The use of geographic information system in local government's modernisation

A case study from the northwest of England

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Abstract

Purpose – Despite a number of studies that have demonstrated the potential of geographic information sharing and analysis in enabling the delivery of modernised e-government services, there is a growing need for an evaluation of the use of geographic information systems (GIS) in local governments. The purpose of the paper is to explore the possibilities in this regard by establishing an evaluative framework based on e-government development models. In addition, the paper will provide some preliminary findings of a case study from the northwest of England, where the framework was used.

Design/methodology/approach – The paper presents an evaluation framework which connects GIS use in local governments, with e-government development models. Semi-structured interviews were used in a case study of some local governments in the northwest of England. The findings are then compared and contrasted with findings from a critical literature review.

Findings – The framework is considered as useful in evaluating the development and use of GIS in local governments under the e-government banner. The results illustrate a wider use of GIS in local governments in the northwest of England and its close connection with the e-government strategy. The study also indicates many local governments are still facing social, technological and organisational challenges in different stages of the development of advanced GIS use.

Originality/value – The paper presents an evaluation framework designed for a new and specific perspective regarding the connection of e-government and the use of GIS. Developing benchmarks with the framework should help politicians and other stakeholders to compare their initiatives with similar ones in other local governments. The paper would also help practitioners and decision makers to understand possible challenges in achieving such modernisation and the potential solutions at different stages development.

Keywords England, e-government, Geographic information systems, Modernization, Evaluative framework

Paper type Case study

Introduction

The modernisation of governance, especially the delivery of public services, in the information age has placed the use, management and exchange of information at the centre of the work of local governments (Mayer-Schoenberger and Lazer, 2007). Consequently, many local governments around the world are reforming the ways in which they operate and provide services to its citizens, supported by the use of information and communication technology (ICT) (Andersen *et al.*, 2007; Koussouris *et al.*, 2011).

The electronic government (e-government) concept emerged in the 1990s with the aim of harnessing the benefits of the deployment of ICT to the public sector. Its positive impact could come from the enhancements to the efficiency of public services,

improved transparency and accountability across government functions and cost savings in government administration (UN, 2008; Srivastava, 2011). E-government was seen as a key tool in the UK's Local Government Modernisation Agenda (CO, 2000). According to the Office of the Deputy Prime Minister (ODPM, 2006), the average local authority in England was 97 per cent "e-enabled" based upon the final implementing electronic government (IEG) returns from all England local authorities in 2005. However, the UK government admitted that a complete transformation has not yet occurred and a shared services culture has yet to be integrated into public administrations (CO, 2005b).

Following on from five years of "electronic government", the labour government announced a new five year plan for "transformational government" (t-government). Like its predecessor, t-government emphasised the important role of information technology in the information age in enabling the delivery of modernised public services (King and Cotterill, 2007). However, the attention has shifted to the evaluation and exploitation of such development (Irani *et al.*, 2008; Shan *et al.*, 2011). Despite this some researchers evaluating e-government development from different aspects found that, according to (Griffin and Halpin, 2005), e-government evaluation is still an under developed area (Irani *et al.*, 2008). In the reminder of the paper, e-government is used to represent the modernised local government in general, whether it is regarded as an e-government or a t-government approach, given the term e-government is recognised internationally.

Concurrently, the use of geographic information system (GIS) in local governments is set to take on a far greater corporate significance as much of the information held by local governments is geographically referenced (Boxall, 2005; GoU, 2008). GI is essential both to understanding and addressing many issues that local governments are facing (Gilfoyle and Thorpe, 2004). The modernisation of public services in key sectors under the e-government banner, such as health, education and crime prevention, depends on the efficiency of the exchange and analysis of geographically referenced data, much of which is held by local governments (CO, 2005a). The use of GIS in local governments has become widely adopted in the last two decades; however, its strategic importance is only being realised with the development of e-government strategies from the beginning of the twenty-first century (Turner and Higgs, 2003).

The evaluation of the effective use of GIS in local governments is a study area of increasing relevance as the widespread availability of GIS in local governments and its close connection with e-government development (Georgiadou and Stoter, 2010). There is evidence that the potential of GIS is not yet being fully exploited (Göçmen and Ventura, 2010; Georgiadou and Stoter, 2010). While obstacles to the use of GIS in local governments have also been investigated, most of these studies are either dated or not connected with e-government development. Evaluation on the use of GIS in local governments is still needed from both theoretical and empirical perspectives (Georgiadou and Stoter, 2010; Turner and Higgs, 2003). A framework would be helpful to guide such evaluation that enables the contextualization of results. E-government development models in the literature are useful for the creation of such a framework. Benchmarking developed from the framework could help politicians and other stakeholders to compare their initiatives with similar ones in others local governments to make sure that their efforts are moving GIS use in the right direction. The findings may also provide insights into the evaluation of e-government development as part at the wider GIS of the e-government strategies.

In this paper, the research objective is to develop an evaluation framework which focuses on GIS development in local authorities, based on e-government development models. The framework is tested in an empirical case study. A selection of local authorities in the northwest of England is chosen for the study. The rest of the paper is organized in several sections. In second section, a conceptual background is outlined. It is followed by the description of the proposed evaluation framework and how it is linked with e-government development models. Challenges and indicators are discussed regarding each stage of the framework. In fourth section, the research methodology is presented. The proceeding section is used for synthesises the research outcomes with findings from a critical literature review. In the final section, conclusions and recommendations are drawn.

GIS and e-government

GI is defined as information that is geographically referenced, i.e. data that is identified according to its location. It is estimated that over 80 per cent of a local authority's information has a spatial reference (e.g. addresses, postcodes) (Gilfoyle and Thorpe, 2004). This information represents not only the built environment, such as road networks, public buildings, e.g. hospitals, police stations, libraries, fire stations, but also elements of the natural environment, e.g. land, trees, rivers. Furthermore, this information includes social and economic characteristics, such as population, average family income, and household car ownership. The information is used by many departments of local governments for different tasks and underpins most of local governments' activities.

The management of GI covers all activities associated with the development and daily operation of computer-based systems for handling GI to satisfy the needs of different users (Gilfoyle and Thorpe, 2004). It includes encouraging the responsible ownership of GI, face-lifting its supply, and ensuring its currency, quality and accessibility. One of the main problems with the management of GI is that much of the information has previously been held in isolated departmental systems (Morad, 2002). A report by the GI Panel states that "too few government-owned datasets that incorporate location can be easily assembled and analysed with reliability from across local and central government bodies" (GoU, 2008).

A GIS is a computer system capable of assembling, storing, manipulating, and analysing geographically referenced information. GIS was firstly developed in the late 1960s as a special information system to handle GI. The main functionalities of GIS include integrating, storing, editing, analysing, sharing, and displaying geographical referenced data. With the improvement of the usability of GIS, the number of, and types of GIS uses and users have expanded exponentially. GIS can now be used by non-technical, as well as technical users in innovative and experimental ways to provide new capabilities in local government (O'Looney, 2000).

According to Turner and Higgs (2003), the connection between the use of GIS and e-government development in local government is symbiotic. While the e-government development can provide a significant boost to the use of GIS in local authorities, the strategic management and use of GIS provides an important enabler for e-government development. Whilst the operational benefits of GIS are apparent to many within the departments of local governments – many of these authorities have been using GIS for over two decades for functions such as planning, research, statistical analysis,

and environmental monitoring – the wider strategic importance of GIS has only recently being realised. Part of the driving force at this recognition of the role of GIS has been governments' targets to make governance more transparent, public services more open and information more accessible under the e-government banner.

It is also clear that the e-government agenda necessitates greater efficiencies in the management of information in local government. This is especially true for the use of GIS in relation to its ability to integrate data from disparate sources and hold this in different systems through a common geographic reference allied to its widespread use in local government. There has been an increased profile in the use of such information in a number of policy domains, through the launch of the Office for National Statistics new Neighbourhood Statistics Service for England and Wales in February 2001 for example. Despite this, there remain relatively few studies that have explored the importance of GIS in the rolling out of e-government projects.

The design of the evaluation framework

As effective GIS use should be a part of fully functional e-government, it is thought that e-government development models could be modified to create an evaluation framework regarding the use of GIS. The designed framework includes three interrelated and sometimes overlapping stages, namely, infrastructure development, service integration, and service transformation. The design of the framework (Figure 1(B)) is based on two e-government development models (Layne and Lee, 2001; UN, 2008).

The e-government development model (Figure 1(a)) stops at the horizontal integration which is correlated with service integration of the second stage of the proposed evaluation framework. The UN e-government model (Figure 1(c)) raised the standard of development to a higher level of e-government aiming to change people's mind-set and pursue service innovation. This is presented as a service transform stage in the evaluation framework. As part of an e-government development, GIS use is facing similar challenges in relation to social, technological and organizational issues
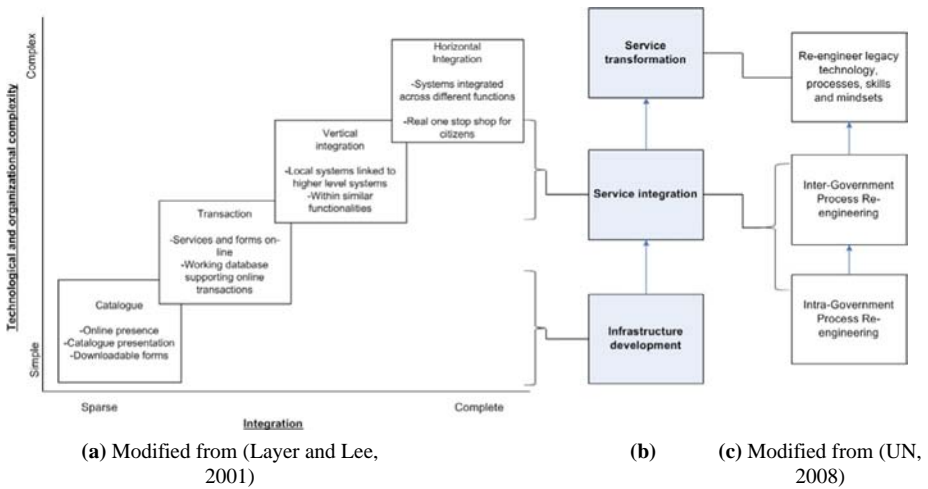

(a) Modified from (Layer and Lee, 2001)   (b)   (c) Modified from (UN, 2008)

Figure 1.
The design of the evaluation framework

at both governmental and individual citizen level (Irani *et al.*, 2007). The next section explains the three stages in detail as well as the challenges for each of them.

Infrastructure development

The first stage relates to the creation of a corporate GIS infrastructure within local government, based on reliable and affordable internet connectivity for citizens, businesses and all stakeholders in a given jurisdiction (UN, 2008). In achieving the goals of e-government, a corporate approach should be adopted in managing information within local government which allows easy data sharing among agencies and the public (DETR, 2000; Patterson and Hoalst-Pullen, 2009).

The main challenges in this first stage are generally more technical and financial rather than managing or people issues. The challenges relates to issues like data access, geographical knowledge representation, resource allocation, maintenance of the information centrally, data security, and common identity management. However, there are several managing challenges include co-ordination and ownership issues.

The development of a corporate GIS is essential for local government's modernisation as it is a part of the overall e-government infrastructure. The term "corporate" is used here to imply, at the very least, a coordinated approach to the introduction of GIS. This involves the vast majority of departments, or sub-sections into which an organization is divided. It paves the way for better management and administration through increased information sharing and co-operation, improved workflows, and the ability to offer seamless services to the public (Campbell and Masser, 1995). A lack of a corporate approach, however, was highlighted as one of the main problems faced by the local authorities in implementing GIS before the e-government initiative (Gilfoyle and Thorpe, 2004).

The degree of development at this stage can be assessed by indicators such as the existence of a central spatial data warehouse, data set custodians, availability of data standards (international and national) and the availability of metadata. A long-standing issue with the use of GIS in local authorities are the redundancies in data collection and storage, particularly when GIS databases are created with little co-ordination among various levels of government and agencies (Nedovic-Budic *et al.*, 2004; GoU, 2008). According to a survey in 2004, the main barrier for geographic data sharing was lack of awareness of what information other departments/organizations had (CO, 2005a). The existence of a central spatial data warehouse cannot only reduce the data redundancy by integrating and summarising data, but also provide a fast, flexible, and multidimensional way to explore spatial data for internal and external use. For example, interactive data exploration and geographic knowledge discovery can aid strategic decision-making (Miller and Han, 2009).

The availability of a formal data custodian can ensure the definitive security and reliability of datasets in the central database (Jacoby *et al.*, 2002). The development of a single custodianship is significance from a technical perspective in that this paves the way for improved uniformity of standards of metadata, fundamental datasets, administrative policies as well as accessibility issues. This addresses some major barriers found in data sharing in local government including a lack of a data sharing protocol and concerns about the data accuracy (CO, 2005a).

Corporate data standards are a prerequisite for the improved ability to integrate information between departments (Gilfoyle and Thorpe, 2004). Besides improving

uniformity, metadata standards provide an ersatz trust mechanism in place of knowing who produced the data personally (Harvey, 2003). As set out in the e-government metadata standard, metadata is necessary for managing and retrieving information of all kinds. Moreover, for metadata to be effective, it needs to be structured and consistent across organizations (CO, 2005a).

Together, all these indicators can reveal the interoperability of GI datasets and the health of the development of GIS from a corporate perspective which is the foundation for GI sharing and analysing in order to improve workflows, and the ability to offer integrated services to the public.

Service integration
At the service integration stage, the focus is starting to move toward the transformation of government services. Officers consider the leveraging of the new corporate GIS infrastructure within local government in order to better share GI internally and externally. Also consideration of how services can be bundled, integrated, and delivered through more efficient and citizen-centric governance models encompassing multiple delivery channels is important here. According to Scholl (2007), integration is central to the development of e-government. To enhance efficiency, user friendliness, and effectiveness, local government often attempts to integrate various government services vertically and horizontally for the enhancement of efficiency, user friendliness, and effectiveness (Moor, 2002). Vertical integration refers to services connected within similar functionalities of units/groups at different levels of local government. Horizontal integration refers to service integrated across functionalities.

At this stage challenges are more likely to relate to management and people aspects which include change of personnel, especially at key positions in GIS development. These also include a responsibility to provide feedback and staff training given the services they provide will extend beyond functional department boundaries. The privacy of citizens requesting services also needs to be seriously considered. Furthermore, the implementation of communication and integration-oriented technologies can be technically challenging. Examples include data ownership, information authentication, exposure level of internal system to public, and data security.

Both vertical and horizontal integration pushes information and data sharing among different functional units and levels of government for better online public services. It is expected that vertical integration within a government department will happen first because technically and politically the barriers between different levels of the same department are much less than the ones between different departments and authorities. The growing number of computerized local land charge systems is a good example of vertical integration. The time taken to handle requests has been reduced from weeks, to days or even hours with benefits both to those involved in property conveyance and to the efficiency and effectiveness of the council (Gilfoyle and Thorpe, 2004). But the full potential of ICT, from the citizen's perspective, can only be achieved by horizontally integrating government services across different departmental functional boundaries (Layne and Lee, 2001).

According to a survey in 2004, only 49 per cent of local government organizations in the UK participated in GIS sharing projects (CO, 2005a). The development of corporate GIS infrastructure can provide a physical foundation to support such participation. However, motivation is also vital for better service integration. This is important at both

operational and strategic levels. Typically, the motivation for service integration is to achieve cost savings, improve service delivery and efficiency, improve decision-making and resource allocation, and the desire (either political or operational) to modernise public service delivery. Service integration is more likely to be achieved successful when there are clear drivers for change, clearly articulated benefits and a clearly defined scope. Furthermore, a long-term corporate strategy for the use of GIS in local government is important to the development and success of service integration which across functional and departmental walls.

Service transformation
The concept of governance and management of government staff may be subject to re-evaluation from the perspective of e-government. Functional specialized departments may not be suitable as a governing structure in e-government (Layne and Lee, 2001). Increasingly, senior managers and politicians in local government are looking for GIS applications to support innovative services where there is a clear citizen focus and business case (Gilfoyle and Thorpe, 2004). It is difficult to determine how much innovation and how long a period of time is required before something can be considered as a "complete changing in character, condition", the class definition of transformation.

In the study, the emphasised aspect of transformation is pursuing service innovation through a broader prism of community and democratic development towards more networked governance patterns within government, across various government levels and amongst all sectors in a particular jurisdiction. The character of such transformation is developing efficient citizen-centric services which result in more customer satisfaction and citizen empowerment (UN, 2008). The service innovation supported and enabled by GIS can bring big changes both at management and operational level. The change of work processes and communication structures will alter the work situation for staff in a local authority in many ways.

The main challenges for this service transformation stage include encouraging a change of the mind-set in local government officials, structural changes in local government, empowering the marginalized and the less powerful, more frequent regular assessment on user demands, usability of interfaces of local government's online service platforms. Fundamentally, service transformation should provide a platform on which to achieve a participatory democracy with active citizen involvement (Peristeras *et al.*, 2008). One challenge of the service transformation stage from a GIS perspective is better communication between the public, local communities and officers in local authorities. This relates to the development of public participatory GIS (PPGIS) (Ganapai, 2010). Basically, the public should be able to, not only access GI through local government web sites, but also input GI in relation to local issues for example regeneration, health, transportation, crime, and education. In a recent study, findings suggested the importance of getting citizen feedback in a move towards a more integrated citizen service information system (Chen, 2010).

Research methodology
In the early stage of the case study, we investigated the current use of GIS in local governments of the northwest of England. A survey of their web sites found that all forty-two local authorities have showed some level of GIS use in their organizations.

Furthermore, 22 of them provide online GIS services through their web sites. All the local authorities in the region were then contacted by telephone to confirm the findings.

In the second stage of the study, an in-depth semi-structured interview approach was taken as it has the advantage being both flexible and information rich (Wengraf, 2001). The interview questions are open-ended and designed around different indicators and the challenges aforementioned in each of the stages in the evaluation framework. Answers from the interviewees often led to other issues being highlighted which were not originally covered by the designed interview questions. This provides opportunity for the researchers to undertake a more in-depth analysis. Each interview was tape recorded and later transcribed. The original transcription was then sent to the interviewee to check and revise for any misinterpretation and/or interviewer bias.

The interview questions were mainly focused on three topical issues concerning the use of GIS in local government namely:

(1) the development of infrastructure for using GI(S), for example, the strategic management of GI;

(2) the integration of GI(S) in back-office systems and public access (front-end) systems; and

(3) new approaches for delivering more effective and efficient local government services which is supported (or enabled) by GI(S).

The researcher contacted officers in local authorities in the northwest region. In total, 25 initial responses were received and 16 were chosen for interview. The criteria for the selection of interviewees was twofold, one was their experiences of using GIS and second was their position in local government. The author purposely made sure that for each local authority at least one interviewee was of senior management level and another one at the operational level of GIS development. This can provide a more comprehensive insight for the study from different perspectives. Most of the interviewees are GIS professional and 56 per cent of them (nine out of 16) have "GIS" in their title (Figure 2). Of these interviewed 81 per sent (13 out of 16) had more than five years experience using GIS (Figure 3).

In the third stage of the study, the confirmed interview transcripts of were analysed and then synthesized with findings from a critical review of other existing literature.
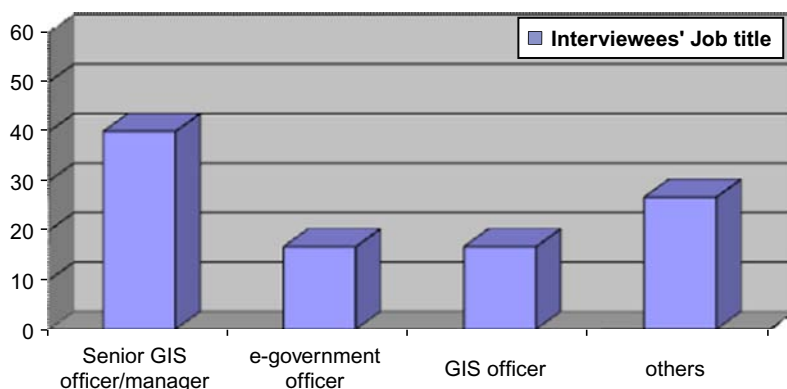

Figure 2.
Interviewees' job title

Figure 3.
Interviewees'
experience with GIS

The summary of the findings were then sent to interviewees for further feedback and comments. The mixed and complementary use of semi-structured interviews, critical literature review and finding synthesis provides a more solid methodological base for the study. The following section presents the findings from the interview survey in detail.

Findings of the survey

There is a well-recognised connection between GIS and e-government development. Almost 75 per cent of the surveyed authorities stated that GIS featured in their e-government strategies. All surveyed local authorities have at least a central database in place for base mapping data. Four out of seven of the surveyed local authorities have formal central spatial data warehouses in place, with a further two local authorities having plans for such development. Five out of seven of the surveyed local authorities have internet and/or intranet GIS available for council staff to use. It should be noted, however, that the sample size was small and there was likely to be bias towards more developed corporate GIS authorities willing to be interviewed.

All surveyed local authorities have certain data quality control mechanisms for example data custodians and metadata in place (Table I). However, it was found that most of the surveyed local councils, five out of seven, are still working in the early stage of GIS development, for instance infrastructure development. Regarding the use of GI for the integration within and between functionalities, all surveyed councils recognised the need for GIS in back-office systems in a corporate framework. Those using GIS in a corporate framework accounted for 57 per cent of the local authorities surveyed. All the surveyed authorities use GIS being used across most of their departments (Table I).

All surveyed councils have employed web-based GIS for public access to GI and services for example, property searches and local service searches. Despite this, not all of them had service integration. Also, information available online is still limited, mainly due to security and/or legal reasons. Some of the available information is still based on redundant data (static data, e.g. pdf files) instead of direct links to the central data warehouse and functional intranet. This means that static copies of GIS data are used, rather than providing direct links to live data sets.

Over 75 per cent of the authorities have departmental service integration, e.g. computerized local land charge system, customer services call system (Table I). This integration of GIS within the front-end system and public access systems are

Local government	Infrastructure development			Service integration			Service transformation	
	Data standard and metadata	Data set custodians	Central database	Single/ departmental function integration	Cross functional integration inside the local government	Multi-stakeholder co-operation (with private and third sectors)	Innovative service procedure	Public participation
A	×	×	×	×	×	×	×	
B	×	×	Under development	×				
C	×	×		×	×		×	
D	×	×						
E	×	×	×					
F	×	×	Under development	×	×	×		
G		×		×				

Table I.
Status on GIS
development of the
surveyed local
governments using the
evaluation framework

more likely fall into the category of vertical service integration. Some councils provide participatory interactive experiences to citizens. However, some interfaces of the existing web sites are not very user friendly for the public. For example, some councils' interactive map interfaces are quite similar to standard commercial GIS software. They are not considered easy for the public to understand and learn (Hamilton *et al.*, 2001; Zhang *et al.*, 2002). Some of the web-based maps are also slow to respond to users' interaction. The problem was widely known by the interviewees, with 63 per cent of them stating that the development and improvement of web-based maps is one of the top priorities for their local authorities' future work.

The interviewees highlighted a number of factors that are preventing synergies between GIS development and e-government strategies. The most common factors highlighted were financial and people issues, such as lack of funding, inconsistent leadership and people's resistance to change. Findings from the survey showed that, although advanced use and management of GIS could bring great benefits to local governments' operations and service delivery, the people issues are vital for its long-term success.

The importance of changing people's mind-sets is confirmed in the survey. Such changes need to happen to not only managers but also those who will be affected at the operational level. A good example found during the interviews was that bin collection routes in one of the surveyed councils had recently been redesigned with the help of advanced GIS analysis. The new routes are expected to cut the council's waste vehicle fuel bills by £400,000 a year based on the council's figure, as well as reducing its carbon footprint. However, the changes have caused disruption and chaos in some areas in the council. This is because a lack of consultation with the workers in the front line which leads to many bin workers not accepting the changed routes. Arguably, this change may bring long-term benefits to the council. However, this will depend on whether the bin workers will accept the new routes or not.

Lack of leadership, in terms of drivers from top management level, is also highlighted in the interviews regarding service integration, and transformation. Drivers coming from top of the management level are regarded as essential for horizontal service integration and service innovation by 70 per cent of interviewee. Furthermore, personnel changes in key posts were mentioned repeatedly in interviews and were thought to have a major impact on the development of GIS. It was also indicated in interviews that GIS development could be difficult without a long-term and formal GIS development strategy in association with an e-government strategy in local government.

Research synthesis
To further evaluate the framework and analyse the findings, a review was taken to synthesize the research outcomes with findings from other literature. In particular the review examined the implementation of GIS in the leading countries on the e-government development list of the UN (2008) report. Through the review, some good practices were identified and linked with the challenges highlighted in the study.

Compared to a former survey undertaken by Turner and Higgs (2003), there seems to be a big increase in the use of GIS in local councils, for example 57 per cent of surveyed local governments have corporate GIS databases up from only 20 per cent. All the local governments surveyed had certain data quality control mechanisms, for example, data custodians and metadata in place compared with only 50 per cent in the former survey.

However, it has been found from the interviews that many of these surveyed are still at the early stage of e-government development, from a GIS perspective. In general, there is a lack of an effective and efficient centralised GI management system. The results indicated that, although the integration of GIS with service systems across their organizations has been widened, the full potential of GIS to the organization, as an enterprise, did not materialize. Most of the interviewees (70 per cent) stated that GIS is mainly, if not solely, used as a tool to visualize the location of a subject, for example land parcels or property.

There are also issues regarding the integration of GIS with services for public access. Many local governments have developed web-based gateways (geoportals) for public as well as business use to find and access GI and associated GIS functions, for example display, editing and analysis of GI data. Most of the Geoportals have been developed in conjunction with redundant "warehouse" copies of live data sets as opposed to linking directly with live data sets (Beaumont *et al.*, 2005). Many usability issues are also found with regards to the Geoportals. These are discussed in the literature, e.g. the problem of bandwidth, the speed of computers on the client or server side, interoperability of data and functions, design of user interface and security and privacy issues.

Resistance to change, lack of funding and leadership are the main challenges highlighted in interviews in terms of barriers to a more extensive development of corporate GIS. Similar findings are also shown in other research. For example, Li (2008) found that GIS development in China's urban governance has been influenced not only by the instrumental functions of GIS technologies, but also by the interactions and relationships among different actors and institutions with various vested interests in the process of structuring and governing urban spaces. There is a fundamental training need for senior officers/managers in key departments of local governments to have a better understanding of the spatial analyses presented to them and how to use GIS to further modernise and innovate in their service section. Strong organizational commitment to citizen services further plays a significant role in the more sophisticated use of such a system (Chen, 2010).

Through the survey, there is clear evidence that service integration and transformation are taking place in local government in the northwest region. All local governments surveyed gave examples that show the use of GIS in service integration and transformation. However, many of them are just starting the development. In some cases such developments are preliminary and in a rather narrow and small area. Two surveyed local authorities are in the process of transforming current land search procedures from a paper-based to a fully electronic file-based system. This involves multiple departments across the authorities. The benefit of the development becomes more obvious for local government. In one of cases mentioned during interviews, a local government has generated significant efficiency savings in public housing management and maintenance services due to the innovation and moderation of the procedure with the help of GIS.

With regards to the financial problem highlighted in the survey, one possible solution for small governments was found in literature. That is to group together with others in their area to implement a GIS solution jointly. It was found that in Norway (one of the top e-government countries) even some of its smallest municipalities such as Iveland (with a population of 1,131), employ GIS on their web site and scored high in an e-government survey (Flak *et al.*, 2005). Clearly, small municipalities are unlikely to

have the resources to implement their own GIS systems. Employing commercial GIS software and using state cartographic data as a foundation, they have implemented a single web site, linked to and from individual municipality sites, in which geographic data from the region are displayed (Flak *et al.*, 2005). This is in line with the United Nations' (2002) suggestion that pooling of resources needs to occur for the development of e-government due to the cross-cutting nature of e-government.

A new trend in software development, "Software as a Service" (SaaS) or service-oriented architecture (SOA), could also help local government in developing joint GIS (Sun *et al.*, 2007). The concept is to deliver software functionality and/or data on demand as a service rather than redundantly housing the same software function or data resource in multiple locations. Small councils could group together for not only base mapping data, but also GIS services from commercial GIS vendors through the Internet. The approach helps local governments overcome barriers to offering next wave e-government services such as a shortage of skilled IT staff and limited financial resources.

A case study in the USA confirmed that drivers from the management level are indeed necessary for the long-term success of GIS in e-government development (Tsai *et al.*, 2009). The study also identified that the primary driver for initiating GIS projects was the awareness of the potential of new technologies by employees in local government IT departments. They would create an organization-wide focus group to initiate and direct the projects as well as providing the initial goals. Currently many of the projects are managed at department level without much formalized strategic corporate guidance. It is critical to provide and apply a formalized approach so that GIS technologies are enacted in order to be strategically aligned with the goals and objectives of the local government (Tsai *et al.*, 2009). This again coincides with the findings of our interview survey.

Conclusions

In recent years the focus has shifted to the evaluation of e-government development internationally. Despite some former researches, it is still an under developed area. As part of the development, advanced use of GIS in local government has attracted more attention from both scholars and local officials. However, such use is still facing challenges from different aspects in achieving the full potential of GIS. An evaluation framework can facilitate the categorization and contextualising of scholars' work in evaluating GIS development under the e-government banner. It is also helpful for politicians and other stakeholders to benchmark their initiatives and guide the further development and use of GIS in their organization.

The paper presents a three-stage evaluation framework which is designed to link the evaluation of GIS use with e-government development models. Two different models are chosen for this purpose. The three stages are namely infrastructure development, service integration and transformation. Each has its own challenges for local government in their implementation. The paper provides some criteria for the assessment of each stage and also makes suggestions with respect to these challenges.

The framework is tested in an empirical case study of local governments in the northwest of England. The study also explores the role of GIS in the development of e-government as perceived by a sample of GIS professionals and senior managers. Despite the relatively small scale of the study, it provides useful preliminary findings

and offers a starting point for further research in the area. It is clear from the study that GIS is seen as a very important technology for local government's modernisation. Among the surveyed local authorities, most of them have implemented GIS although for many the development is still at an early stage.

The key variables involved in the delivery of a successful GIS under the e-government theme can be summarised as "people", "process", and "technology". While technology is increasingly resilient and "fit for purpose" evidence from the study indicates that the success or failure of such development is less a technological issue and more a "people" issue. In particular the issue relates to the ability to change public service cultures and motivate public sector workers to new ways of thinking and working. In the same vein, trade union concerns need to be addressed and workers provided with adequate skills and competent management and leadership.

Findings of the study also indicate that it is critical to provide and apply a formalized corporate approach so that GIS technologies are enacted in order to be strategically aligned with the goals and objectives of the organization's plan on e-government development. It is found in the study that many local authorities are still facing challenges rooted in the first stage of the framework. However, there are increasing examples of developments in the later stages, that is, the service integration and transformation.

The interviewees consider the framework as useful in evaluating the development and use of GIS in local governments. The indicators for each stage of the framework facilitated the contextualization of findings in the case study and allowed more structured conclusions to be drawn. Its use could help officers in local governments to understand which stage of the GIS development they are in and learn from other real world cases. This may offer opportunities for staff to be able to address challenges they may face in each stage.

The research has some limitations which need to be addressed in the future. First a small sample of officers were chosen for the interview stage after the initial wide online survey. Therefore, the findings are indicative. Second, the people who agreed to be interviewed are more likely to have strong GIS use in their organizations. This certainly has an impact on the findings. In order to have a more robust and representative figure, a survey at a larger scale should be taken. Last but not least, more specific indicators related to the challenges faced by local officers could be added in each stage of the framework. This would aid benchmarking of GIS development and use in local governments.

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