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# Territorial Governance, E-Government and Sustainable Development Policy: A System Dynamics Approach

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**Abstract.** The goal of this paper is to demonstrate how system dynamics modelling can be used in e-government policy and systems as an aid to support territorial analysis, planning and governance, sustainable performance in urban areas and the assessment of policy outcomes. Topics such as renewable energy, efficiency, the design and exploitation of urban energy, water and waste management infrastructure and the alignment of different stakeholders provide relevant fields of study for the analysis of this paper. Specifically, we reflect upon the way in which a preliminary dynamic performance management model of an exemplary case study can be used to foster a common shared view among different policy makers as a way to highlight new ways to enable sustainable development in urban areas.

**Keywords:** territorial governance, e-government, sustainable development policy

## 1 Introduction

Territorial governance is an important element of the many complex challenges the world faces today. These include: sustainable development, adaptation and mitigation to climate change, rapid urbanization, growing food and energy insecurity, increased natural disasters, etc. [1]. Good territorial governance is typically seen to be supported by the development of e-government policies and systems at the state, regional and urban levels [2, 3].

Sustainable development in metropolitan regions in Europe and around the world is generally measured in terms of both being part of a global economic network (i.e., for instance, in relation to the proliferation, spread and emergence of transnational corporations) and generating a strong public service making the urban territory more attractive to international knowledge, technology and innovation [4, 5]. The former are considered building blocks of a sustainable innovative economy, a strategic resource in the urban territory, which is tightly related to public sector reforms. Such features are critical factors since the design and development of present and future e-government policies and systems is seen as the key locus of innovation in the public

adfa, p. 1, 2011.

sector [6], in order to enable the enhancement of performance management in government organizations, and specifically in urban governance and sustainability [3, 7, 8].

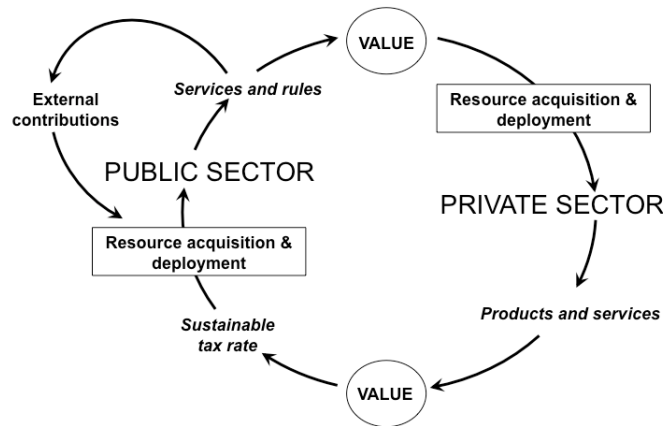
Implicit in this world-wide programme of e-government, found in countries of all levels of development, is a strong sense of managerialism, with e-government often seen as an essential part of a necessary process of reforming and reshaping management practices in the public sector, especially in projects and reforms which will establish accountability systems, increase transparency and reduce corruption [2, 18-20]. Earlier studies of system dynamics (SD) have been developed to map the dynamic complexity related to e-government policies [9-11]. SD has also been used to explore the core capabilities of local governments as key-factors to exploit the benefits of digital government [12]. It has also been applied to model stakeholders behaviour, learning, knowledge management, inter-institutional dynamics and citizens trust in e-government policy initiatives [13-17]. Yet the evaluation of territorial governance policy on the performance of urban areas requires a more nuanced methodological approach. One where the contextualisation of the systemic geography of a city and its critical institutions [2, 21] are considered in order to understand the nature of innovation dynamics in urban regions, in terms of sustainable development. Though urban studies are a tradition in SD literature [22], to our knowledge, this is the first paper to propose a dynamic performance management system applied to territorial governance, e-government and sustainable development.

E-government policies and systems within the scope of this paper address sustainable development, innovation and economic growth in urban areas and the state's spatial development plans (including state infrastructure for water, energy and waste management), metropolitan and regional policies and other governmental interventions and activities such as in the environment, housing and energy efficiency. However, it can equally be of relevance for tourism, health care, education, crisis management, disaster management as well as for the participation and interaction with the citizens in the creation and re-creation of the city's landscape (also in the politics of urban planning).

The exemplary case study of Hammarby in Sweden was chosen because of its advanced programmes and achievements in the key areas of study of this paper, namely territorial governance, e-government, sustainable development and urban environmental performance. Hence, how can e-government support territorial governance and the coordination of sustainable development policies across different urban organisations and stakeholders? How can we use SD to design a dynamic performance management system, which can: a) outline key performance drivers of sustainable development, and b) enhance a common shared view among policy makers about sustainable territorial performance (i.e. sustainable development and good urban governance)? The following section reviews the literature on territorial governance, e-government and sustainable development. Next we address the use of SD in the assessment of urban performance for sustainable development. Then we present the exemplary case-study of sustainable development, e-government and eco-cycle modelling in Sweden. Conclusions follow a discussion of the agenda for policy performance management in sustainable urban development.

## 2 Territorial Governance, E-Government and Sustainable Development

Addressing and being prepared for climate change is a key policy priority in Europe. Both the Lisbon Agenda and the EU Strategy 2020 are calling for measured and targeted improvements in urban environmental sustainability, emphasising specific methods and clear performance objectives. These include the rapid ratification of the Kyoto Protocol and the introduction of the Energy Performance Building Directory in the European region, an energy taxation directive adopting environmental liabilities for building owners, stressing the sustainable use of energy within a new regulatory framework. Therefore, one of the most important challenges faced by metropolitan regions and municipal governments globally is to identify and support policies, systems and dynamics leading to good territorial governance and sustainable development in view of climate change.



**Fig. 1.** A systematic framework embodying both the public and private sector: value generation as a focus for assessing performance and a prerequisite for information flows in sustainable development policy.

van der Molen and Wubbe [23] highlight the importance of urban e-government policies and systems when the public administration, private sector and citizens decide on issues where the spatial component is one of the determinants of decisions, such as when there is a need to access relevant spatial information, and could contribute in a meaningful way to the process of spatial decision making. Without these digital facilities, modern governments cannot understand the built environment of cities, manage land efficiently, utilize computer capacity to assist policy making, or retrieve significant value out of land. In the latter circumstances the value that can be considered important for good territorial governance would be safeguarding the reliability, availability, access and use of spatial information, which can be used in e-governemnt for the fulfilment of societal objectives, sustainable development and climate policies [24]. Gathering and compiling such information, beyond the public sector policymaking and decision making processes, would encompass industrial activities, small and

medium sized enterprises and many complex relationships between the political and the organisational systems in the public and private sectors [25].

Figure 1 shows public and private sectors dynamics, and how the rules underlying the survival and development of both sectors lie behind their own capability to generate value, to promote sustainable development. Figure 1 also shows how public sector performance does not only provide feedback under the form of taxes and financial contributions from the community receiving a given set of services, but also in terms of external contributions and, we would add, the same applies to information flows in sustainable development policies. So, the private sector feeds back to the public sector: public opinion is primarily affecting the political level, and income primarily affects the funds that the public administration will be able to raise through taxes and other sources to provide the administration level with resources to afford public expenditures. This, we would add, happens increasingly via specific programmes of modernisation and informatisation of the public sector (commonly referred to as new public management [19, 26] and often noted in e-government initiatives [19-23].

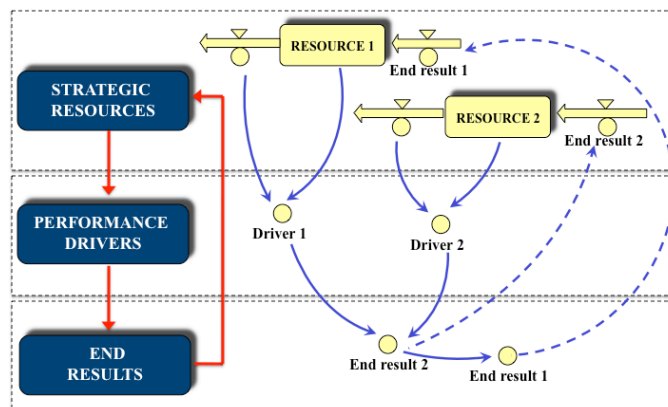
However, recently the same argument has extended also to the possibility to foster sustainable economic development and the aversion of climate change through policy making and regulation, the promotion of investments, purchases and employment, and by implementing ambitious modernization programmes for the delivery of public services (i.e facilitating creative interaction between universities, scientists and researchers on the one hand and industry and commerce on the other driving technology transfer and innovation) [3]. Yet there is no clear comprehensive or holistic methodology in place about how to enhance performance management, monitor and assess progress towards sustainable territorial performance in urban areas via the parallel improvements in public sector innovation and in the implementation of EU policies and guidelines [1].

### **3 A Dynamic Performance Management Approach to Enhance Sustainable Development in Urban Areas**

According to Bianchi & Riverbank [33] one possible avenue to enhance performance management in the public sector is the application of system dynamics, where modelling organizational systems and simulation techniques are used for understanding the behaviour of complex systems. The advantage of using this approach is placing performance measures into the broader context of the system, responding to the reality that even simple policy and process changes to impact specific outputs and outcomes are not likely to be that “simple” in organizations [35]. The main focus is on the wider system, and policy implications for each player can be taken by the light of the responses that the observed system’s behaviour is likely to give, as a consequence of changes in its structure.

If one takes the point of view of each decision maker on behalf of whom a SD model is developed, such a perspective could be defined as ‘external’, since it does not primarily reflect the observation point of a specific decision maker [16]. A critical tipping point in managing organizational and territorial (inter-institutional) performance

is associated to the capability of policy makers to: a) identify those strategic resources which most determine the success in the environment (i.e. competitive and social systems) where an organization or different organizations operate; b) insure that the endowment of such resources is satisfactory over time; c) keep a proper balance between the different relevant strategic resources. SD can then be used to enrich performance management in local government, focusing specifically on how the development of conceptual and simulation models can foster a common shared view of the relevant system among stakeholders. This implies that the number and range of stakeholders involved in making decisions influencing strategic resource dynamics — and, therefore, the relevant system’s performance and feedback loops — are often located in several organizational units and institutions in a given territorial area.



**Fig. 2.** A dynamic performance management view.

Figure 2 illustrates how the end-results provide an endogenous source in an organization to the accumulation and depletion processes affecting strategic resources. End-results that most synthetically measure the overall organizational performance are flows affecting the accumulation of corresponding strategic resources that cannot be purchased. These are: 1) resources generated by management routines, and 2) financial resources [33]. Figure 2 also highlights that performance drivers are a measure of factors on which to act in order to affect the final performance. For instance, if related to an end-result such as the number of new business initiatives undertaken in a urban area in a given time span, corresponding performance drivers could be associated to the (financial and socio-political) perceived stability of a region, and to the perceived transparency and promptness of the public sector (e.g., in terms of authorization protocols or supply of various services, such as those related to security, transportation, social assistance, housing).

In order to affect such drivers in the desired direction, each decision maker must build up, preserve and deploy a proper endowment of tangible and intangible strategic resources systemically linked each other. The growth of a single organization and of a territorial community (like a urban area) embracing different institutions can be sustainable if the rate at which end-results change the endowment of corresponding stra-

tegic resources is balanced. This implies that each institutional decision maker is able to increase the mix of strategic resources and that this increase is not obtained by reducing the endowment of the wider strategic resources in the territory [33].

#### 4 The Case Study: Sustainable Development, E-Government and Eco-CycleModelling in Sweden

We now describe the case study of Hammarby [36], a district of Stockholm in Sweden, including how specific territorial governance policies, e-government systems and dynamic performance measures were used to promote urban development and environmental sustainability. Our goal is to show how a systems approach can help public officials move to good territorial governance and performance and identify several possibilities of how SD can be used to improve territorial performance in terms of sustainable development.

Hammarby is an admirable example of urban transformation, demonstrating the potential of sustainable development policy and eco-cycle modelling in the dynamic performance assessment of the interaction between different urban processing systems. Formerly a run-down part of town in Stockholm’s industrial area affected by heavy pollution problems, it become an environmental role model in less than a decade. The city council developed the eco-cycle model to integrate environmental results with strategic planning. An ambitious programme to recycle all waste or waste water to turn into renewable energy was introduced to efficiently use the resources required by households (fig. 4).

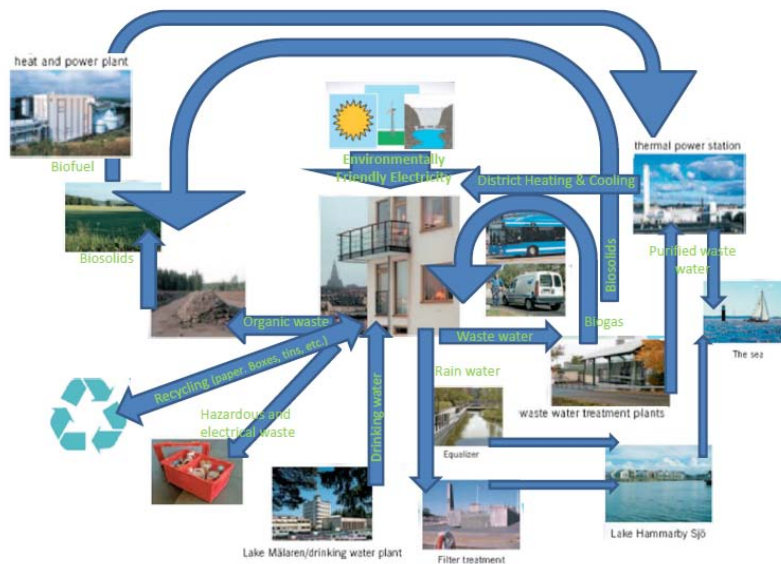


Fig. 3. Hammarby’s territorial management model.

The initial success of the Hammarby model to bring forward the priorities of integration of urban sustainability, information and communication technology and energy efficiency led to the recent establishment in 2011 of a Minister for Information Technology and Energy within the Ministry of Enterprise, Energy and Communication. Coordinating various former individual policy makers and institutions, the ministry is a notable example of how territorial governance and e-government can support the coordination of sustainable development policies across different urban organisations and stakeholders.

A preliminary territorial dynamic performance management model is presented in figure 5.

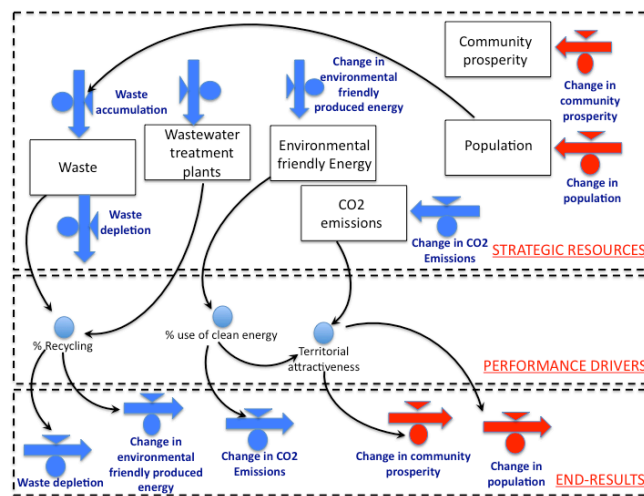


Fig. 4. A SD insight model portraying Hammarby's territorial performance

The figure shows how the outcome indicators to take into account in order to monitor the effectiveness of adopted territorial policies in the investigated case-study, can be referred to two different sequential levels. On the one side, waste depletion and the change in environmental friendly produced energy are specific end-results for the project. They allow decision makers to affect waste accumulation and the stock of environmental friendly produced energy. Such end-results are affected by the recycling % (i.e. the ratio between recycled and total waste). Such driver is, in turn, affected by the investments in wastewater treatment plants (strategic resource) and by the stock of waste.

Figure 5 also shows how the stock of environmental friendly produced energy affects a second critical driver, i.e., the % use of clean energy. This driver, on the one side affects the change in CO2 emissions in the territory (i.e. a third end-result); on the other side, it directly affects the territory attractiveness (i.e. a third performance driver). In fact, a higher % of clean energy produced in the territory will not only affect the environmental pollution levels, but also will directly generate less expensive available electric power available for the different players in the territory.



The ultimate effect (i.e. the outcome) of the described policies can be related to the effect of territory attractiveness – other things being equal – on community satisfaction (prosperity and wealth) and on the stock of population. This set of outcome measure is likely to play a quite counter-intuitive behaviour in the urban area. In fact, on the one side a higher achieved community prosperity will sustain more investments to foster the described policy. This might also imply a stronger and wider level of participation by several decision makers from different public/private sector institutions. This would indicate a higher level of trust and cohesion in the territory. Therefore, such first effect of the policy would underlie a growth-oriented reinforcing loop.

The role of e-government policies and systems in the production of the results described above is not the least important. As early as 2001, the Swedish government appointed a forum for ICT and the environment, under the then Minister for the Environment. Work was implemented in a working group consisting of representatives from industry, research, the Swedish Environmental Protection Agency (Swedish EPA), ministries and environmental organisations. Members of the group and its secretariat staff were recruited from both the private and the public sector [38, 39].

According to a 2007 Swedish Country Report to the International Council for Information Technology in Government Administration [37], the following three emerging e-government trends were reported from within Sweden: a) the traditional reliance on independent individual agencies is complemented with a reliance on functional ‘agency federations’; b) The Swedish national agenda becomes more and more intertwined with the agenda as an EU Member State; c) The new (Autumn 2006) Government is signaling more emphasis on joined-up issues and an extended eGov portfolio for Verva, an Administration Development Expert Agency.

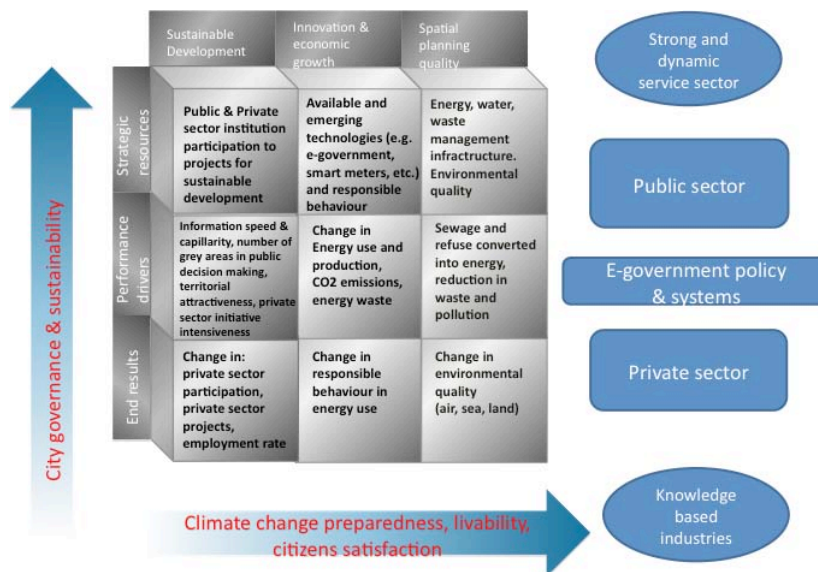
Hence, while Hammarby’s vision was being implemented by the municipal government of Stockholm all Swedish government agencies were preparing to move from an agency centric mode of information production and management to a service oriented architecture to offer their information vault capabilities ‘as a service’ [40] increasing private sector initiative intensiveness and projects fostering information transparency and capillarity. Various cooperation projects were implemented between the government, public authorities and the construction industry [39]. And finally a number of successful best practices have emerged from the private sector (especially in knowledge based industries), substantially increasing projects and initiatives also in traditional sectors like buildings, transport and logistics – overall increasing the attractiveness of the territory and creating new professional profiles, job opportunities and employment.

## **5 Towards an Agenda for the Evaluation of Urban Performance and Sustainable Development**

Figure 6 illustrates the building blocks of territorial performance, sustainable urban development and the role of e-government policies and systems. The end-results of the exemplary case study presented in this paper can provide an endogenous source in

the urban territory to the accumulation and depletion processes affecting strategic resources for sustainable development. These can be outlined in terms of climate change preparedness, liveability and citizens' satisfaction. In fact, they can be modelled as in or out-flows, which change over a given time span the corresponding stocks of strategic resources and as a result of actions implemented by public decision makers, possibly with the active participation of private sector institutions.

For instance, municipal projects for sustainable urban development may change private sector participation in such projects (strategic resources) as well as the overall employment rate (end result). A responsible behaviour in energy use (an end-result) and the use of available and emerging technologies in the public sector and surrounding region (a strategic resource) may lead to the reduction of CO2 emissions (end-result) and can in turn influence performance drivers such as energy use. There are also interdependencies between different strategic resources, urban infrastructure and the resulting spatial planning and environmental quality of an urban area: energy produced, water used and waste produced and recycled may affect not only the reduction in waste and water pollution, but also air quality. Furthermore, both presence and functioning of e-government policies and systems can in turn affect changes in energy use and production and support overall progress towards sustainable development both in terms of processes as well as outcomes.



**Fig. 5.** Building blocks of territorial performance, sustainable urban development and the role of e-government policies and systems.

A dynamic performance management perspective would stress that city governance and sustainability can improve if the rate at which end-results change the endowment of corresponding strategic resources is balanced. This implies that metropolitan management could be able to increase the mix of strategic resources and this increase is

not obtained by reducing the endowment of the wider strategic resources in the territory including climate change preparedness, urban liability and citizens' satisfaction. As shown in the case study, the combination of monitoring data with other urban data sets provided the base for the design of a dynamic performance management system on the theme of climate change and sustainable development supported by e-government policies and systems. If analyzed and designed from the perspective and demands of policy makers and with the adoption of a SD approach, e-government policies and systems can provide tailor-made information and maps which can directly be used in support of an integrated climate change policy, city governance and sustainable territorial development.

## **6 Conclusion**

The case study of Hammarby provides evidence of the building blocks of territorial performance, sustainable urban development and the capacity of an integrated e-government policy and for the simultaneous consideration of the environment in budgets, excellent spatial planning, reporting and SD based territorial policy development and monitoring. Most interestingly, a scenario analysis using a preliminary dynamic performance management system highlights a number of counter-intuitive elements in the capacity to transform waste into environmentally sustainable electricity, the increase in job opportunities and of the employment rate and the conversion of a former city brownfield in Stockholm into one of the world's most successful eco-villages.

In conclusion, preliminary SD models can be used to highlight new ways enabling sustainable development in urban areas. The case study also suggests that SD can provide policy makers with an overview of the strategic resources, performance drivers and end results needed to support improvements in the environmental quality of urban areas and for future investigations on the roles of public and private institutions in the development and implementation of climate change policies. We also find that a SD modelling in an inter-institutional context for the integration of sustainability issues in performance management and for the evaluation of sustainable development in urban areas may provide policy makers with new ideas to enable sustainable urban development and foster a common shared view among policy and decision makers allowing the networking of stakeholders at different levels (i.e. city, region and national) for the promotion of welfare and development and the extendibility of these networks to interact in collaborations on a global scale.

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