardisation	Intermediary	Network
Organisational dimension				
Vision	Focus on individual organisation	Developed with all stakeholders	Implementation	Commonly shared, and frequently reviewed
Leadership	Focus on individual organisation	Questioned	Accepted	Respected by all stakeholders
Communication	Focus on individual organisation	Open between public parties	Open between all stakeholders	Open and interactive between all
Self-organising ability	Passive problem recognition	Neutral problem recognition	Actively helping to solve identified problems	Actively working on innovation
Cultural dimension				
Power distance (PD)	Large PD	Reasonably large PD	Reasonably small PD	Small PD
Avoiding Uncertainty (AU)	Much AU	Relatively much AU	Less AU	Little AU
Male (M)/ Female (F)	M	M	M/F	M/F
Individualism (IDV)/ Collectivism (COL)	IDV	IDV/COL	COL/IDV	COL

The matrix theory was used to analyse the GII of Natuurmonumenten (Nature monuments).

5. APPLYING THE MODEL TO THE NATURE RESERVES GII

In the Netherlands there are three important players in the Nature reserves domain. Natuurmonumenten, Staatsbosbeheer and 12 Provinciale Landschappen. Here, we apply the developed model to Natuurmonumenten and Staatsbosbeheer. Within these organisations, we interviewed several people with at least one from a specific type of GI group (manager, coordinator, professional user, end-user).

5.1 Natuurmonumenten

Natuurmonumenten is a non-profit organisation managing approximately 100,000 ha. nature reserves in the Netherlands. It has 880,000 individual members, and employs about 600 staff members. Further, 2600 volunteers assist Natuurmonumenten in managing the nature reserves. The main office is based in 's Gravenland and there are 6 regional offices.

Throughout the organisation GI is used stemming from a variety of sources including the Kadaster, provinces, water boards, *Staatsbosbeheer*, and the *Provinciale Landschappen*. Natuurmonumenten also gathers own data on their nature reserves. One of these being the Nature type database. *Natuurmonumenten* is using one GIS in its organisation based on Arcview 3.3.

Applying the model

A vision has been developed in the past, but is outdated and a new vision is required. Leadership is clearly in one person, the manager of the GIS system. Communication is limited to the professionals working with GI. There are no initiatives or arrangements to inform others. Some people pro-actively address issues, sometimes by developing their own tools and making them compliant to the organisations system. Others are more reluctant.

Natuurmonumenten is a flat organisation (few management layers). However, between the regional offices and the main office some power distance occurs. Staff members are often pro-active and often do not avoid uncertainty. Sharing data is considered important even though practice shows that this is still limited. The *Natuurmonumenten* was assessed fit the collectivism category while noting that due to the regional offices also distance and as a consequence individualism was present. Table 4 summarises the findings.

Natuurmonumenten can be classified in between the phases 'Exchange and Standardisation' and 'Intermediary' of the matrix. Especially the components Vision and Communication need to be developed further.

Table 4: Maturity matrix applied to *Natuurmonumenten*.

Stage / Aspect	Stand alone	Exchange/ standardisation	Intermediary	Network
Organisational dimension				
Vision	Focus on individual organisation	**Developed with all stakeholders**	Implementation	Commonly shared, and frequently reviewed
Leadership	Focus on individual organisation	Questioned	**Accepted**	**Respected by all stakeholders**
Communication	Focus on individual organisation	**Open between public parties**	Open between all stakeholders	Open and interactive between all
Self-organising ability	Passive problem recognition	Neutral problem recognition	**Actively helping to solve identified problems**	Actively working on innovation
Cultural dimension				
Power distance (PD)	Large PD	Reasonably large PD	Reasonably small PD	**Small PD**
Avoiding Uncertainty (AU)	Much AU	Relatively much AU	**Less AU**	Little AU
Male (M)/ Female (F)	M	**M**	**M/F**	M/F
Individualism (IDV)/ Collectivism (COL)	IDV	**IDV/COL**	**COL/IDV**	COL

5.2 Staatsbosbeheer

Staatsbosbeheer manages approximately 250,000 ha. of nature reserves in the Netherlands. It is an independent administrative body whose principal is the ministry of *Landbouw, Natuur en Voedselkwaliteit* (LNV) (Ministry of Agriculture, Nature and Food Quality).

Applying the model

Leadership is in principal in the main office in Driebergen. However, decentralisation processes have resulted in more power for the regions.
The communication has suffered from the vacancy in the position of communication manager in the main office. GIS people meet every quarter, but there is no official link to the management levels.
Staatsbosbeheer is characterised by the research as a hierarchical and bureaucratic organisation. Due to the independent operating regions, the distance to the main office is considered to be relatively large. The research further identified a more male culture with short term successes for GI as the primary objective. Table 5 summarises the findings.
Also *Staatsbosbeheer* is classified in between the phases 'Exchange and Standardisation' and 'Intermediary' of the matrix. Especially the components Self-organising ability and Power distance appear to be least developed.

Table 5: Maturity matrix applied to *Staatsbosbeheer*.

Stage / Aspect	Stand alone	Exchange/ standardisation	Intermediary	Network
Organisational dimension				
Vision	Focus on individual organisation	**Developed with all stakeholders**	**Implementation**	Commonly shared, and frequently reviewed
Leadership	Focus on individual organisation	**Questioned**	**Accepted**	Respected by all stakeholders
Communication	Focus on individual organisation	**Open between public parties**	**Open between all stakeholders**	Open and interactive between all
Self-organising ability	Passive problem recognition	**Neutral problem recognition**	Actively helping to solve identified problems	Actively working on innovation
Cultural dimension				
Power distance (PD)	**Large PD**	**Reasonably large PD**	Reasonably small PD	Small PD
Avoiding Uncertainty (AU)	Much AU	**Relatively much AU**	**Less AU**	Little AU
Male (M)/ Female (F)	M	**M**	**M/F**	M/F
Individualism (IDV)/ Collectivism (COL)	IDV	**IDV/COL**	**COL/IDV**	COL

6. CONCLUSION AND FURTHER RESEARCH

In this paper we tried to combine the models of Kok and van Loenen (2005) and Hofstede (1980) in one new model. Our objective was that this new model would comprehensively take into account the organisational aspects of a GII. This should allow us to better assess the status of a GII and to provide tailor-made recommendations for GII developers.

The new model was applied to two organisations responsible for the management of nature reserves in the Netherlands. Although the outcomes of the research were recognised by the respondents in the research, the way forward remained ambiguous in terms of strategy to follow.

However, the research did not address the stage of development of the Nature Reserves GII in the Netherlands; only individual organisations were assessed. Since the start of the research several attempts were noticed that seriously look into ways to stimulate data sharing among these organisations, and to promote cooperation to improve nature reserves management in the Netherlands.

Although this presented model has further extended the initial model developed by Kok and Van Loenen (2005), it raises the question of a possible correlation between the identified components in the organisational and cultural dimension. And what applied to the organisational model also applies here: what exactly constitutes a large power distance, how to assess the individualism of a GII and how to classify the

outcomes of such assessment in one or more maturity categories. Further research is needed to further develop the matrix and to make it applicable to practice so that policy makers can take advantage of it.

REFERENCES

de Graaf, P. (2006) Geographic Information Infrastructure and Local Land Use Plans: Research at the development of GII and DURP, and their mutual relation within Dutch municipal organizations, (GIMA MSc. thesis)

Eelderink, L. (2006). Towards key variables to assess National Spatial Data Infrastructures (NSDIs) in developing countries, MSc thesis GIMA.

Grus, L., J. Crompvoets, A. K. Bregt, B. van Loenen, T. Delgado Fernandez (2008). Applying the Multi-view SDI Assessment Framework in several American countries and The Netherlands. The University of Melbourne: Melbourne, Australia.

Hofstede, G. (1980). *Cultures consequences: International Differences in Work-related Values*, Beverly Hills, CA: Sage Productions.

Huisman van Zijp, A. (2008). De invloed van organisatie en cultuur op een geo-informatie infrastructuur. MSc thesis Delft University of Technology, the Netherlands.

Kok, B., van Loenen, B. (2005). How to assess the success of National Spatial Data Infrastructures? *Computers, Environment and Urban Systems*, 29: 699-719.

Kurvers, W., (2007). Implementing Local Spatial Information Infrastructures: Are Municipalities Inspired?, M.Sc. Thesis, Manchester Metropolitan University (UNIGIS), Manchester, at:
http://www.home.versatel.nl/w.kurvers/Spatial_Information_Infrastructures_W. Kurvers.pdf

Kurvers, W. (2008). "*SDI assessment from an organizational perspective",* in B. van Loenen (ed.) *Assessment and socio-economic aspects of geographic information infrastructures*". Delft: Netherlands Geodetic Commission, at:
http://www.ncg.knaw.nl/Publicaties/Groen/pdf/46VanLoenen.pdf

Van der Toorn, W., and E. de Man (2000). "Anticipating cultural factors of GDI", in R. Groot and J. McLaughlin (eds.), *Geospatial data infrastructure. Concepts, cases and good practice,* Oxford University Press.

Van Loenen, B. (2006). Developing geographic information infrastructures; The role of information policies (dissertation ed.). Delft: DUP Science.

Van Loenen, B. and E. van Rij (2008). "Assessment of SDIs from an Organisational perspective", In Crompvoets, J., A. Rajabifard, B. van Loenen, T. Delgado, *A Multi-View Framework to Assess SDI*. The University of Melbourne, Melbourne, Australia, at:
http://www.csdila.unimelb.edu.au/publication/books/mvfasdi.html

Visser, E. (2008). Kernregistraties Ruimtelijk Beleid en Bouwprojecten: Hoe kunnen de vragen "wat mag waar" en "wat komt waar" snel en volledig worden beantwoord, MSc. Thesis UNIGIS.