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Knowledge management in urban governance; building adaptive capacity through ICT-GIS-based systems in the global South

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Abstract

Knowledge management (KM) in local governance processes is being transformed through digitization (ICT), spatialization (GIS), and participatory processes; the question is whether this increases the potential for building adaptive capacity and inclusivity. The question is linked to discussions on how knowledge construction and circulation can improve competences in local government, make urban planning more knowledge-based, and provide greater recognition of citizens' knowledge (accountability). Local governance networks need such instruments in building adaptive capacity, and in dealing with increasing complexity and uncertainty. By utilizing the results from extended case studies in six medium-sized cities in India, South Africa, Brazil, and Peru, all participating in the Chance2Sustain research network, we examine how uneven technological and organisational changes are transforming the ways in which local government works. Knowledge management in urban governance is configured through several issues: 1) discourses for digitizing KM in local urban development; 2) actor networks producing socio-spatial knowledge; 3) embedding KM in decision-making processes (power struggles, exclusion); and 4) influences of KM on work practices, interfaces with citizens, and organisational outcomes.

The results show that 1) KM discourses concerned four issues: strategic urban planning and integrated land use planning; geographic boundaries in urban development discourses; streamlining work processes, and mapping needs assessments; 2) initiatives mainly link government with the private sector; 3) codified and technical knowledge remain dominant in discussions on urban development; and 4) although efficiency is improved, transparency and accountability to citizens remain limited. Generally, KM is not used strategically for dealing with future complexity and uncertainty.

Key words: knowledge management, urban governance, digital systems, cities

Introduction

Recent discussions on urban development have given increasing importance to the role of knowledge construction, circulation and utilization (e.g. McFarlane 2011; McCann and Ward, 2011; Campbell 2012). Such discussions are set against the background of global urbanization, discussions on the extent to which cities draw on resources and contribute to economic growth, as well as environmental concerns.

Several debates deal with the issues surrounding knowledge. Most are dominated theoretically by urban contexts in the global North, leaving wide gaps in understanding how cities in emerging economies deal with knowledge management. As future urbanization will be concentrated in the global South, greater attention to changing knowledge management in cities there is needed (Robinson 2006). Several processes are currently transforming knowledge management: the expansion of information and communication technology infrastructure (ICT), the spatialization of information through the use of geo-technologies (geographic information systems, real-time monitoring with GPS), and interfaces with citizens through open-access platforms (e.g. Google Earth) (Pfeffer et al. 2015; Georgiadou and Stoter 2010).

In this article we raise the question of how the digitization and spatialization of knowledge management (KM) is transforming urban governance in six medium-size cities in India, Brazil, South Africa and Peru¹. Local governments need such instruments in dealing with the increasing complexity of their mandates, and in addressing social inequalities and economic growth, in a context of increasing environmental and economic uncertainty. This question fits into broader discussions on how urban governance networks can build their adaptive capacity through KM, improving their competences (efficiency and effective processes), and providing greater accountability to their citizens (cf. McCall and Dunn 2012; McCall, Martinez, Verplanke, 2014). The debates within which our question fits are discussed briefly here.

The first debate concerns how discourses on urban development and policy mobility develop. Such discourses have three main themes. The first focuses on changing mandates for urban local authorities, particularly the shift from managerial to entrepreneurial policies among local governments. The second focuses on how local governments can build facilities for middle classes and professionals, and implicitly discusses how to deal with inequalities and differing levels of urban citizenship. The third theme focuses on how knowledge travels in policy mobility, with the Internet potentially stimulating exchanges globally. The general debate is dominated by the global city networks research, where the substantive focus is on economic growth and providing facilities for middle-class lifestyles (Brenner 2004; McCann and Ward, 2011; Kennedy et al. 2011). Although social inequalities are recognized, discourses about informal settlements are usually negative, and policies focus on implementing ‘slum-free cities’ (Davis, 2006).

International city networks are seen as means for knowledge/policy mobility, incorporating various knowledge sources through networks of professionals across sectors, organizations and geographic locations (McCann and Ward, 2011).

This debate has several gaps. Emphasizing urban growth ignores urban inequalities and how to reduce them, although extensive poverty and informal settlements exist in Southern cities. In knowledge networks and policy mobility, there is an implicit assumption of universal access to the Internet and information sharing. However, access to information and knowledge provides power in policy-making, so that assumption is unlikely to be true (Baud and de Wit, 2008).

The second debate concerns the networks involved in managing and planning cities, and the knowledge produced and circulated in that context (transparency, accountability). A major concern is the actors who are involved in city policymaking, and their power to express their priorities. The discussion has focused on coalitions between local authorities and the private sector (regime theory); and relations between local state and civil society (e.g. Cornwall and Gaventa, 2001; Gaventa 2006). The main issue concerns the power that civil society organizations have in order to ensure that their visions of urban development and the needs of marginalized social groups are included. Deliberative processes have provided platforms for developing stronger forms of citizenship (Heller 2009). ‘Negotiated spaces’ facilitate discussions between urban residents and local governments, although the channels and degrees of power remain quite variable and differ for the middle class and marginalized residents (cf. Baud and Nainan 2008; Shatkin 2007). Such spaces provide platforms for bringing citizen-based contextual-embedded knowledge into political discussions within networks (Scott and Barnett 2009).

The third debate concerns how knowledge is built, exchanged, and contested in urban KM (cf. Harvey and Tulloch 2006; Kahila and Kyttä 2009). Current discussions focus both on how spatialized knowledge is produced and how local government is transformed through digitization. The former discusses how mapping processes incorporate specific points of views in their topics (Kitchin et al. 2013; Wood, 2012; Monmonnier 1991). It adds to our knowledge of concentrations of poverty, crime, health and environmental vulnerabilities (Baud et al. 2008; Martinez 2009; Pfeffer et al., 2012). The latter provides governments with the opportunity to streamline work processes and make their work more effective, and to be more transparent and accountable to the citizens (e.g. Martinez, Pfeffer and van Dijk 2011)².

Utilizing knowledge management for local governments is increasingly important in the face of future volatility in economic growth and possible shocks, expected impacts of climate change in the availability of basic resources (water, energy) and the complexity of such changes. It implies that building an adaptive capacity within local governments is quite strategic in order to deal with the issues above (cf. Peyroux et al, 2014; Hordijk and Baud 2011).

Configuring knowledge management in urban governance

This article concerns how knowledge management (KM) within urban governance is becoming transformed through digitization (the use of ICT) and spatialized through the use of geographic information systems (GIS). It focuses specifically on KM, in which local governments play a central role, both within government and in interaction with citizens. We examine how different types of knowledge are incorporated into governance processes (cf. Pfeffer et al. 2011; Hordijk and Baud 2011; McCall and Dunn 2012), as well as the extent to which spatial dimensions are included in such knowledge-building processes (e.g. GIS-based; maps, visualisations)³. Finally, we examine mainly digitized processes of knowledge management; hybrid KM systems, with several modes of interaction (mobile phones, internet, face2face) coordinated by municipal administrations (Richter 2014)⁴.

The main concept we utilize is that of a (spatial) knowledge management configuration with the following dimensions:

- 1) discourses about (spatial) knowledge management,
- 2) actor networks /coalitions producing and using spatial knowledge and their relations,
- 3) embedding knowledge management in decision-making processes (exchange and contestation),
- 4) changes in work processes and outcomes resulting from the use of spatial KM.

We are specifically interested in the introduction of digitized information, electronic platforms, and GIS-based systems in local government, and to what extent digital KM activities are linked between line departments (water, town planning, public works), and interfaces with citizens⁵. We see the production of knowledge as a relational process, where power, internal capacity, competency issues and external competition may hinder knowledge exchanges (e.g. Giezen, 2012; Healey 2007; McFarlane 2008). We use the term ICT-GIS-based for various products based on new modes of communication (internet, mobile phone) and/or which have a spatial dimension (geographic location, visualisations).

This paper presents the results of six extended city case studies, carried out within the Chance2Sustain project⁶. The case studies utilized the research dimensions above, for which data was collected by national research teams through structured and informal interviews with key actors⁷. The full reports of the case studies are available online at the EADI-Chance2Sustain website (<http://www.chance2sustain.eu>).

In comparing ICT-GIS-based knowledge across cities we consider the specificities of their historical contexts in order to provide “nuanced, complex, contextual accounts” (Robinson, 2011). Using the relational concept of comparison means that we do not measure our ‘cases’ against a universal yardstick, but “consider both similar and different urban outcomes” (Robinson, 2011: 13). Below, the six cities are briefly set in their context (Table 1).

Table 1. City contexts of case study locations

City	Main context features
Callao, Peru	Mandatory concertación processes ⁸ Pro-growth & pro-poor agenda Strong concentration of industrial-service sectors in region High level of urbanization Social inclusion and public participation Institutional restructuring – improving local capacity City within Lima agglomeration
Cape Town, Durban, South Africa	Post-apartheid transformation – legislative and policy reform Pro-growth & pro-poor agenda Institutional restructuring – lack of capacity at local level Spatial restructuring (in Durban- inclusion of large peri-urban area post-2002) Excellent financial management Good record of service delivery Deeply entrenched spatial inequality High level of urbanization
Guarulhos, Brazil	High level of urbanization High economic activity – services and industry Spatial inequality and segregation Pro-growth & pro-poor agenda Social inclusion and public participation Institutional restructuring – improving local capacity Spatial restructuring – inclusion of peri-urban/poor areas Good financial management Good record of service delivery
Kalyan Dombivili, India	Peri-urban city in urban agglomeration – high level of urbanization Pro-growth & pro-poor agenda Spatial inequality between Kalyan and Dombivili Municipal boundary restructuring Institutional restructuring – improving local capacity Entrenched financial management Improving service delivery but still uneven Pioneer in e-Governance
Chennai, India	Metro-agglomeration and major port driven by IT-BPO and car industry Acute water, electricity and mass transport shortages Corporation area expanded Pioneer in e-Governance Online bill & tax payment

The following sections set out the case study results by configuration dimension.

Discourses/rationales for introducing ICT-GIS-based spatial knowledge management

Several discourses were used as rationales for the introduction of ICT-GIS-based KM in local governance, linked to how local governments work in their specific contexts. They relate to four issues:

- a) Strategic urban planning and integrated land use planning;
- b) Determining geographic boundaries as a pre-condition for more effective planning and urban development discourse;
- c) Streamlining work processes of local governments and relations with other levels of government, citizens and the private sector;
- d) Poverty/needs assessment, mapping and location of facilities (Table 2).

Table 2. Rationales for introducing ICT-GIS KM systems

	Strategic urban planning/ integrated land use planning	Determining geographic boundaries;	Streamlining work processes LG	Poverty, needs assessment & location of facilities ⁹
Callao	x	x		
Guarulhos	x		x	x
Durban	x	x		x
Cape Town	x	x		x
Kalyan			x	x
Chennai		x	x	x

X= this rationale was found in the city concerned

Strategic urban planning and integrated land use planning

A first rationale for using ICT-GIS-based KM concerns strategic urban planning and integrated land use planning. This was found mainly in the South African and Peruvian cities, in contrast to India where this discourse was largely lacking (Table 2)¹⁰.

In South Africa, after the 1994 change of government, a transformative vision was developed of a reduction in the existing spatial segregation and in the inequalities linked to apartheid policies. Now, urban strategic planning by local and provincial governments includes a strong spatial perspective, in which the Spatial Development Framework provides guidance for future urban development (Watson 2002). In Durban and Cape Town,

strategic urban planning utilizes the notion of the ‘compact city’, where high population density facilitates the building of facilities and services, and a spatially defined ‘urban development line’ limits the area where the full range are provided. In Cape Town, the ‘coastal edge’ added to the recent spatial development framework (SDF, 2012) demarcates coastal zone areas with environmental risks, and limited future development. Strategic planning in South Africa has also started to include discourses concerning competitive, managed cities through the Growth, Employment and Redistribution (GEAR) policy, with a greater market influence on spatial forms. Examples are the “private-sector-driven, up-market, commercial and residential” gated developments such as the aerotropolis in Durban and Century City in Cape Town (Harrison et al., 2009: 139).

Integrated land use planning involves processes in which geo-referenced databases from different sources support policy choices (found in Cape Town, Durban, Callao, Guarulhos, and Chennai). In each case, different actors and processes are involved.

In Durban and Cape Town, urban spatial planning was revolutionized in the 1990s by the linking of digital databases and maps, and the provision of fairly up-to-date maps which showed the spatial spread of urban phenomena, and assisted in decision-making.

In Peru the regional government of Callao works on the integration of land use planning together with several municipalities bordering Lima city and including parts of the Lima metropolitan region¹¹. It is a leader in developing ICT-GIS-based KM systems for local governments, and in integrating regional planning based on three knowledge processes; spatial planning, determining boundaries, and specific reports on issues of concern. For spatial planning, documents are prepared collectively by the Callao regional government, working with line departments of its government, local governments, NGOs and knowledge institutes (MIP) in a *concertación* process¹². Delineating boundaries in a common database was a precondition in making planning feasible and in reducing contestation. Publicly accessible reports on specific topics provide a deeper understanding on specific issues and can be used as a basis for decision-making.

In Guarulhos, Brazil integrated land use planning has been a major municipal concern. They collect, organize, and analyze (spatial) data to inform their urban development policy, which has attracted municipal investments to peri-urban and poorly serviced areas for greater social inclusion. Although Guarulhos is the second largest municipality in the state, it remains a small player in the SP metropolitan region¹³. Its Development Plan 2004 defined five geographic zones, setting out broad terms for economic development, environmental protection and social responsibility. A new development plan translates those terms into concrete issues; utilizing improved data production and administrative modernization. The result is that discussions between government departments, professional associations and private sector interests in the city are now based on reliable figures.

Determining municipal boundaries

A second discourse concerns how boundaries for urban development strategies are established when KM is digitized and spatialized. Boundaries (of plots in the city) have to be established more accurately when linking databases to base maps in GIS for city planning.

In South Africa the establishment of physical boundaries is a much-contested process and includes extensive public participation. In Durban the redrawing of municipal administrative boundaries was part of the post-1994 spatial restructuring, and brought marginal areas into larger municipal entities to reduce the effects of spatial segregation (Durban became the eThekweni Municipality). The main idea was that changing municipal boundaries would facilitate cross-subsidization and smooth out inequalities. The new boundaries were integrated into databases and base maps for the planning of urban developments, and the results from the 2002 Census allowed the systematic mapping of existing urban inequalities.

In Peru the precise demarcation of boundaries between municipalities in the constitutional province of Callao in preparation for the ICT-GIS system was a pre-condition for current spatial planning processes, which are directed towards ecological economic micro-zoning and the spatial management plan. Currently, the provincial government is working with the municipalities to develop background reports for further detailed planning processes linked to major issues in the area.

City boundaries are also redrawn by economic expansion which occurs through or despite city development plans, which exist in all case studies¹⁴. However, where economic growth is fuelled by private developers, city borders are changed as governments come to terms with the new status quo. In Chennai, India where the 'IT corridor' south of the city has dominated economic growth, city borders were extended in 2011 by the state government to include large parts of the southern corridor, ensuring that the substantial revenues from the included areas would go to city government.

This discussion shows that digitizing spatial knowledge on boundaries requires more accurate, up-to-date and non-contested information to support urban planning and development. Whereas SA had the instruments in place at a sophisticated level, these had to be developed in Peru by initiatives at the provincial level, and Brazil and India are still in the process of being developed at local levels¹⁵.

Work processes in local government: Administrative efficiency and effectiveness

A third discourse on the introduction of digitized and spatial knowledge concerns improvements in efficiency and effectiveness. This discourse is very strong in India, where the focus of e-governance initiatives has been designed to improve work processes in order to enhance access and delivery of government services to citizens, employees and the managements of urban local bodies, while aiming to strengthen effective governance

and increase transparency (JNNURM, Mandatory primer 1, e-Governance, ULB reform, n.d.). The lack of accurate and up-to-date databases, among other issues, has hampered urban local governments in India from having efficient and effective revenue collections and from being able to monitor developments in their cities; this lack has prevented residents from exercising their citizenship rights effectively and has allowed informal (corrupt) practices to become extensive (Roy 2009). Initiatives for digitization and spatializing information within local government have been very uneven in Indian cities; our case study cities Kalyan Dombivili and Chennai were early innovators.

Poverty and needs assessment mapping and locating facilities

Cities have also used digitized and spatialized knowledge to map deprived areas in order to rationalize budget allocations to those urban areas with the most pressing needs; a rationale found in both Durban and Cape Town in South Africa. The Infrastructure Branch of the eThekweni municipality has developed a composite deprivation index to analyze the spatial concentration of deprivations, and developed two GIS models as tools for strategic decision-making: the ‘Access to Services’ model and the Cost Surface model¹⁶. Both tools provide basic spatial information for decision-making on the location of infrastructure. The models reduce unit costs in promoting a compact city, help determine facility prioritization for informal settlements, and reduce political pressure on location choices. This model is now used in decision-making in both cities, and in Cape Town more integrated decision-making processes across municipal line functions are being promoted.

In India a national programme for urban poverty reduction and slum eradication (RAY), incorporates GIS-based slum mapping in its procedures. The plans are intended to be participative and involve residents and NGOs/CBOs in guiding community mobilization activities for Slum Surveys, data validation, and slum-level redevelopment/ upgrading models. In practice, slum mapping in pilot projects is currently done by consultant firms. In Chennai slums in five zones were surveyed, but the survey met with resistance from residents, who have little faith in such processes (Sekhar, Hindu, December 15, 2012)¹⁷.

Actor networks producing and using knowledge

This section discusses the main actor networks that are building digital and spatial knowledge management configurations. In our case study cities the main actors are government departments at different levels, working individually or with hybrid networks (Table 3). They mainly work closely with private sector companies. Cooperation with universities as knowledge institutions is less institutionalized. Urban residents are only recognized as knowledge producers in consultation processes and in feedback processes to local governments.

Table 3. Actor networks in producing ICT-GIS initiatives

Case study cities	Local/ government levels	Private sector	Universities	Citizens (NGOs)
Callao	x (regional)	x		x
Guarulhos	x	x	x mainly in environment	not integrated with municipal
Durban (eThekweni)	x	x	x (MoU)	x
Cape Town	x	x	x(African Centre	X
Kalyan Dombivili	x	x	x (technical advice)	x (e-grievances)
Chennai	x	x	x (technical univer-	

In Peru the Callao regional government (Constitutional province) has established a strong regional network with local municipalities, the private sector and NGOs, and works with other actors in exchanging knowledge through online information systems concerned with regional and local issues (concertación process) in an inclusive manner.

In Guarulhos, Brazil local government is spatializing and digitizing information, and has informal links with a university for environmental issues. The national spatial data infrastructure (INDE) sets out the context and the national bureau of statistics (IBGE) provides socio-economic data and map layers for local government to produce GIS-based maps.

The City of Cape Town has widened its network by working with the African Centre for Cities (ACC). A series of ‘city labs’ facilitate engagement between academics and city officials. Durban Municipality has recently started working with its University (UKZN) and allows academics to undertake applied research with municipal officials on projects which benefit the city.

In India Kalyan Dombivili was an early innovator in promoting e-governance (1999) and is now a model for other local governments in Maharashtra. Although local government is the initiator, they work with private sector companies who are very influential in determining the level of expertise implemented by local government.

Local government in Chennai initiated an integrated digitization project with a private company in the late nineties. However, the complexity of the project led to it being scaled down after several years. Recent initiatives to link local government, development authorities and state government departments in one network to develop integrated ICT-GIS systems were also not successful.

Knowledge exchange and contestation

A basic rationale for digitizing and spatializing knowledge is the opportunity to exchange and coordinate it for more effective local governance. However, the extent of equal access and the contestation of knowledge are issues of concern.

The results showed a lack of knowledge sharing among municipal departments, which limits the possibilities of integrating the mapping of issues for strategic urban planning (e.g. such as is used in Callao and Durban). In Durban data files are held on a central server and are shared by line departments; each department can build on this central database with data relevant to their own function. In Callao a similar regional infrastructure provides information across municipalities. In Guarulhos a joint municipal geo-portal is being developed for limited data exchange between departments. In India the majority of projects are cocooned within their own organization and within a GIS department. In Kalyan Dombivili the lack of information shared between municipal departments means that the opportunity of integrating information on social policy, environmental issues and revenue collection is lost.

Secondly, results showed that exchanges can be limited and contested when local governments use the private sector as consultants. In Kalyan Dombivili private consultants can analyze the data and prevent such capacity building among municipal staff. In Durban influential GIS consultants are commissioned to analyze spatial data and provide the ability to use knowledge to a greater advantage.

Thirdly, staff in various organizations can undermine the potential transparency of such systems. This particularly applies in situations where KM provides monitoring systems of payments by urban residents, and staff input records of such payments. Existing forms of corruption are threatened by ICT-GIS, and therefore their introduction and correct use is resisted. Audits of e-governance in KD and Chennai have signalled such issues.

Fourthly, there is a limited input of community knowledge. In Durban and Kalyan Dombivili (middle-class) residents provide feedback through digital grievance systems (Martinez et al 2011). In both localities input from poorer communities is limited as it is filtered through councillors who represent communities in participatory processes. That system remains vulnerable to political manipulation. The fifth issue is whether GIS provides valid and reliable knowledge for decision-making. In Durban the Infrastructure Unit promotes GIS as 'objective' knowledge which allows facilities to be located and the prioritizing of service provision free from political influence. However, such databases need to be validated. This includes the validity of indicators used, the reliability and accuracy of data input, and the regular updates of data inputs¹⁸.

Conclusions: effects of using spatial knowledge management (SKM) for urban development

In conclusion we come back to our main question of how knowledge management (KM) within urban governance is being transformed by digitization and spatialization, and its effects on urban development strategies. KM configurations consist of several dimensions: 1) the discourses around digitized KM and types of information/knowledge acknowledged; 2) the networks of actors producing socio-spatial knowledge; 3) the embedding of KM in decision-making processes; and 4) the effects of KM on work practices and outcomes.

The discourses for introducing ICT-GIS based knowledge management were many and varied, including cities, organizations and their mandates. The discourses concerned four issues: strategic urban planning and integrated land use planning; determining geographic boundaries in urban development; streamlining work processes of local governments, and mapping poverty and needs assessments. This suggests that in the South the main rationale for using digitized and spatialized knowledge is focused on gaining firmer control of complex urban development processes, by establishing non-contestable boundaries and expanding urban land use planning databases. This focus is strategic for future economic growth, but also provides possible inputs for prioritization in improving basic services and reducing inequalities. Importantly, knowledge management was geared towards increasing government competences in raising revenues, reducing corrupt work practices, and improving management information systems.

The actors generally recognised as producing knowledge in urban planning and management are mainly governments working with the private sector. Initiatives are national, local and regional. The strongest networks in the development of ICT-GIS initiatives are found between local government and the private sector. However, the technical expertise of the private sector means that their power over local government is strong, and likely to grow, as the ‘smart city’ discourse requires technical expertise outside local government competencies. Links with knowledge institutes and civil society organisations in developing knowledge management are weaker.

The main sectors in which ICT-GIS based knowledge management was introduced concern strategic planning, tax assessment and collection, and locating facilities. Some initiatives for greater interaction with urban residents were found; an increased access to administrative information through websites and through grievance feedback systems. However, these were mainly used by middle-class residents; low-income residents still work through political representatives.

Generally, spatial knowledge platforms and mapping products are strongly dominated by experts using and producing codified and technical information products. This information is positioned as objective, but is occasionally contested. Several examples of civil society initiatives in building ICT-GIS-based knowledge platforms and databases were found in the city case studies (see Pfeffer et al. 2013). In addition, more deliberative processes in Lima show that creating ‘spaces’ for more interactive processes contributes to mutual knowledge building (Miranda Sara, Pfeffer and Baud, 2016). Also the regular interaction in Durban between citizen initiatives and city experts leads to exchanges of information and mutual knowledge.

Knowledge exchange remains a difficult issue. Even within government, knowledge does not travel well between departments and different levels of government. Knowledge sharing is scarce and in some contexts there is active resistance to the digitizing of internal databases due to the fear that greater transparency and control will reveal incompetence

and corruption. However, some initiatives are being undertaken in this area. Knowledge exchange and feedback from residents is usually limited and confined to strict guidelines. However, counter-mapping issues elsewhere are opening up through NGOs (e.g. Chegado.com in Argentina, Ushahidi in Africa).

The main conclusion is that building ICT-GIS based knowledge management configurations is very uneven across cities, sectors and countries. Although a variety of rationales exist for doing so, related to discourses on urban growth, effective urban management, and reducing inequalities, a great deal of effort is still needed to implement digitized and spatialized knowledge management in such a way that it includes a range of knowledge – including from citizens - effectively used in urban planning and management in many cities in emerging economies.

This means that the adaptive capacity of local governments is still limited as they lack the full range of databases over time to support longer-term urban development strategies, and do not yet have interactive processes in place, which would provide more community-embedded knowledge for future decision-making.

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Notes

¹ This article is a shortened and adapted version of the Baud et al. article in *Habitat International* 2014, entitled “Digital and spatial knowledge management in urban governance: Emerging issues in India, Brazil, South Africa, and Peru”.

² Major questions within this debate are whether the digitization and spatialization of information and knowledge empower citizens (transparency and accountability) or whether such tools increase levels of surveillance (Prins, Broeders and Griffioen 2012).

³ For a definition of tacit, codified and contextual-embedded knowledge, please refer to van Ewijk and Baud (2009) and the literature review of WP5 (Baud et al. 2011).

⁴ “About 60% of the Indian population have mobile phones, but there are only about 2 million active users of mobile Internet services – less than 0.1% of the population.” (Wright et al., 2010: 8).

⁵ The introduction of ICT-GIS-based KM systems influences work processes and interfaces with citizens in planning processes, administrative processes, interactive processes which provide feedback from citizens, and in the CSO-based construction of community knowledge (cf. Pfeffer et al. 2012).

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⁷ In addition, post-graduate students carried out 2-3 months fieldwork concerned with similar topics in the various cities.

⁸ Concertación is the process in which stakeholders work together toward final outcomes.

⁹ In Peru this is done at the national level and provided to local governments.

¹⁰ In Chennai the Development Authorities have their own GIS section, which provides maps for the Master Plan.

¹¹ This area is strategic in terms of economic activities (harbour, airport, industry), as well as environmentally important (coastal zone), with higher levels of immigration than elsewhere.

¹² They include the report on delineating and determining territorial boundaries in the Constitutional province of Callao, zoning for spatial demarcation, the organization of the district of Ventanilla, and reports on human settlements (Mercedes Mi Peru, Porcino Park project, a report on all settlements in Callao, and one on hazards in human settlements in Callao province).

¹³ This is the result of the size of the city of Sao Paulo itself, as well as of the institutional challenges to the orchestration of action plans by a metropolitan body.

¹⁴ In Kalyan Dombivili the CDP of 2011; in Chennai the 2009 CDP Review; in Guarulhos the Macro-zoning plan of 2004; in Durban the Spatial development Frameworks in 2002, 2008 and 2011; in Cape Town the SDF of 2012.

¹⁵ In India in particular the establishment of land boundaries is an ongoing process with high levels of contestation (Collabland, p.c. NIT-Chennai 2013).

¹⁶ The 'Access to Services' model models the supply of and demand for social facilities across the Metropolitan area and is able to predict the future social services requirements for housing. The 'Cost Surface' Model predicts the cost of servicing any piece of land in the city.

¹⁷ This programme was discontinued by the new Modi government in 2014, and was replaced by the Smart Cities programme.

¹⁸ In India eligibility for food subsidies is determined by households' 'below the poverty line (bpl)' status, determined both by political access as well as income levels. Databases on bpl households therefore reflect a set of mixed criteria, making them invalid for poverty mapping.