Ispa, Italy
12-13 January
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Report of
International Workshop on Spatial Data Infrastructures' Cost-Benefit / Return on Investment

Assessing the impacts of Spatial Data Infrastructures

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Executive summary

This report provides a summary of the outcomes of a two-day workshop organized by the Joint Research Centre of the European Commission in partnership with the US Federal Geographic Data Committee, GeoConnections Canada, and the Geoide Network. This was the first meeting specifically dedicated to assessing the socio-economic impacts of Spatial Data Infrastructures (SDIs), and for this purpose brought together experts directly involved in such studies to share experience and develop a network of good practice. The meeting was hosted by the JRC on the 12-13 January 2006 at its premises in Ispra, Italy.

The meeting was timely because there is a growing awareness across governments and communities of practitioners that much more attention needs to be paid to assessing the social and economic impacts of SDIs now that a significant number of such infrastructures is being established. The few studies available and summarised in this report provide useful guidance on the range of methods available but are all characterised by a large number of assumptions the validity of which has yet to be tested. This is because they are by and large ex-ante studies undertaken to justify political and financial support, and we have yet to see enough studies of SDIs in practice able to assess the extent to which initial assumptions are valid. Moreover, work to date has focused primarily on set-up costs, and short term efficiency benefits which are relatively easier to assess, than wider measures including indirect and organisational costs, and longer term social, political and economic benefits. With this in mind, the following recommendations are made:

1. To develop a shared portfolio of studies at different levels of granularity: the micro level (e.g. time saving, expenditure reduced or avoided within organisations), meso-level (cross organisational, regional, sectoral), and macro-level (national or international comparative studies, cross-sectoral studies) and build the knowledge base of assumptions made, assessment methods, and outcomes.
2. To develop a clearer and shared definition of SDI components and their interactions, so that studies of such components (e.g. geo-portals) can also be assessed for their contribution to the overall SDI framework.
3. To give priority to longitudinal studies of SDIs in progress, for which an initial assessment was made, to validate the assumptions made, and identify the risk factors involved. This may include self-assessment but the more it is shared and open to scrutiny, the more cumulative knowledge can be developed.
4. To develop a theoretical framework underpinning the identification of SDI benefits (i.e. what kind of benefits, both positive and negative, would we expect and why from an SDI)
5. To pay particular attention to identifying user communities, and eliciting their assessment of value deriving from an SDI
6. To pay particular attention to regional SDIs, and to application-driven approaches as ways to identify more easily stakeholders, user communities, and potential benefits.
7. To regularly exchange experiences with related fields, particularly in the GI technology, and utilities sectors, and e-government to share results, and find synergies for undertaking joint assessment studies including surveys.
8. To develop greater understanding of total geo-spatial investments across government programmes and develop a baseline against which additional SDI costs can be related to.

Structure and objectives of this report

This report provides a summary of the outcomes of a two-day workshop organized by the Joint Research Centre of the European Commission in partnership with the US Federal Geographic Data Committee, GeoConnections Canada, and the Geoide Network. The meeting was hosted by the JRC on the 12-13 January 2006 at its premises in Ispra, Italy.

The objectives of this workshop were:

1. To review what we know thus far on Spatial Data Infrastructures (SDI) Return on Investment (RoI)/cost-benefit studies outcomes. Are there consistent findings emerging? Are there major discrepancies? How far can we generalize findings (i.e. importance of context on outcomes)? Are there major gaps that need to be filled?

2. To analyse the methodologies adopted: what are they? What seems to work well and what does not? How can we learn from the experiences we have to progress the field? What implicit and explicit assumptions are made? Are they reasonable in the light of current experience? Any lesson to be learned from RoI studies in other infrastructure projects (e-gov, telecoms, utilities, transport)? What is special about SDI compared to these other experiences?

The workshop included 25 invited experts with specific experience in RoI/Cost-benefit studies and SDi impact assessment (see Appendix). The expected outcomes were to start developing a portfolio of international case-studies in this under-researched field, and work towards a common methodology to deploy in future studies at different levels of jurisdiction (local/regional/ national) which will enable robust comparative assessments to be made.

The workshop included a number of presentations (available on the site http://sdi.jrc.it/ws/costbenefit2006/) and a great deal of discussion. The report does not claim to be a full account of all the presentations or discussions, but attempts to summarize the key emerging issues with some examples of best practice and reference to additional material consulted after the workshop. All the participants to the workshop contributed through the discussions held at and after the workshop to the preparation of this report and are listed in Appendix. The editors however take full responsibility for the views expressed in this report, which do not necessarily reflect those of the contributors or the organizations they represent.

The report is structured in four Sections: the first, provides background to the issue addressed and sets the problem space; the second, highlights examples of current best practice in Europe and North America; the third discusses the relationship between RoI/Cost Benefit Analysis for SDIs and related work undertaken for e-government initiatives; and the fourth, summarises the key issues and identifies directions for future work in this field.

Introduction

The development of Spatial Data Infrastructures (SDI) at global, national, and sub-national levels has been increasingly documented by a number of studies, including Masser (1999, 2005), Williamson et al. (2003), Craglia et al (2003), Vandenbrouke (2005), Crompvoets and Bregt (2003). For the purpose of this report, we define an SDI as a coordinated framework of policies, institutional arrangements, technologies, standards, data and people, that enable sharing and effective usage of geographic information. Given the geographical spread of these initiatives across continents and levels of government, and experiences spanning 10 years or more in some cases, one would expect to have by now some solid evidence of the economic and social impacts of SDIs to inform decision-makers, investors, and society at large. Unfortunately, this does not seem to be the case, and relatively few published studies have addressed this important issue. As argued by David Rhind (2000), former Chief Executive of the Ordnance Survey of Great Britain:

> *We know very little about how much money and other resources are actually being expended on maintenance of the existing national Spatial Data Infrastructures, let alone on creation of enhanced versions of them or who is providing these resources. In broad terms, we do not know whether these resources are being applied wisely. It would seem helpful therefore to carry out some sound accounting of this expenditure: arguments for adding to it or for using it more effectively or efficiently are unconvincing if we do not know the present practice.*

Although written in 1999-2000, the statement above is still broadly valid. Evidence in this sense, at least for Europe, comes from the State of Play series of studies conducted by the University of Leuven on behalf of EUROSTAT (Vandenbroucke, 2005) which indicate that of the 32 countries analysed, the vast majority had no integrated approach to the development of SDIs, and very few had conducted cost-benefit studies.

Our collective lack of knowledge of the costs (human, social, economic, and environmental) and the benefits of establishing, operating, maintaining, and updating an SDI is due not only to the paucity of studies in this field, but also by the following other dimensions:

1) some or most of the studies available refer to the costs and benefits of setting up and operating a Geographic Information System in a single (or more rarely multiple) organisation. Although both GIS and SDIs share common ground in respect to the nature of the information used (geographic) and at the present time it is often the case that the information discovered and accessed via an SDIs is then used in a GIS to perform some level of analysis, it is questionable whether the findings of studies relating to GIS are extendable directly also to SDIs. What seems to be a distinguishing feature of an SDI is its distributed nature and connectivity via networks that makes it more difficult to identify ex-ante the user communities of the infrastructure. This in turn increases the difficulty of identifying and quantifying the benefits of the SDI. This does not intend to belittle in any way the complexity of studying the costs and benefits of a GIS, which are well documented, but only to suggest that such complexity is likely to increase as the user community becomes more diffused and varied;

2) many of the studies are opaque on the assumptions made and methods used to operationalise the costs and benefits, or more generically the impacts of the infrastructure under study, so that the estimates made vary considerably, and more importantly it is difficult

to understand who to believe and why. This was clearly argued by Longhorn at the workshop and supported by his analysis of the studies he could identify in this field and reported in Table 1 below. As shown, not only the ratios Costs to Benefits vary considerably but often the units of analysis are not comparable. Even more crucially, whatever the assumptions made to arrive at these figures, there seems to be no monitoring mechanisms put in place to validate the assumptions made over time, and therefore contribute to knowledge in this field;

3) we lack a real understanding not only of how much an SDI costs, but also of the proportion of this cost in relation to existing investments in geospatial information, technologies, and other related SDI components. This is crucial for a proper assessment of the additional investments required by an SDI. However, as argued by Lance (2005) and reiterated at the workshop, "government geospatial investments seldom are documented or tracked in a systematic manner, and there are political disincentives for better investment coordination. A 'disconnect' currently exists in most countries between geospatial efforts and public 'control instruments' that could streamline SDI activities". The numerous problems relate to the departmental structure of governments that makes horizontal integration (and accountability) difficult, the project-based nature of much of the funding streams in which the geospatial component is not identified lack of clarity over definitions and boundaries of the objects to measure, and difficulty also in separating geospatial investment from generic IT investment. Although these deficiencies appear to be acknowledged, particularly in North America (e.g. following the US Congressional hearings in 2003 and 2004, see GAO, 2004) and being addressed by the Office for Management and Budget in the US, and the Treasury Board in Canada, it is probably still the case that the vast majority of SDIs across the world are at Level 1 of the SDI Maturity Model put forward by Lance (Table 2).

Table 1: Some Cost-Benefit & Economic Study Results

Date	Organisation	Country	Type of Study	Benefit-Cost
1990	New South Wales state	Australia	Economic aspects of digital mapping	2:1 to 9:1
1990	Western Australia Dept. of Land Administration	Australia	Land Information Programme	5.9:1
1991	Office of Information Technology of South Australia	Australia	GI in the Public Sector	2.9:1 to 5.8:1
1992	AUSLIG	Australia	Economic & Social Benefits of Public Interest Programme	3.8:1
1992	Dept. of Defence	Australia	Economic Benefits of Hydrographic Programmes	2.7:1
1993	Gov. of Victoria	Australia	Strategic Framework for GIS Development	5.5:1
1994	Australian Government Analytical Laboratories	Australia	Economic & Social Benefits of AGAL Community Service Obligations	N/A
1994	Australian Bureau of Agricultural & Resource Economics	Australia	Economic Analysis of Remote Sensing for Land Management	[1]
1995	ANZLIC	Aust/NZ	Australian Land and Geographic Data Benefits Study	4:1
1996	Coopers & Lybrand for OS GB	U.K.	Economics of collecting, disseminating and integrating government GI	[N/A]
1998	US Department of Agriculture	USA	Return on Investment (ROI) for GIS Projects from agency-wide Business Process Reengineering study	$168M savings p.a
1999	US Dept of Agriculture, Forest Service	USA	Quantitative & qualitative benefits of GIS use in 'large fire' management	N/A
1999	Dept. of Land & Water Conservation, NSW	Australia	Business Case for Community Access to Natural Resources Information (1999-2003)	1.82:1 average
1999	OXERA for OS GB	U.K.	Economic contribution of OS GB	[4]
2000	PIRA International (USA)	EU-wide	Commercial Exploitation of Europe's Public Sector information	[2]
2000	Centre for International Economics, Sydney (for GSDI)	Global	Describes preferred methodology for preparing business case for SDI	N/A
2001	Baltimore County (Maryland, USA) Office of Information Technology	USA	10-year forecast CBA for savings across local gov departments due to use of GIS and access to geodata	IRR - 64% to 168%
2002	Austrian Federal Ministry of Economics and Labour	Austria	Economic analysis of CBA for Austrian cadastral GI	23:1 [3]
2003	Environment Agency UK & Univ. of Sheffield, UK	EU-wide	Contribution to the Extended Impact Assessment for INSPIRE	4.4:1 to 8.9:1
2004	European Commission INSPIRE	EU-wide	Extended Impact Assessment for INSPIRE	5.4:1 to 12.4:1
2004	US Geological Survey US Dept. of Interior	USA	Determined net present value (NPV) of USA National Map programme over 30-year time span	$2 billion benefit
2004	Frontier Economics Ltd for Acacia Board, UK	U.K.	CBA assessment for definitive, national property address infrastructure	[N/A]
2005	Booz Allen Hamilton (USA)	USA	Geospatial Interoperability Return on Investment Study	RoI of 26.2%
2005	Statistics Canada Dept. of Justice (Canada) GeoConnections (Canadian NSDI)	Canada	Quotes various statistics from other studies (non-Canadian) rather than CBA for Canadian GI/SDI	N/A

[1] Remote sensing returned 'net gain" of AUS$1.5 million and AUS$66 million in monitoring trees and fertilizer use.
[2] Economic potential to society of wider use of PSI, of which GI played a major part (over 50% of total PSI value).
[3] The Austrian analysis includes tax revenues in the benefits to the state, as well as registration fees; this is more a "monetary revenue:cost" ratio than the CBAs reported in other studies.
[4] The Oxera study indicated that the topographic data of Ordnance Survey GB underpinned UK£ 100 billion of the UK economy.

Source: This table was compiled by Roger Longhorn and distributed as handout at the workshop.

Table 2: SDI Investment Maturity Model

Maturity Level	Description
Level 0 – Non-existent	There is no thought-through rationale for budgeting SDI.
Level 1 – Initial (Ad Hoc)	Creating investment awareness, but as yet ad hoc, unstructured, and unpredictable investment processes characterize this stage. Budgeting of SDI-relevant activities is an agency-specific process undertaken with little to no knowledge of what other agencies are planning/budgeting.
Level 2 – Repeated (Aware)	Building the investment foundation; agency 'geospatial investment portfolios' are being compiled; basic SDI project/activity selection capabilities are being driven by the development of selection criteria, including benefit and risk criteria, and an awareness of SDI priorities when identifying activities for funding. Executive oversight is applied on a project-by-project or activity-by-activity basis.
Level 3 – Defined (Refined)	Developing a complete investment portfolio: an SDI committee has a clear picture of what is taking place across all agencies; a cross-agency portfolio has been developed, and a well-defined investment process has been development for future investments based upon collective selection criteria and integrated selection, control and evaluation processes. Executive oversight is applied to SDI development as a whole.
4 – Quantitatively managed	Quantitatively managing investments/improving the investment process: organizations are focused on evaluation techniques, such as performance measurement, to improve investment processes and portfolio(s), while maintaining mature selection and control techniques.
5 – Optimizing	Optimizing: the SDI committee has mastered the selection, control, and evaluation processes and now seeks to shape its strategic outcomes by benchmarking its geospatial investment processes relative to other 'best-in-class' countries.

(Adapted by Lance 2006 after Information Technology Investment Management (ITIM): A Framework for Assessing and Improving Process Maturity (GAO-04-394G; March 2004; Version 1.1)

4) there are shifts in emphasis in different countries between an economic assessment of infrastructure projects, including SDIs, and a social/policy one. A good example in this respect is Canada, where the shift in policy from assessing the cost and value of services predominant in the 1990s to the current emphasis on improved social policy response and performance measures has also impacted the discussion on the Canadian SDI. In particular, there has been a growing realization that the value of geospatial information is not the same as the producers' costs, but must be more strongly related to the user assessments of value. In turn this has resulted in a change in focus from cost-benefit analyses based on the assumption that "Value derives from greater operating efficiencies", towards Return on Investment studies based on the premise that "Value derives form the usefulness of the data", and more recently to demand-side valuation in which the starting point is that "Value derives from the *users' assessment* of the usefulness of the data" (see Stewart, 2006).

This change in focus reflects well the transition of SDIs from a first generation characterized as having a specifically national focus, an emphasis on the development of spatial data bases, and often (but not always) leadership provided by the national mapping agencies (Masser 2005) towards a second generation of SDIs more process-oriented and characterized by an increasing recognition of the other stakeholders of geographic information within society. Hence the emphasis moves from the development of products towards a process that emphasize partnerships, agreements and a broader set of applications. This in turn tends to move the leadership of the SDI from data producers towards new organizational models which are generally independent and designed to be representative of these different stakeholders (Rajabifard et al. 2003).

The changing nature of SDIs, and the shifts in political perspectives at least in some countries outlined above suggest that methodologies to assess the impacts of SDIs also need to adapt to be able to capture more than just financial dimensions but also user perceptions and wider social impacts. It is with these considerations in mind that the following Section reviews some of the examples of good practice currently emerging, and then draws out some of the lessons to be learned.

Examples of good practices

The INSPIRE Extended Impact Assessment

INSPIRE is a proposal by the European Commission aimed at establishing an Infrastructure for Spatial Information in Europe to make interoperable spatial information readily available in support of both national and Community (environmental) policy and to enable the public to access this information. The proposal, currently being evaluated by the European Parliament and the Council of Ministers, is based on the following key principles:

- that spatial data should be collected once and maintained at the level where this can be done most effectively;
- that it must be possible to combine seamlessly spatial data from different sources across the EU and share it between many users and applications;
- that it must be possible for spatial data collected at one level of government to be shared between all the different levels of government;
- that spatial data needed for good governance should be available on conditions that are not restricting its extensive use;
- that it should be easy to discover which spatial data is available, to evaluate its fitness for purpose and to know which conditions apply for its use.

The proposal was the subject of an Extended Impact Assessment in 2003-04 aimed at assessing its environmental, social, and economic impacts. To do so a panel of experts nominated by the Member States and Accession Countries and representing both geographic and environmental sectors, assisted by an external contractor, estimated the likely impacts focusing in particular on the economic ones, as a preliminary analysis suggested that there were unlikely to be negative social and environmental impacts arising from such a proposal.

As indicated in the Introduction, a particular challenge in conducting this assessment was the almost complete absence of previous studies containing quantitative information on the costs and benefits of introducing infrastructures for spatial data. The chosen approach was therefore to determine the impacts by referring to the expert knowledge available in the working group and to existing case studies of introducing components of spatial information infrastructures in a variety of settings.

Central to the whole approach of assessing the impacts of INSPIRE were:

1) to ensure that all assumptions made were clearly stated and backed up wherever possible with evidence from case-studies or direct experience from members of the working group. If

a range of impacts could be estimated, then make generous assumptions regarding costs and conservative assumptions regarding benefits;

2) to subject the assessment, and its assumptions, to a wide-ranging consultation within each Member State and with the public, including the private sector;

3) to group the policy measures proposed by INSPIRE around the key components of the infrastructure, namely data specifications and harmonization, metadata and catalogues (including portals), data policy, and coordination mechanisms including outreach;

4) To focus on the *incremental* costs/investment requirements and benefits of the proposed INSPIRE policy measures, i.e. over and above what would happen without INSPIRE.

In each Member State there are existing costs and benefits associated with the production and use of the various data sets that will be covered by INSPIRE. However, as also discussed earlier in the Introduction (see Lance 2006) an accurate estimate of the overall geospatial investment in each country is not available. Therefore, the decision was taken that whatever the baseline investment already taking place, the impact assessment would concentrate on providing figures for the additions to these base expenditures from the INSPIRE initiative. In some cases INSPIRE would simply refocus expenditures that would have taken place in any case, so that there would be no incremental cost. But in others new investment would be needed as a result of the INSPIRE requirements—though equally there would be new benefits. Two complementary approaches were adopted, depending on what data was available:

- the first, was to estimate the incremental costs and benefits as a proportion of the costs (or benefits) of related activities. The output of such an analysis takes the general form: incremental cost of, say, the creation of metadata, is 10% of the data collection costs;

- the second, attempts to quantify the costs and benefits in monetary terms, over a defined output. Here the output takes the general form: the costs of the creation of metadata for the complete INSPIRE data sets for all member and accession countries are X person-years, which is equivalent to € Y millions, based on an explicit assumptions on per-day gross costs of a person dedicated to such task.

5) to focus on the estimation of benefits for the environmental sector, which is the one most immediately addressed by the INSPIRE proposal, on the assumption that if the case could be made on the basis of this one sector alone, then the extension of INSPIRE to other sectors would accrue proportionally greater benefits than costs, as some of the investments made to establish the infrastructure were already in place.

Details of the assumptions made and results of the assessment are included in Craglia et al. (2003) and are summarised in Table 3 and 4 below.

Table 3: Summary investment requirements for INSPIRE
Initial Estimates (all figures €m per annum)

	EU	National organisations	Regional/local
Harmonisation	2.7	1.8	1
Metadata	0.7	3.5-4	68-70
Data Policy Framework		0.5	
Coordination and implementation including outreach	3	20	100-170
Total investment per annum over 10 years	**6.4**	**26-27**	**170-240**

Table 4: Summary Quantified benefits
Initial Estimates (all figures €m per annum)

Type of benefit	Quantitative estimates
More efficient EIAs and SEAs[1]	100-200
More efficient environmental monitoring and assessment	100
More cost-effective expenditure on environmental protection	300
More cost-effective implementation of the environmental *acquis*	50
More effective implementation of EC projects	5-15
More effective expenditure on Trans European Networks	140
Reduced duplication of spatial data collection	25-250
Improved delivery of risk prevention policies	120-400
Improved delivery of health and environment policies	350
Total	**1190–1800**

Although the estimated benefits were significantly greater than the costs, the consultation with the Member States indicated that the initial investment required was perceived to be too high. As a result, a revision of the Impact Assessment was carried out in 2004 with the following objectives:

- Revise some basic assumptions in light of more recent survey information (labour costs and exclusion of costs already incurred for example through e-government initiatives)
- Clarification of issues in the original contribution to the XIA report that could lead to misinterpretation (impact of INSPIRE on local level and ratios between implementation and co-ordination)
- Assessing the impact of the reduced scope of INSPIRE, for example by phasing the requirements for harmonisation to be more stringent on a reduced group of themes, and less stringent or phased in time for the others.

The conclusions of these revisions to the unit costs assumptions and scope of the INSPIRE proposal led to a reduction of the investment estimated from a range of 200-300 m€ to 93-138 m€ per year for 10 years. The annual benefits for the revised scope were also reduced from their original range of 1190-1800 m€ per year to 770-1150 m€ per year. For details of the revised assumptions please see Dufourmont (2004).

A number of useful lessons can be drawn from this experience:

1) The experience shows that it is possible to come to a broad assessment of the likely impacts of an SDI, even in a complex and varied context such as Europe covering 25 different countries. The whole exercise lasted approximately 6 months for the original assessment, and an additional 2 months for the revision with a very limited budget that covered the few face-to-face meetings for the Working Group and a small external contract to a part-time editor. Given the time and budget constraints no in-depth studies could be undertaken, and the methodology deployed was very much based on a Delphi panel technique utilizing the expertise of the Working Group members. In this respect, the composition and level of knowledge of the Group were clearly crucial to the process;

2) the most crucial methodological decision taken was to ensure that all assumptions made were explicit and open to scrutiny. This made it possible to arrive to some "sensible" estimates even in the absence of very solid evidence through the process of review and

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1 Environmental Impact Assessments and Strategic Environmental Assessments as required by Directive 85/337/EEC and Directive 2002/41/EC, respectively.

feedback. Moreover, this transparency gave confidence to the process as a whole, which is absolutely crucial. The converse approach of providing maybe solid estimates but with a black-box approach not open to scrutiny raises suspicions that may undermine the entire process. It is also important to notice that such openness allows for independent validation and cumulative knowledge to develop. So for example, the INSPIRE Impact Assessment undertaken by the Dutch Ministry for Housing, Spatial Planning and the Environment in 2005 for the Netherlands, largely confirmed the estimates of costs done for the European assessment, while as far as the benefits, it did not come to explicit figures but estimated that particularly in cross-border regions the benefits could be high (Rijntalder et al. 2005);
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3) as expected, it is easier to estimate costs than it is to estimate the benefits of an SDI, and even more so as one moves from benefits internal to one or more organizations (Efficiency benefits like time or money saved) to less tangible benefits like improved decision-making or policy outcomes (effectiveness), and more difficult still for wider social and economic benefits to end-users. In the estimation of benefits, one of the more solid pieces of evidence came from a survey of 50 private and public sector organizations engaged in undertaking Environmental Impact Assessment (EIA), and Strategic Environmental Assessments (SEA). This survey was commissioned by the European Commission DG Environment during the INSPIRE impact assessment, and provided valuable evidence of the costs incurred by not having an infrastructure like INSPIRE. Although the estimated savings in data discovery and access, and time saved were relatively small (approximately 5% and 8% respectively) for each of the impact assessments, their overall contribution amounted to well over 100m euros per annum given that each year there were some 10,000-19,000 EIAs and 3000-5000 SEAs carried out in the EU-15 alone. What this shows, is that with a relatively modest survey, it is possible to gain solid evidence by concentrating on small improvements that can be repeated many times, rather than trying to estimate huge changes in very large projects which maybe more difficult to estimate with any accuracy;

4) one of the most important outcomes of the impact assessment was the process itself, because it required the sharing of experiences and the development of a consensus over multiple iterations on how to translate the high principles of INSPIRE into tangible activities that could be measured. This was crucial for the assessment work, but also helped to forge a share understanding among the multiple partners, and the Commission's services that then informed the drafting of the proposed legislation and the process of parliamentary scrutiny. This process of clarification and detailing is of course not yet complete, and has developed further through the discussions and amendments proposed by Parliament and the Council, and at the present time, also through the detailed technical work of the teams in charge of drafting the implementing measures of the legislation. So the process of undertaking an impact assessment is as important or maybe even more important that the outcome in terms of figures quantifying the costs and benefits (although these are clearly also required by funding agencies);

5) having a "positive" cost-benefit ratio might be a necessary but is by no means a sufficient condition to move forward with a large project or initiative such as an SDI. The political dimension of such projects is very present because the allocation of public funding is inherently a political matter and not just a technical one. In the case of INSPIRE, it was necessary to go back to the assumptions and reduce the ambition of the proposal in order to move one step forward, but the political discussion continues to date even if no alternative estimates of impacts have been made public;

6) last but not least, the experience of this impact assessment and of the many assumptions made, has highlighted very clearly the need to put in place a rigorous framework to validate the assumptions through practice as the SDI infrastructure is developed. Only in this way will

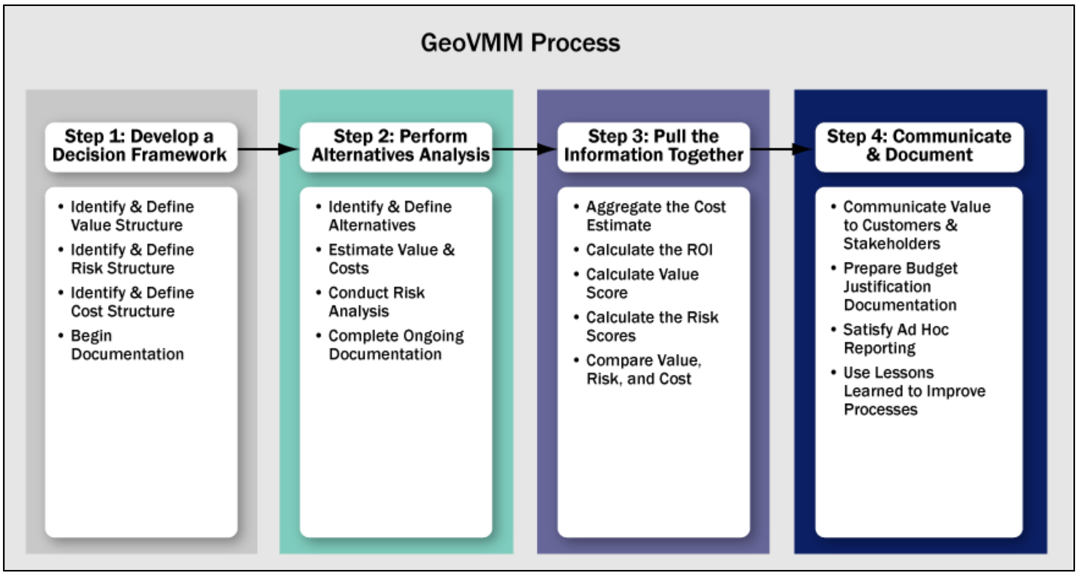
it then be possible to improve the process and develop more robust estimates. We shall return to this issue later in this report.

Geospatial Interoperability Return on Investment Study

This study was undertaken in 2005 by the consultancy Booz Allen Hamilton on behalf of NASA's Geospatial Interoperability Office. The study compared two government applications of geospatial technologies: one project utilizing a high degree of open geo-interoperable standards (ISO 19100-series standards, the Open Geospatial Consortium specifications, and the Federal Geographic Data Committee standards) and another project implementing none or few of these standards. The comparison used cost figures from the each of the projects and an independently-developed value matrix to measure the value of geospatial interoperability specifications.

The methodology used is called GeoVMM, an adaptation to the geospatial sector of the Value Measuring Methodology (VMM), a cost-benefit and risk analysis tool designed to capture the dimensions that are hard to quantify in a traditional financial return-on-investment study. Originally developed by Booz Allen Hamilton and academics affiliated with Harvard University's Kennedy School of Government under contract with Social Security Administration and the General Services Administration. VMM assesses costs, benefits, and risks for five major stakeholder groups: Direct User, Government Financial, Government Operational / Foundational, Social, Political / Strategic. The GeoVMM process contains four steps (Figure 1).

Figure 1: GeoVMM Process



Source: Booz, Allen Hamilton, 2005

Because objectivity is a central concern, establishing an independent framework is essential. Thus Step1 is defined as 'Develop an Objective Decision Framework' and is made up of three structures: value, cost, and risk.

The Value Structure describes and prioritizes value (or benefits) in two layers. Within the first layer are the five Value Factors or major categories of value (Direct User Value, Social Value, Government Financial Value, Government Foundation/Operational Value, and

Strategic/Political Value) that must be addressed when considering the full value of an initiative.

Prioritization of the five Value Factors was completed by both senior-level government staff and private individuals representing commercial interests. For the purposes of this study, data on the prioritization of the Value Factors was taken from a November 2004 moderated session with NASA, U.S. Geological Survey (USGS), OGC, National States Geographic Information Council (NSGIC), Census Bureau, FGDC committee members, as well as others in the geospatial community. The Expert Choice survey was also administered to another group that included representatives from the Department of Defense, the U.S. Geospatial Intelligence Foundation, the Office of Management and Budget, and the State of North Carolina.

Within the second layer of the value structure, project- or initiative-level staff and analysts work with representatives of user communities and partner agencies to identify and prioritize measures that specifically define value (benefits) within each of the five Value Factors. The definition of each measure includes the identification of a metric, a target, and a normalized scale. By identifying a metric for each identified value measure, it is possible to measure and determine whether an initiative has delivered the desired benefits. By translating (or normalizing) performance measurements onto a single scale, it is further possible to compare both objective and subjective measures of value. (The normalized scale used in this business case ranged from 0 to 100, where 100 is the best possible score). For this study, analysts, with input from representatives of the user and partner communities, prioritized the benefits within the Value Factors, assigning each with a "weight," and developed corresponding metrics. Table 5 shows the measures defined for each Value factor and the scores assigned by the Experts.

The Risk Structure articulates the risks associated with the initiative, including those that impact costs (risks associated with cost overruns) and value (risks that may jeopardize the realization of the benefits). Risks considered include lack of industry support, internal cultural resistance, lack of management support, and lack of understanding of standards development. The Cost structure considered system planning and development, system acquisition and implementation, system maintenance and operation.

In Step 2, the two case-studies were analyzed in respect to the most likely costs, benefits, and risks based on the framework developed in Step 1.

In Step3: 'Pull Together the Information', the financial measures were calculated together with value, cost, and risk scores. Two decision metrics for each alternative were also produced: the return on investment (ROI) and an index reflecting the level of benefits, or value, achieved for each alternative. Alternatives are then compared to best case. Conclusion is dependent on the completeness and quality of planning and analysis in the prior steps.

In Step4, the outputs of GeoVMM were used to communicate the value to stakeholders.

Table 5: Weights Assigned by Experts to GeoVMM Value Factors

Direct User Value		**26.5%**	
	Data Availability	38%	10.1%
	Ease of Use	37%	9.9%
	Broad Data Sharing Capabilities	25%	6.5%
Social Value		**28.7%**	
	Better Decision Making Ability	27%	7.8%
	Extra-Governmental Coordination	20%	5.8%
	Minimal Barriers	20%	5.7%
	Institutional Effectiveness	20%	5.6%
	Efficient Use of Taxpayer Resources	13%	3.7%
Government Foundation/Operational		**24.4%**	
	Ease of Integration	23%	5.6%
	Intragovernmental Collaboration	17%	4.1%
	Public Participation and Accountability	15%	3.7%
	Interagency Collaboration	14%	3.4%
	Reuse, Adaptation, and Consolidation	14%	3.3%
	Mainstreaming of GIS	11%	2.7%
	IT Performance	6%	1.5%
Government Financial Value		**11.6%**	
	Total Cost Savings	62%	7.2%
	Total Cost Avoidance	38%	4.4%
Strategic/Political Value		**8.8%**	
	Close Working Relationship	30%	2.7%
	Supports Improved Decision Making	30%	2.7%
	Supports NSDI	28%	2.4%
	E-Gov Support	12%	1.0%
Total			100%

Source: Booz Allen Hamilton 2005, pg. 16

The study demonstrated to NASA the value of supporting the geospatial interoperability standards. Standards-based projects were shown to have a 119% ROI over the program that did not implement standards. A $1.00 invested in open standards-based projects nets a $1.19 in savings in Operations and Maintenance compared to projects not based on open standards. Standards lower transaction costs for sharing geospatial data when semantic agreement can be reached between parties, e.g. the higher implementation costs for Case Study 1 (the standards based project), are combined with lower operations and maintenance (O&M) costs.

Risk adjusting the costs for Case Study 1 increased project cost 24.6% overall, while risk adjusting the costs for Case Study 2 increased project cost 56.6% overall.

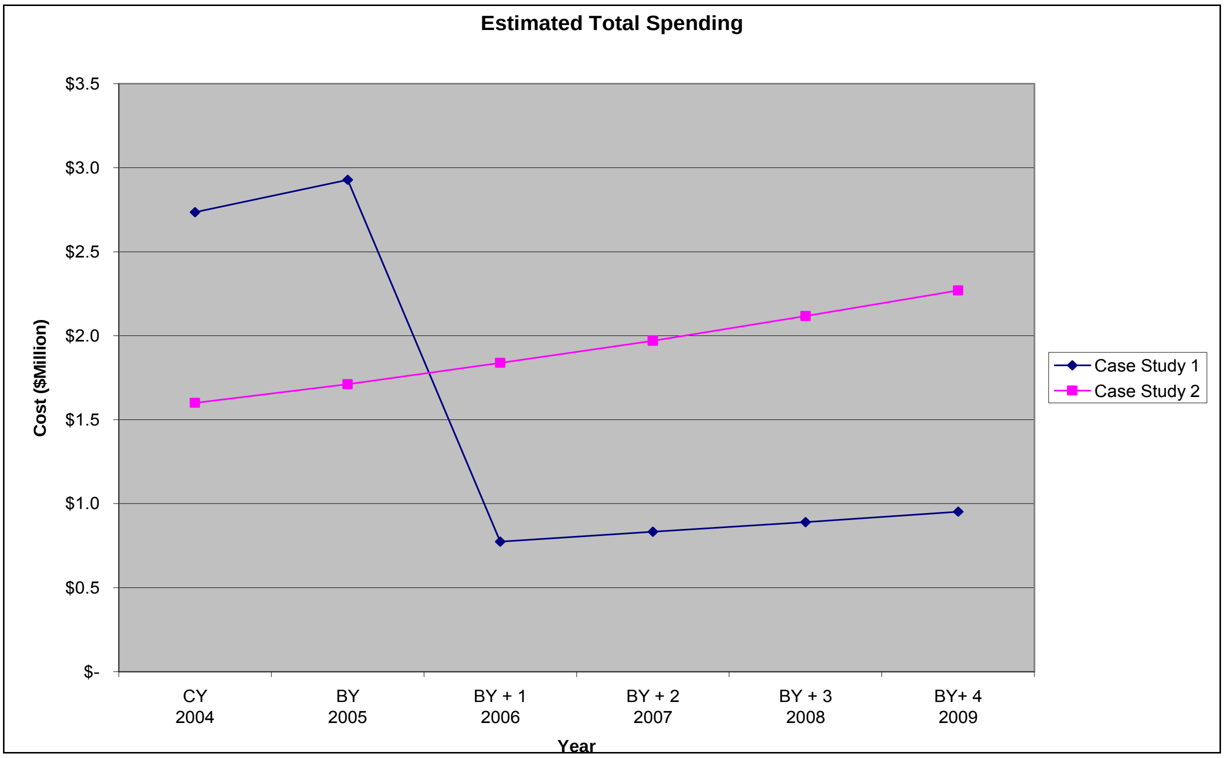
Table 6: Risk Adjusted Costs of case-studies

Risk Adjusted (Constant Year Dollars)		
Case 1	**Total**	**%Increase due to risk**
1.0 System Planning & Development	$488,704	14.3%
2.0 System Acquisition & Implementation	$6,726,045	24.1%
3.0 System Maintenance & Operation	$1,901,380	29.3%
Total	$9,116,129	24.6%
Case 2	**Total**	
1.0 System Planning & Development	$399,227	27.4%
2.0 System Acquisition & Implementation	$619,718	33.2%
3.0 System Maintenance & Operation	$10,486,607	59.6%
Total	$11,505,551	56.6%

Source: Booz Allen Hamilton 2005.

Initial costs for the standards-based project were higher. Total costs for standards-based project dropped in the third year, reflecting lower costs for maintenance and operations.

Figure 2: Estimate Costs Case-studies



Source: Booze Allen Hamilton 2005.

Lesson learned from the study:

The dimensions of integrating spatial information across the enterprise are often not well understood. Evidence shows that geospatial information should be considered part of the core information infrastructure of an organization. But the case for investing in geospatial information or associated technologies is often justified in technical terms or with a narrow focus on improved technical efficiencies. How geospatial investments will result in a return on investment to the larger organization is both poorly substantiated and understood.

The problem is compounded by the difficulty of measuring the costs and benefits of knowledge assets. It is difficult to use traditional cost-benefit methods to measure returns to groups other than direct users, and public sector agencies have no profit motive.

In addition to this methodological challenge, there are two other important issues: firstly, that even if a case is made through a positive analysis of costs and benefits, management may perceive that the upfront costs exceed the long-term return and that benefits accrue only to external partners; secondly, the process of national and international standardization and the value of adopting standards is poorly understood. Geospatial standards may not be perceived as applicable for the typical geospatial application (standalone within an organization and not networked), or may be rejected because potential users do not know how to create a profile (i.e. extending, tailoring, or constraining), or they may be perceived as not meeting business needs, leading at best to the development of local practices rather than the adoption of complex international standards. Industry may further compound the problem as it may be reluctant to contribute to the development of standards if it sees no tangible returns from standards setting, or a drain on its intellectual capital (time horizon for realizing positive network effects). Geospatial technology vendors that serve only the domestic market may feel little or no pressure (from market or government) to support geospatial standards, especially ISO standards.

An insight into the disconnection between national and international SDI and standardization activities and local practice is provided by Harvey and Tulloch (2003) in their research of data sharing practices in US local government. Almost 50% of the officials interviewed in Kentucky in 2001 and Minnesota in 2003 had never heard of the US National Spatial Data Infrastructure (launched in 1994), and although just over 50% declared that they used standards in their geospatial activities, when probed further it was evident that there were multiple interpretations and views of what exactly “standards” means.

With these considerations in mind, the NASA study provided important evidence that the adoption of standards can improve geospatial information sharing, foster improved decision-making, build business resilience, and lower maintenance and operations costs over time. This should be noted even in jurisdictions that claim to be isolated, and thus not “needing” standards.

From a methodological point of view, the use of GeoVMM has provided a useful structured framework to capture a wide range of benefits to multiple stakeholders and arrive to a shared agreement on the relative weights of each set of measures identified.

Modeling Benefits and Costs of The National Map

The Geography Discipline of the U.S. Geological Survey (USGS) has conducted the cost-benefit analysis (CBA) of The National Map (TNM), a USGS initiative to provide public access to geospatial data from multiple partners in order to improve decision making. TNM enhances the United States' ability to access, integrate, and apply geospatial data at global, national, and local scales. Though still under development, TNM is a critical component of the National Spatial Data Infrastructure. The project is a huge undertaking and involves the creation, integration, and maintenance of elevation, land cover, hydrography, geographic names, aerial orthoimagery, transportation, structures, and boundary datasets for the entire United States.

The two main changes to USGS Geography were considered. Firstly, the increased funding to build and maintain data, and secondly, the ways in which spatial data is used. The former includes the frequency, market size, ease and/or cost of use, and quality of outcome. Facilitating access to geospatial data, enlarges the spatial data users market that, in consequence, demands increased quality products.

Considering the above mentioned system boundaries, the three main benefit sources can be derived:

- the improved net benefits of applications,
- the spurring innovation of new applications,
- the growing user community for applications.

The benefits of TNM derive from the value of its data as they are used to permit, facilitate, or improve some decision or process by helping to reduce the costs to generate, populate, or operate spatial databases and by making it faster and cheaper to carry out tasks and projects (efficiency gains) or improve the outcome of projects because of better information (effectiveness gains). Other benefits could derive from the creation of novel applications of spatial data that are currently impossible or inefficient because of imperfections or gaps in available information.

Mathematically, the net benefits (NBs) of the TNM programme, are equal to the benefits of its information, minus program costs.

$$NB_{TNM} = B_{TNM} - C_{TNM}$$

Note that costs are for the program only, not for the applications in which TNM data are used. Benefits must come from TNM data being used; an application implemented by a local entity using only its internal data derives no value from TNM.

To refine the study, let v_{jst} equal the NBs of TNM data as used in an application *j* by a user in state *s* at time *t*. For the study, the three possible states where defined, representing tiers of sophistication of the applications that a user may implement. The exact definitions of the tiers are loose, but follow general guidelines.

- Tier 3 applications, which are the simplest, include paper mapping and simple overlay analysis in a GIS.
- Tier 2 applications use digital spatial data (DSD) in a GIS to do more complex route planning or locational analysis.
- Tier 1 applications include complex geospatial statistics and formal optimization modeling. Users in the higher tiers may implement applications from the lower tiers, but lower-tier users cannot implement higher-tier applications.

Then:

$$v_{jst} = NB_{jst(TNM)} - NB_{jst(SQ)}$$

where $NB_{jst(TNM)}$ are the NBs of an application implemented by a user in a specific tier at a specific time using TNM data, and $NB_{jst(SQ)}$ are the NBs of the same application in the status quo - that is, without TNM data. The difference is the value of TNM in that application. Expanding this equation, shows how this value is derived:

$$v_{jst} = (B_{jst(TNM)} - C_{jst(TNM)}) - (B_{jst(SQ)} - C_{jst(SQ)})$$

Depending on the application, having TNM available can decrease the costs of the application (lower $C_{jst(TNM)}$) or increase the benefits derived from the application (higher $B_{jst(TNM)}$), or both. Then, by subtracting the status quo NBs of the same application, we obtain the incremental value of TNM's data.

Finally, the net benefits of TNM are defined by sum changed NB's over time & space, where P_{st} is the proportion of available applications that are implemented within a given time period, and K_{st} equal the number of data users in each tier *s* at each time *t*.

$$NB_{TNM} = \sum_{t=1}^{T}\left[\left(\sum(\bar{v}_{st} \cdot J_{st} \cdot K_{st} \cdot P_{st}) - C_{TNM(t)}\right) \cdot \left(\frac{1}{(1+r)^{t}}\right)\right]$$

$$\bar{v}_{st} = \sum_{j=1}^{J_{st}}\left[(B_{jst(TNM)} - C_{jst(TNM)}) - (B_{jst(SQ)} - C_{jst(SQ)})\right] \Big/ J_{st}$$

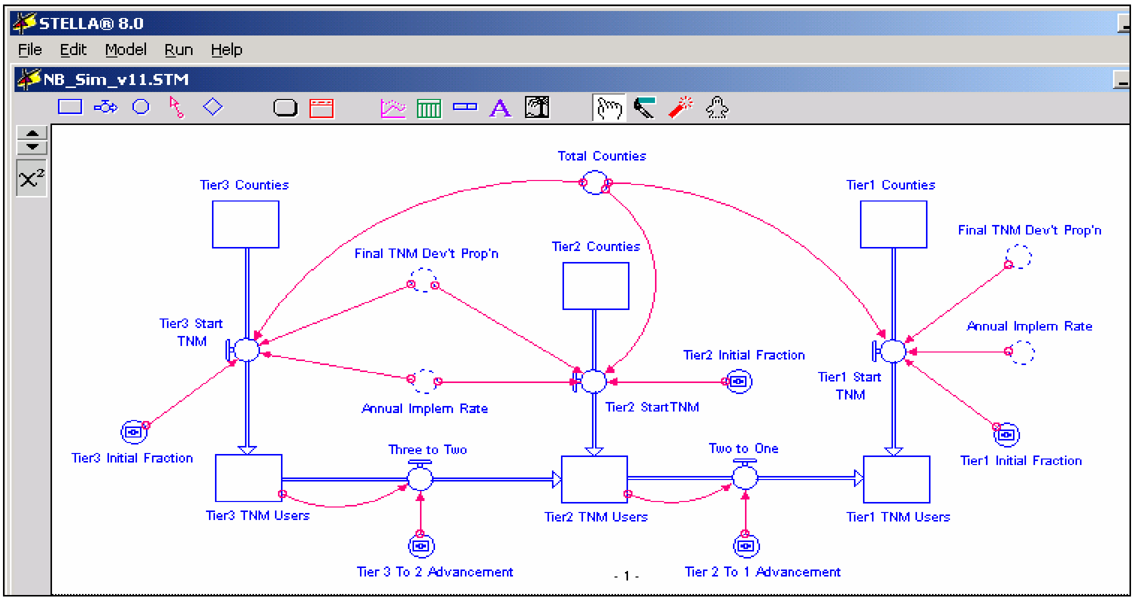
NOTE: In the equation above J_{st} is application J by user in state 's' at time 't' The term $1/(1+r)^t$ is used to discount the benefits and costs occurring at some future point, *t,* by the discount rate *r*.

Changes in the numbers of applications (innovation), of places each one occurs (diffusion), and of users in each tier do not appear explicitly in the above equations. However, the computational simulation model can address these variables. Having the economic model and lacking solid data, the authors used simulation technique. Apart from obtaining the "best guess" answer, such technique allows for sensitivity analysis, and it becomes more accurate as TNM grows. At the same time the computational simulation model fulfills the function as decision support system.

The computational simulation model, named NB-Sim, was run to simulate the number of application implementations, average improvement per implementation, diffusion of existing applications, and innovation of new applications as well as perform summations and discounting. Spatial units of analysis were counties. By "county" we mean all the users within a county, including municipal, academic, private, and state-government applications. "Counties" become "Users" as TNM grows.

Initially, a small number of applications (less than 25) would use TNM was assumed, with the number increasing as users grow. Additionally, it was assumed that innovation is at an intrinsic rate of 2 percent per year, based on the innovation rates for other technologies.

Figure 3: Modelled Dynamics of adoption of The National Map

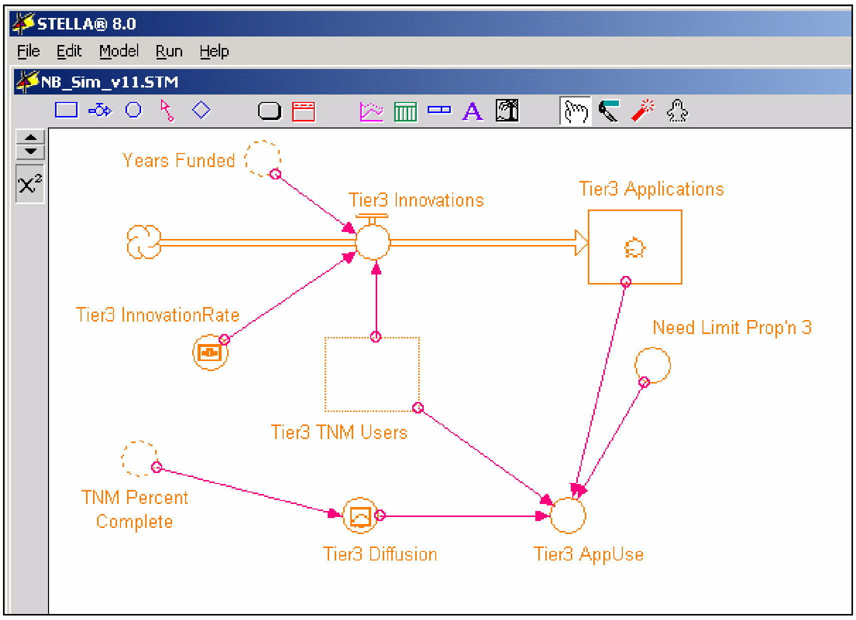


NOTE: As counties become users of The National Map, some advance upward through the tier system. The rates of these transitions are determined by the annual implementation rate (Annual Implem Rate) and final development proportion (Final TNM Dev't Prop'n).

Source: Halsing, Theissen and Bernknopf, 2004.

Taking into account that no adoption of technology happens instantaneously or completely, the model accounts for a time lag in counties' adoption of TNM with a variable termed cumulative diffusion rate. Another model variable, termed need limitation, captures the fact that not all applications are needed in every place or in every year. The need limitation adjusts the total number of implementations by randomly selecting a fraction from a decreasing exponential distribution. On average, 10-15 percent of available applications are implemented (Fig. 4).

Figure 4: Modelled increased in Applications



NOTE. The number of application implementations in a tier (Tiern AppUse) is determined by the multiplication product of the number of users, number of applications, a cumulative diffusion fraction, and a need limitation. New applications are innovated at a constant rate multiplied by the number of users.

Source: Halsing, Theissen and Bernknopf, 2004.

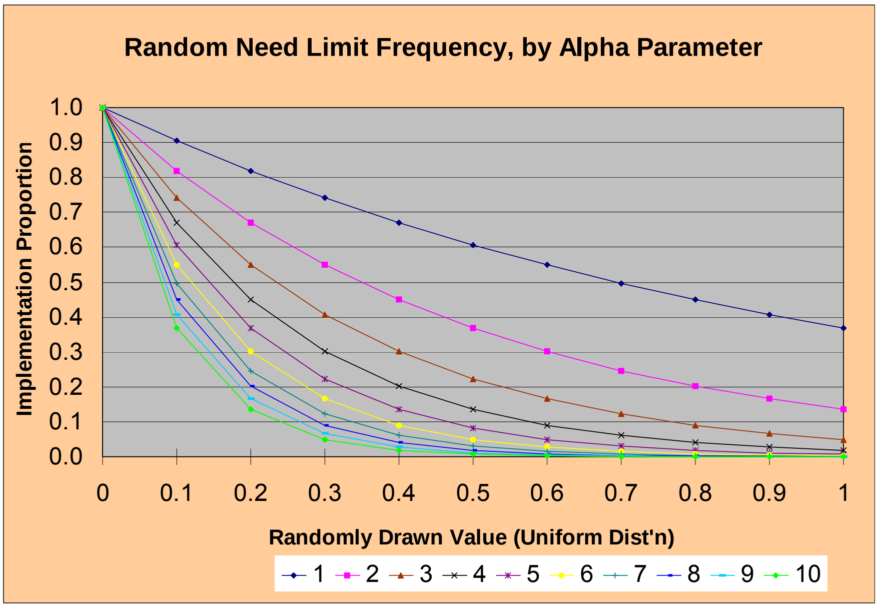
The computational model also accounts for another transition - the advancement of users through the tier system assisted by the ease and lower cost of using TNM's data (Fig. 3). Slow advancement was assumed (1 percent per year), but still beneficial since higher tiers have faster diffusion rates and adopt applications sooner.

In sum, each year, NB-Sim develops an estimated number of application implementations for each tier of county-scale users. A similar process happens in a fourth tier, representing federal DSD applications. Each tier's implementations are multiplied by an average improvement in the NBs of an application, the value of which is randomly drawn for each model year from a normal distribution centered at $1,000 per implementation ($10,000 for federal applications). This multiplication product represents the value-in-use of TNM's data in each tier and year. NB-Sim also annually sums and discounts the results by 3.2 percent per year (based on data from the Office of Management and Budget circular A-94).

The key equation used within NB-Sim computational simulation model is described as follows: **# Users x # App'ns x Diffusion % x Need %**

There is a need limitation frequency (%). Such random draw from decreasing exponential function $y = e^{-\alpha \cdot X}$ ($\alpha = 6$) is shown on Fig. 5.

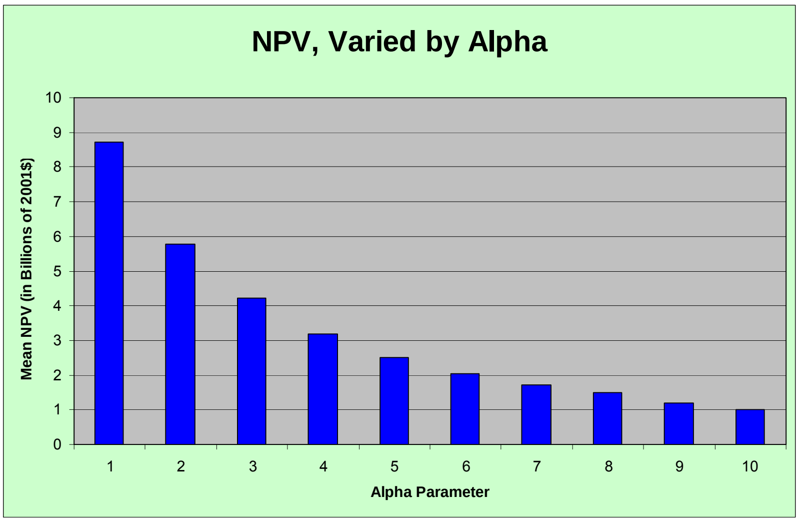
Figure 5: Random Need Limit Frequency



Source: Halsing, Theissen and Bernknopf, 2004.

NB-Sim subtracts discounted annual costs from annual benefits and reports the running-total NBs. Considering the net present value (NPV) of benefits, varied by parameter α, one can easily notice that value for α really matters (Fig. 6).

Figure 6: Mean net present value (NPV) of benefits, varied by α parameter.



Source: Halsing, Theissen and Bernknopf, 2004.

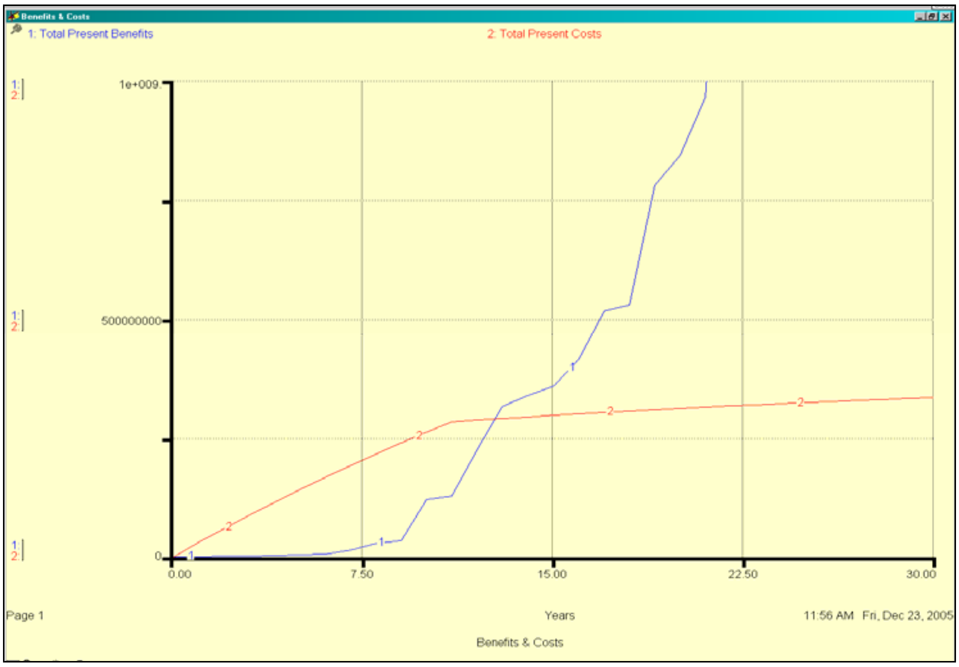
Key Assumptions:

To perform the analysis the following data assumptions and values were taken (for the cost side): 30-year lifespan, and the annual expenses of $25 million for a 10-year development period and of $5 million for maintenance of TNM during the next 30 years; diffusion equal logistic growth (~ TNM % complete), tier advancement equal 1% per year, discount Rate equal 3.2% (OMB), $1000 increase in mean NB gain/application, and 65% of counties were placed in tier 3, 30% in tier 2, and 5% in tier 1. Additionally, it was assumed that innovation is at an intrinsic rate of 2 percent per year, based on the innovation rates for other technologies.

Results from the "most likely" estimates of model parameters and data inputs indicate that, over its 30-year projected lifespan, The National Map will bring a net present value (NPV) of benefits of $2.05 billion. The average time until the initial investments (the break-even time) are recovered is 13.9 years (SD = 1.5 yrs).

Figure 7 is a graph of the total benefit and total cost curves of a single model run over time. The curves cross in year 14, when the project breaks even. The kink in the cost curve is the change from development costs to maintenance costs only. Note the slow upward climb of the benefit curve until the project nears completion, when most of the country's spatial-data users have had time to see valuable data, adopt The National Map as their data source for existing tasks, and innovate new applications for spatial data. The area above the cost curve and below the benefit curve between years 14 and 30 represents the net present value (NPV).

Figure 7: The accumulating benefits (blue curve) and costs (red) of The National Map over 30 years of the simulation model



Source: Halsing, Theissen and Bernknopf, 2004.

The benefits of $2.05 billion seems to be very promising, nevertheless these results are based on certain assumption and we are still lacking some important knowledge as for costs and benefits of actual applications, and complete accounting of how data is used, or how to monetize the benefits of those uses.

It is worth underlining that the following assumptions were not questioned: The National Map is (or will be) fully funded and politically supported, and it is technically feasible in a relevant time frame. The partners of TNM project will contribute data freely, and the TNM itself will not be superseded by other providers (GOS, Google Earth).

Some suggestions for further study encompass: finding applications in pilot project areas; estimating the costs and benefits of applications "without" TNM, and later reassess "with" TNM. Moreover, it would be useful to measure changes in costs, benefits, usage, and number of applications. Such data should be plugged into NB-Sim to see the new results (source: Halsing, et al., 2004).

Dutch Experiences in Cost Benefit Analyses

The Dutch Ministry of Transport, Public Works and Water Management and the Ministry of Economic Affairs have commissioned a large-scale research programme entitled 'Economic Effects of Infrastructure' (OEEI) in 1999-2000. The results of OEEI were published as a guide for the evaluation of infrastructural projects (Eijgenraam et al. 2000), largely related to transport, but also applicable to other infrastructures including SDIs. The guide makes it possible to present the impacts of infrastructural projects in a more structured and transparent way in order to facilitate decision-making.

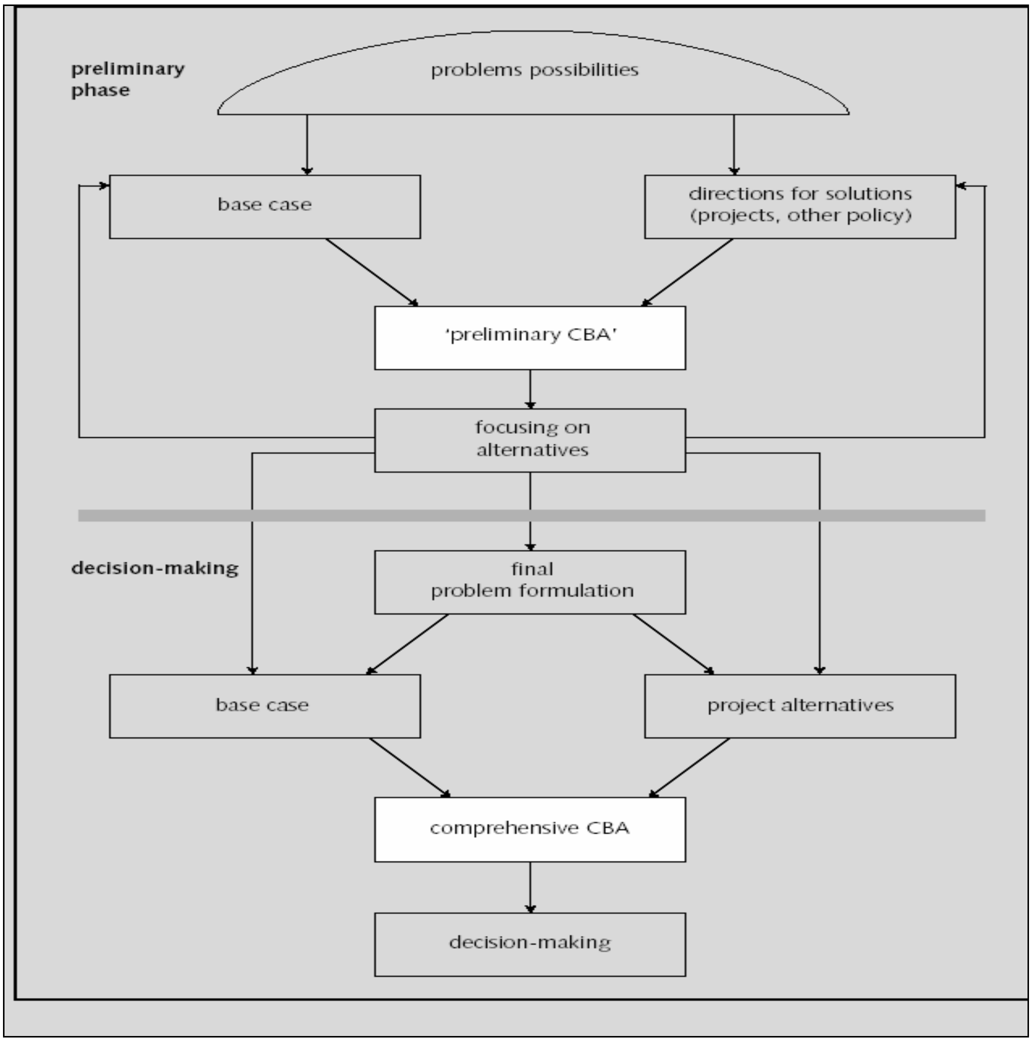
The most important recommendation of the guide is that, in respect to large infrastructure projects, a broad welfare-economical approach should be used. This implies that social cost-benefit analysis (CBA) must be used as the appraisal method for government investment.

Decisions on major infrastructural projects are inevitably associated with great risks which, among other things, relate to uncertainty over future developments and effects. Under such circumstances, a reliable and policy-relevant form of information is needed to (1) to obtain a greater degree of agreement over the methodological framework for social evaluations of major infrastructural projects; and to (2) provide research instruments for determining the effects and their contribution to welfare.

CBA information is useful in almost every stage of policy preparation because it is an iterative process in terms of which certain items are expanded quantitatively and improved during the course of the research. CBA ensures broad information on all relevant topics is available for decision making (prior to making final decisions on the project, a comprehensive CBA is carried out).

Figure 8 outlines the role of CBA in the decision-making process.

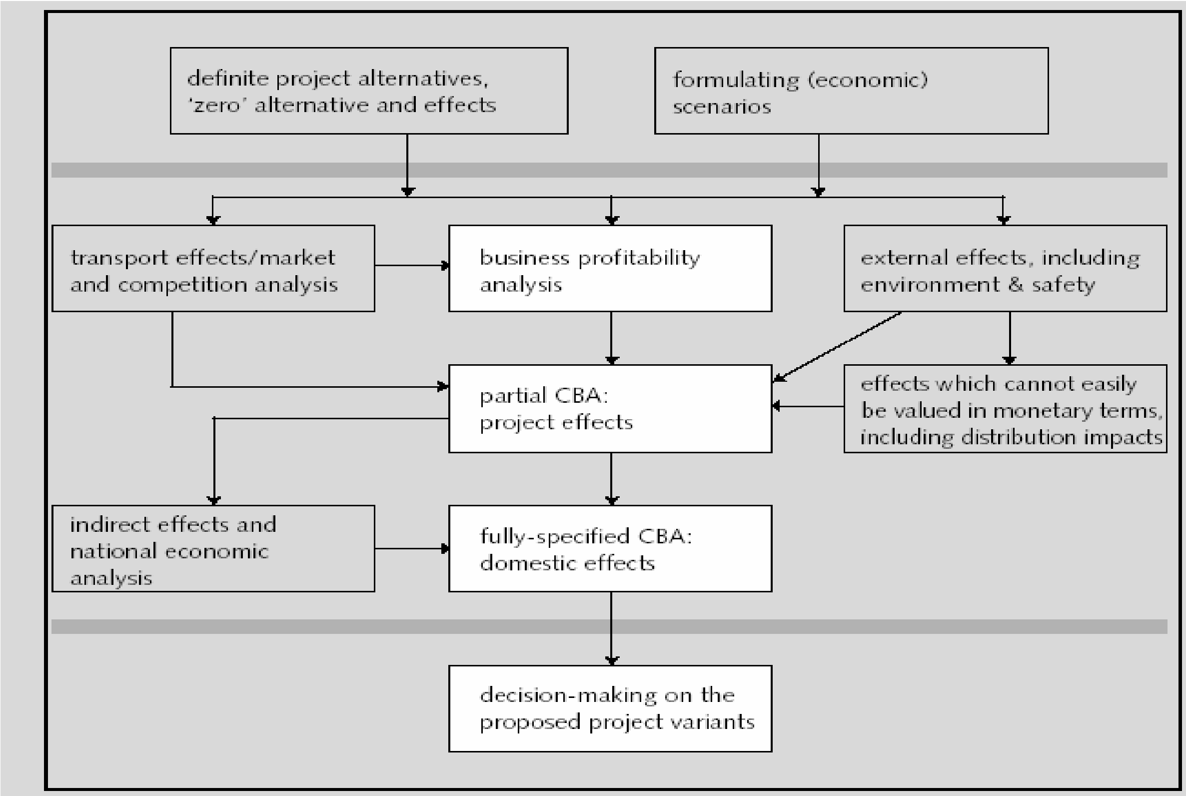
Figure 8: CBA in the decision-making process



Source: Eijgenraam et al. 2000

The CBA should be seen as the concluding stage of a large number of analyses. Figure 9 is a schematic representation of the various valid forms of project analysis and their mutual relationships. The steps involved are not taken just once (compare Fig. 8). Some parts which have been researched globally at an earlier stage may need to be revised at a later stage as additional information is obtained from other research.

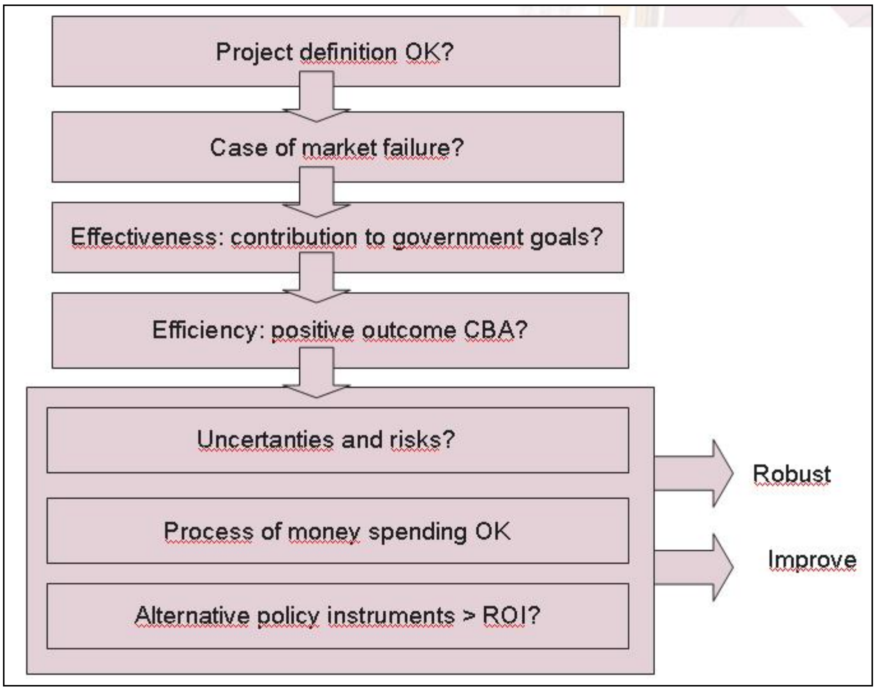
Figure 9: Multiple Stages of CBA



Source: Eijgenraam et al. 2000

It should also be noted that in an effort to assess the indirect effects of infrastructure projects (both positive and negative) the guide advises to deploy several methods, each with its own strengths and limitations, which taken together create a better picture of the likely impacts. Such methods include: the macro-economic function, case-studies, targeted fieldwork (surveys and interviews), and models to assess the sensitivity to different assumptions and spatial variations of impacts. It should also be underlined that CBA is only one step in a CPB (Netherlands Bureau for Economic Policy Analyses) Guide for evaluation of infrastructural projects (see Fig. 10).

Figure 10: CBA as part of a process of assessment



Source: Eijgenraam et al. 2000

Specific to the GI field, the first major CBA was undertaken in 2000 when the analysis of the Building Register was done. It covered only cost analysis (experts knowledge, macro figures of the Cadastre/ persons register, and micro figures of tax register) and concluded it as an investment between 200 and 400 m Euro. Then, the following Dutch GI CBA were performed: Space for Geo Information (2001), the Authentic Registers (2002), Digital exchange in Spatial Planning (2003), the Building register and addresses (2004).

An example of such studies is the one referring to the alignment of four major registers (the Authentic registers) which contain details of population, firms, buildings, and land parcels, all underpinned by geographic location through the large scale mapping of the Netherlands and the address file. The CBA was undertaken by Ecorys-NEI in 2001-02 at a time when the Population register and Cadastre were already well developed, while the other registers were at different stages of completion and accuracy, and the link among them through a unique address file still needed to be developed involving also a complex interaction between central and local administration.

The CBA followed the OEII guidelines, and estimated the costs for the completion and alignment of each register, as well as direct, indirect, and external benefits. The estimation of costs could benefit from knowledge derived form existing developments or pilot projects, and Table 7 shows one of the matrices developed to assess the cost of aligning the Companies Register, based on 1.7 million company records and an initial stage with 50 variables.

Table 7: Activities and Cost categories for Company Register (BBR) in the period 2001-2020 (net cash value in millions euro, in prices 2002)

Cost categories activities	Technical implementation	Coordination and consultation	Legal adaptations	Purchase hardware and software	Total
Inventory	1.8	1.0	4.4	0.1	7.3
Completing files	0	0	0	0	0
Creation systems	22.2	1.2	0	39.7	63.1
Checking	41.0	13.3	0	0	54.3
Management and maintenance	20.6	6.9	0	10.3	37.8
Total	85.6	22.4	4.4	50.1	162.5

Source: Ecorys-NEI, 2002

As recommended by OEII, the identification of benefits required a wider approach including case-studies, interviews, surveys and the extrapolation of their findings at the national level. For example, in estimating direct efficiency benefits to local authorities that would arise out of the project, interviews in the municipality of Moerdiik, estimated that 41 out of the 220 Full-time equivalent staff in the municipality used building data on a daily basis. If each saved 2 minutes per day from more accurate and synchronised information, the municipality would save some 7750 euros per annum, which generalised across all 475 municipalities pro rata would amount to some 13 million euros.

In another study of the Social Security Administration (UWV) it emerged that its staff dealt every year with some 60,000 incorrect addresses. Given an estimate of 10 minutes to retrieve the correct address, the programme of alignment would result in potential savings of 10,000 hours per annum or some 350,000 euros.

Similarly, in estimating the indirect benefits, assumed that a more accurate register of companies would save for each of the 1.75 million establishments at least 1 minute a year in filling and checking forms. This would amount to some 29,000 hours or 1.3 million euros per annum.

Table 8 below summarises the overall costs and benefits for the programme. As shown, in addition to monetized terms, there are also a number of hypothesised benefits for which it was not possible to convert to currency, or not enough information was available to make an estimate.

Table 8: Summary of costs and benefits in millions euro net cash value (NCW) 2002.

Costs and Benefits (excl. residual value)	Cash value 2002
Costs	Million euro
Population Register	0
Companies register	163
Cadastral recording	0
Building register	258
Geographical core file	11
Address file	14
Total cost	**446**
Benefits (excl. residual value)	
Direct Benefits	
Efficiency gains to users	149
Reduction fraud Municipalities (GSD)	32
Reduction fraud Social Security (UWV)	0
Increased Property tax recovery	252
Increased recovery of charges by Water Boards	63
Reduction costs process and management	11+PM
Reduction costs purchase	1
Indirect Benefits	
Administrative charge reduction	73+PM
New applications in the market	11
Lower costing GIS research and higher output	PM
External Benefits	
Improvement policy (policymaking, implementation and monitoring)	NK
Increased quality research and provision of information Knowledge spillovers	NK
Total Benefits	**592**
Benefits-Costs difference (cash in mln euro)	146+PM
RoI (in %)	9%+PM

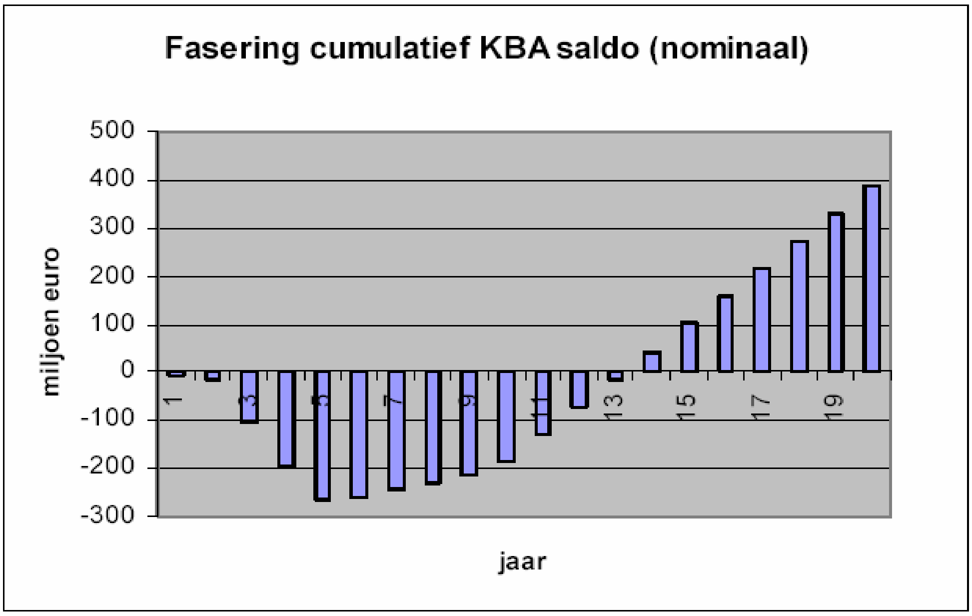
Source: Ecorys-NEI, 2002

NK = not quantifiable in monetary terms

PM = not quantified because of lack of information

An important aspect of the CBA is also the phasing of investments and break-even point estimation. In the case of this programme of aligning the basic registers, it was estimated that the investment would be front-loaded and starting to pay back in approximately 12 years, as shown in Fig. 11. This maybe one of the considerations why the government decided not to fund the programme even though the CBA had been rated as “Robust”.

Figure 11: Estimated Phasing of the difference Benefits-Costs.



Source: Ecorys-NEI, 2002

Regional Experiences: Catalonian SDI

The Catalan SDI initiative (IDEC), funded by the Information Society Department of the Regional Ministry of Universities, Research and Information Society, is the most advanced SDI activity in Spain. Its leadership and management is done by the Institute of Cartography of Catalunya (ICC). In December 2005, IDEC was formalized by means of a law of the Catalan Parliament, which also established an IDEC Support Centre.

The goal of IDEC is to compile information on existing GI data and products, generate and make accessible metadata, and provide several interoperable services offering its technological services platform to other interested agencies. The Geoportal of IDEC (http://www.geoportal-idec.net) offers several services, among others: a free of charge online metadata catalogue, a WMSClient or viewer which connects with a dozen of WMS from other organizations and access to more than 100 layers.

The first provider is ICC - Regional Map Agency that distribute for free the basic data (topo, orto) at 5.000 and 50.000 scales, from the end of 2003 (initially, with digital support but now through WMS and WFS). The geocoding services, created by IDEC and exploited by ICC, are free for Regional Government agencies, and in the future for everybody. The first online use of these services was integration in a new application of the Industry Department.

To identify and measure the benefits of SDI, two cost-benefit studies have been done.

Case Study 1 - Cartographic Institute of Catalonia (ICC)

The Institut Cartogràfic de Catalunya (Cartographic Institute of Catalonia, ICC) is a public entity of the Generalitat de Catalunya (Catalan Autonomous Government). ICC main objectives are: producing, reproducing and spreading of Catalonia cartography, densifying and surveying the lower order geodetic network, creating, structuring and organizing the Cartoteca de Catalunya (Catalonia Map Library), achieving the road cartography projects, etc. ICC data are used mainly as a referenced cartography essentially for its visualization and finding other thematic data.

In the case study the access to ICC cartography through the traditional system was evaluated. This can be understood as the process to obtain digital cartography in CD or DVD support from ICC shops. ICC costs (digital cartography recording and selling) and client costs (steps to obtain cartography and incorporate it in their own database/server) were considered.

ICC Costs:

- Recording of the data on CD/DVD = 3333 hours/year = 66,500 euros
- Selling of CD/DVD = 2161 hours/year = 43, 220 euros

User costs:

Human resources: 7 hours per user (4 hours of displacement, 1 hour for applying and collecting the CD/DVD, 2 hours for adapting and incorporating into their database)

Equipment costs: 14 euros per DVD

In 2004, the ICC shops received 3705 orders, which meant 4300 CD and 9000 DVD edited and recorded. On this basis the total costs to users would be:

(7 hours X 20 euros/hour + 14 euros of CD/DVD) X 3705 users = 518,714 euros

Since April 2005, it is possible to obtain ICC cartography through an OGC client that makes a standard request to the ICC server to receive an image or a vector dataset of the required area. The direct annual cost were estimated as: 250.000 € (2005), where 220.000 € for human resources, and 30.000 € for investments. The indirect costs are much more difficult to evaluate (about 40%).

Differences between costs observed in the two ICC methods are relevant concerning the CD/DVD edition and recording processes and their selling. Using the IDE platform it could be possible to save 4389 hours per year at the ICC, which represents 87,780 Euros, while Users would save some 414,960 Euros. According to this study, therefore the total savings for the ICC and users would be of 502,740 Euros per year even allowing for some 20% of sales still going through traditional channels.

Case Study 2: The Catalan Architects Association (COAC):

The COAC has a corporative Geographic Information System (GIS) which is used to locate the architects visas. Additionally, through its Web Page, the COAC is implementing a service to locate collegiate architects as a complementary information. The territory may be seen through two layers: streets and orthoimages that in many places cover the lack of information of the streets base. The Web Page cartography is stored in both the COAC server and the Cartographic Institute of Catalonia (ICC) one. The cartographic data can be accessed in two different ways as follows:

- The own connection to the COAC server: Once a collegiate architect has been selected by the user the address is obtained in the corresponding city map. When requesting this service, the web client makes a request (not standard) to the COAC server which returns an area image.
- Connection to the ICC server: the user can obtain the orthoimage 1:5000 from the place where the collegiate architect is located. In this case, the web client makes a request, according to OGC standards, to the ICC server that returns an image of the required area.

The case study encompassed the evaluation of ICC 1:5000 orthoimages using the OGC client/SDI platform. The economic expenses that COAC has to stand to incorporate into its web client OGC standard connections were evaluated. Human resources, software/hardware as well as cartography price were considered. This was compared to the traditional solution to acquire the ICC 1:5.000 orthoimages.

The differences analysis showed the reduction of time and money that the implementation of OGC standards and the policy of free of charge cartography imply. Although the total savings is small (some 400 euros) this applies to just one search of data for one architectural practice, and therefore when multiplied across all architectural practices and all data searches and downloads it leads to hundreds of thousands of euros per year of savings. Moreover, through the SDI platforms, the data downloaded is always up-to-date, which also reduces the need for multiple purchases.

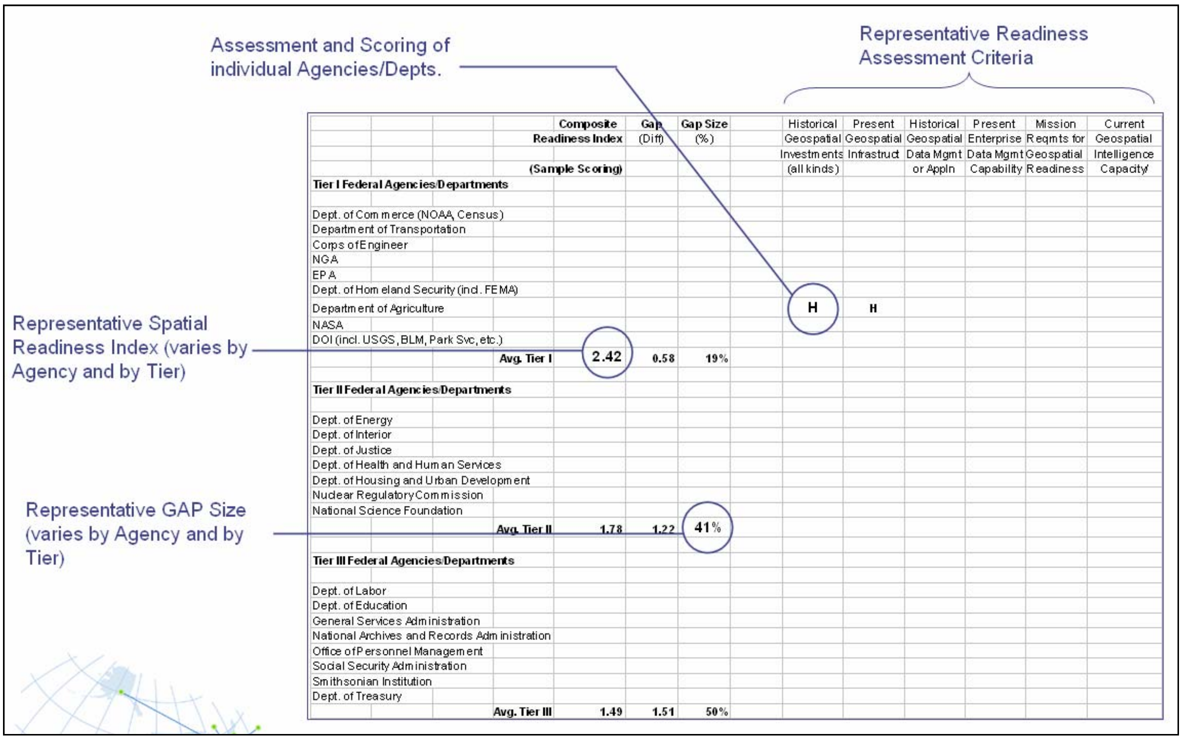
Geospatial One-Stop (GOS) Initiative

Geospatial One-Stop: Portal for Discovery GOS is a Presidential Management Council initiative - one of the 24 e-government priorities that the Office of Management and Budget oversees. This initiative makes it easier, faster, and less expensive for all levels of government and citizens to access geospatial information. From a policy perspective, GOS adds three unique benefits to the implementation of the NSDI. These include raising the visibility of the strategic value of geographic information, increasing federal accountability for geospatial data stewardship, and establishing a collaborative model for an intergovernmental initiative. From a program perspective, GOS implements the basic elements of the NSDI by providing an Internet portal (www.geodata.gov) to facilitate data sharing in favour of decision support and by encouraging partnerships across organizations.

The GOS economic Model (GEM) uses the same underlying simulation software (Stella) which was used in developing The National Map Economic Model (NB-Sim). It provides a comprehensive tool for deriving estimates of GOS Net Benefits (Total Benefits - Total Costs) - for each Alternative. GEM captures multiple Benefit Streams, as specified by the Value Proposition (reduces duplication of data, increased availability or accessibility of data, leveraging future data purchases, increased spatial readiness). The GOS economic Model provides the ability to control for uncertainty of certain input parameters and estimates.

As in the case of the National Map study, in which counties were organised in three tiers representing spatial readiness and complexity of spatial data use, so in the GIS study, Federal Agencies were ranked according to their degree of spatial readiness (see below).

Figure 12: Tiering of Federal Agencies based on spatial readiness



	Composite Readiness Index (Sample Scoring)	Gap (Diff)	Gap Size (%)	Historical Geospatial Investments (all kinds)	Present Geospatial Infrastruct	Historical Geospatial Data Mgmt or Appln	Present Enterprise Data Mgmt Capability	Mission Reqmts for Geospatial Readiness	Current Geospatial Intelligence Capacity
Tier I Federal Agencies/Departments									
Dept. of Commerce (NOAA, Census)									
Department of Transportation									
Corps of Engineer									
NGA									
EPA									
Dept. of Homeland Security (incl. FEMA)									
Department of Agriculture				H	H				
NASA									
DOI (incl. USGS, BLM, Park Svc, etc.)									
Avg. Tier I	2.42	0.58	19%						
Tier II Federal Agencies/Departments									
Dept. of Energy									
Dept. of Interior									
Dept. of Justice									
Dept. of Health and Human Services									
Dept. of Housing and Urban Development									
Nuclear Regulatory Commission									
National Science Foundation									
Avg. Tier II	1.78	1.22	41%						
Tier III Federal Agencies/Departments									
Dept. of Labor									
Dept. of Education									
General Services Administration									
National Archives and Records Administration									
Office of Personnel Management									
Social Security Administration									
Smithsonian Institution									
Dept. of Treasury									
Avg. Tier III	1.49	1.51	50%						

Source: Nebert, 2006

The model was developed around four key components:

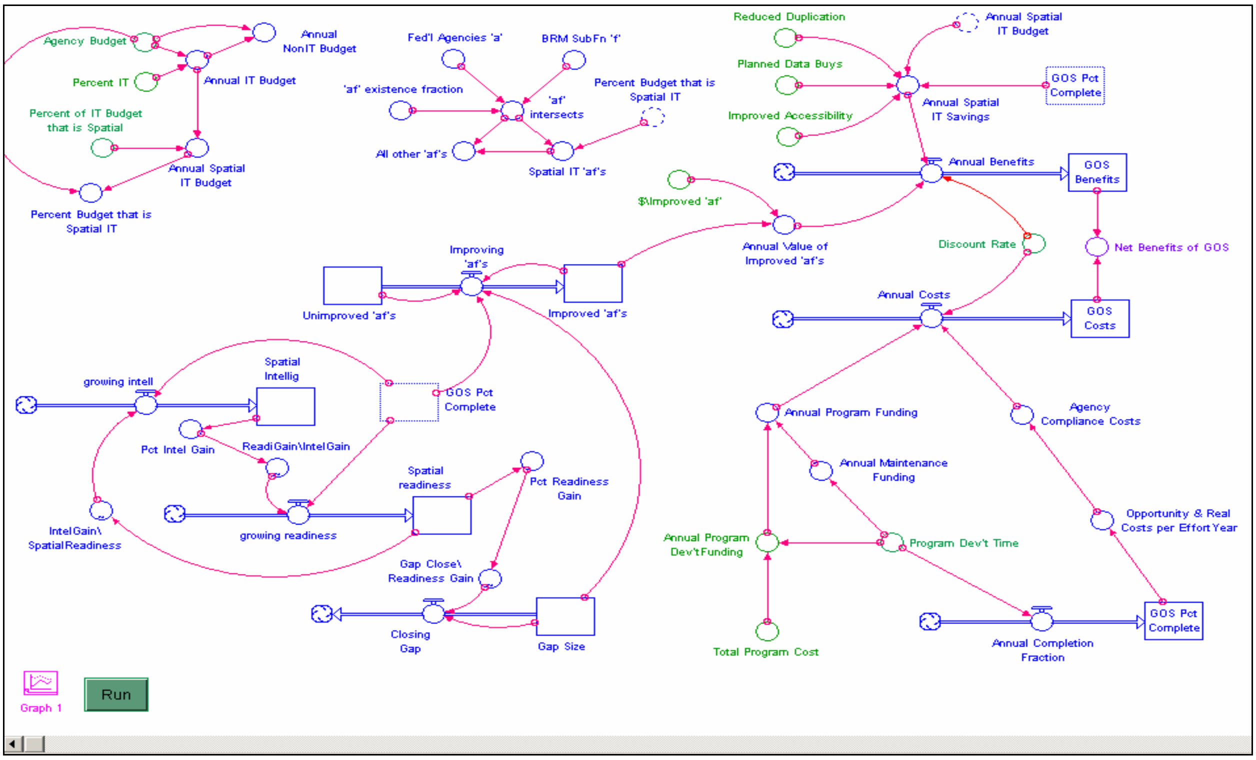
Federal Budget Input (Fig. 13 – UL corner) - This portion of GEM shows how budget information is represented in the model. This information is later tied to the Federal agencies Business Reference Model (BRM) sub-functions.

Spatial Readiness (Fig. 13 - LL corner) Component of GEM Model shows the various components of Spatial Readiness and how the Model handles the relationship between increasing Spatial Readiness (and Spatial Intelligence) as the Gap Size is decreased.

Benefit Estimation (Fig. 13 – UR corner) – This portion of GEM shows the key Benefit components that are based upon improvements in federal agency efficiency and coordination, through GOS. It also provides for increasing benefits based upon improvements to agencies BRM sub-function.

Cost Elements (Fig. 13 – LR corner) Component shows the various GOS Cost components and how costs are accumulated on an annual basis. The accumulation of costs leads to increase in GOS Percent Completion. This increased completion is, in turn, tied to the rate at which benefits accumulate on an annual basis.

Figure 13: Structure of the Model for the Geospatial One Stop



Source: Nebert, 2006.

The GOS Modelled Cost/Benefits include use of the portal to register data, services, applications, and planned acquisitions.

Table 9: Outcome of GOS Model

(amounts as $000)	FY2002	FY2003	FY2004	FY2005	FY2006	FY2007	FY2008	FY2009	FY2010
GOS Discounted Costs	5.4	5.2	84.8	2018.5	1951.6	1894.8	1833.7	1776.4	3427.7
GOS Discounted Benefits	0	7.2	66.3	308.5	855.6	1861.3	3852.9	3156.6	5844.1
GOS Net Present Value	-5.4	2	-18.5	-1710	-1096	-33.5	2019.2	1380.2	2416.4
GOS Cumulative NPV	-5.4	-3.4	-21.9	-1731.9	-2827.9	-2861.4	-842.2	**538**	**2954.4**

Source: Nebert, 2006.

Other GIS-Related studies

There have been several studies in the past attempting to capture the costs and benefits of implementing Geographic Information Systems within individual organisations or (sometimes) across multiple organisations. More recently specific components of an SDI (e.g. Clearinghouses) have also been assessed. A selection of existing studies was referred to by Nebert (2006) and include:

Benefits of GIS (Gillespie)

In years 1994-97, 62 federal case studies were prepared to compare with/without GIS. Study focused on intra-agency deployment of GIS. The effectiveness benefits, i.e. B/C ratios, ranged from 1.2 to 5.6.

Georgia State Clearinghouse

Assessment methodology from GITA was applied on three candidates for greater comparability. Benefit of coordinated basemap development of Georgia State Clearinghouse proved: cost savings $1.2M. Other indicators: For centralized data dissemination: cost savings $373K, efficiency gains 20-60%; for re-use of digital orthoimagery by local government: savings $2.3M; and more than $1.5M (over 7 year period) operation savings.

MetroGIS Performance Assessment

Local government consortium in the Minneapolis, MN region was collaborating on common data infrastructure. Performance reports 2002-2004 include such measures as: visits, downloads, download profile, workload. However, no metrics of savings were reported, and there are no annual reporting post-2004.

State of Ohio funding alternatives

The findings of the review of 50 State approaches to funding geospatial data acquisition and coordination showed which combination of sources and methods are required for covering operating costs. These are: Dedicated Funds, Mission Driven Funding, Assessments on Agencies, Central and Capital Fundings, and Cost Recovery. The study concluded that probably the most successful approach was one considering multiple sources of funding.

Business Case for NSDI

In 2003, the FGDC team was convened to identify and analyze activities that demonstrate a beneficial 'business case' for participation in the NSDI. Based on the preference criteria, i.e.: multi-participant cost/benefit, espouses SDI tenets (data, metadata, catalog, services, standards), and applies comparison methodology, circa 20 case studies were evaluated on a collaborative website at USGS. The review showed little consistency in approach (no comparability).

A review of past studies was also undertaken by GITA, the Geographic Information Technologies Association- www.gita.org) and is available on http://fgdc.er.usgs.gov/FutureDirections/docs/Business%20Case%20Summaries.doc

GITA Project for Business Case Development and Return on Investment Methodology

Objectives

The basic purpose of this project, co-sponsored by GITA, the FGDC, GeoConnections, and AWWA Research Foundation, is to demonstrate and document a method for assessing an organization's return on investment for implementing and sharing geospatial information and technology. The rationale for the project is the recognition that one of the major impediments to implementing GIT projects is that they are often very complex and expensive, thus GIT benefits are difficult to predict. Consequently, it has been difficult to defend these projects against public and private sector managers on the basis of return on investment, cost savings, increased service levels and other documentable processes. Once a standardized method for calculating and documenting these benefits is developed, more organizations will be better positioned to justify the implementation of their geospatial technology projects, thus expanding the collective contributions to the NSDI. Apart from standardized and documented methodology for developing GIT business cases, the list of the project benefits encompasses also the workbook with templates to assist organizations in applying the standards, and resource for supporting better Geospatial Information & Technology (GIT) investment decisions by utilities and governments. The collaborative version of the ROI workbook, methodology, templates will enable organizations to quantitatively determine the business value of taking a collaborative, multi-organizational approach when developing and accessing geographic data and services.

The project consists of several phases, i.e. Project Conception, Literature Review, Users Survey, Workbook and Template Development, Case Studies Development, Business Case Development and Return on Investment Methodology Workbook Completion.

Review of the Literature

The literature review was substantially completed through a review of conference proceedings and papers published through AWWA and GITA. Information Technology specific return-on-investment trends were also collected and will be incorporated into the methodology documentation. The available literature is typically more project “story” related vs. ROI focus while ROI analysis required for project approvals and post implementation audits. Nevertheless, the proactive maintenance, mobile applications and multiple department usage initiatives showed increased benefits to the organization.

Large amounts of money involved in GIT together with competition with other investment opportunities, and need for full validation of project prior to initiation are the main reasons for using ROI methodology in this sector. This methodology enables identification of opportunities to structure project to achieve interim benefits quicker. The ROI methodology can be used in many project phases i.e.: Strategy Development, Project Initiation, Project Detailed Design completion, Project completion, When in operation for some time, and When assessing replacement of the tool.

Traditional models were based on labor savings by implementing technology. Now organizations are much leaner, and often have existing systems, resulting in less incremental benefits available. Thus ROI should now focus on the financial statement drivers and corporate strategies, while current “hot buttons” are as follows: Lean Operations (eliminate waste/shorten cycle times), Compliance Tracking, Reliability Centered maintenance, Asset Management, and Optimization of Material.

GIT Applications

The uses of Geospatial technology by utilities and government agencies were grouped into twelve major categories and the papers identified in the literature review were cross referenced to these categories and to the business sector they were developed from. There are: Automated Map Production and Data Maintenance, Engineering, Planning and Design ,Call Management, Outage Management, Dispatch, Emergency Preparedness, Field Infrastructure Management, Facility Management (Plants, Buildings, Land), Quality of Life, Public Health, Safety and Community Services, Development Review, Zoning and Permitting, Property Appraisal / Tax Assessment, Customer Relationship Management, Regulatory Compliance, Environmental Quality and Watershed Management.

User Surveys

A series of web surveys for each of the twelve usage categories of Geospatial technology were developed and are in the process of being finalized for distribution to participants. 219 surveys were completed, and many organizations completed multiple surveys: majority of responses from U.S. (63), Canada (16), Australia (4), while single responses from Brazil, Hungary, India, Japan, Netherlands, Nigeria, Portugal and Turkey.

The analysis of the respondents by Sector shows: Government (32), Water/Wastewater/Storm (24), Electric (14), Gas (6), Oil & Gas Pipelines (6), Others – Transportation, Education, Steam Distribution, Telecommunications, Consulting.

Survey Results

The survey showed that the most common implementations were: Automated Mapping and Data Maintenance (79 projects), Planning/Engineering Design & Construction (29 project), Field Infrastructure Management (28 projects), Emergency Response/Critical Infrastructure Protection (19 projects), Call Management/Outage Management/ Dispatch (16 projects), Environmental Quality/Watershed Management (11 projects).

As for Automated Mapping and Data Maintenance, 66% of the projects were in production. Most respondents saw benefits in multiple areas, among them the most common are: reduced map production costs, more accessible data, eliminate reconciliation tasks. Rarer but notable benefit was identified as ‘avoided liability by providing timely and accurate information to the field’.

As for Planning, Engineering Design and Construction, 61% of the projects were in production. The benefits were broader spread, perhaps indicating more single user/department targeted projects in this category.

As for Field Infrastructure Management (50% of projects in production), organizations were seeing benefits in multiple areas of productivity, safety, and access to information. Very few were sharing common costs with other organizations.

In the project on Emergency Response & Critical Infrastructure Protection (58% of projects in production), the majority of benefits were in the primary areas of protecting public and critical infrastructure. Consolidation of emergency operations centers was being done by some organizations. And some saw benefits in claims/insurance management.

As for Call Management, Outage Management & Dispatch (47% of projects in production) projects, the most focused benefits were around improved customer service/public goodwill followed closely by reduced travel times and duplication of work. Opportunities to improve external stakeholder relations were also seen.

And as for Environmental Quality and Watershed Management (90% of projects in production), the primary benefits seen were: the avoidance of fines associated with environmental damage, and a healthier environment and good citizenship.

Case Study Development

Case studies were selected from literature review, survey responses, industry contacts, and collaboration with partners. The first case study tested templates and approach. Participants i.e. City of Cleveland, Ohio USA; Washington State Dept. of Transportation, USA; EPCOR, Canada; Telus, Canada; Honolulu Board of Water Supply, Hawaii USA, were chosen to cover a range of applications/benefits and cost.

Typical GIS Strategic Benefits and GIS costs

The most common examples of intangible or broad categories of strategic benefits identified include: provision of better information for improved decision making, shared data and services, more consistent access to data, improved services to citizens/customers, ability to integrate data among other systems, and ability to generate new 'understandings', from the data easier access to data. Costs are highly front-loaded on most GIS programs. Consequently, information about all the potential benefits an organization could expect to obtain becomes vital in determining the business case and ROI. The non-extensive list of the typical GIS costs includes: hardware integration with pre-existing computing infrastructure; evaluation, selection, acquisition and installation of software; undertaking requirements/needs analysis; contractual aspects; systems customization; applications portfolio development; interfacing to other 'data servers' and operational systems; business case analysis; project management; delivery and installation; business process re-engineering; transitional costs (i.e. parallel running of old and new systems); on-going cost implications (i.e. staff costs and consumables); data purchase; data capture, data conversion; data re-survey and validation; training, human resources planning, skills development and re-skilling.

Typical Project Constraints

The analysis of the case studies identified some typical project constraints i.e.: the lack of a business case to obtain funding, insufficient staff or skills to implement and maintain an enterprise GIS, inefficient work practices, no enterprise strategy - individual departments developing their own GIS databases and applications. Additionally, much of the data is in a form that needs to be converted/migrated (e.g. paper data), or incorporating data is of questionable reliability (inaccurate data). Often there is lack of metadata and standards, and the legacy system integration is pricey.

Project Status

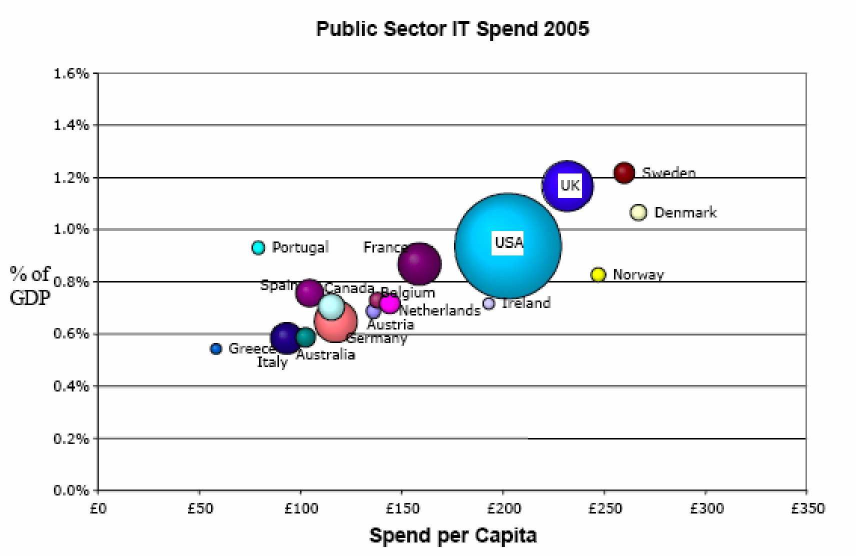
Most of the case studies are completed, the rest are scheduled for beginning of 2006. The Workbook is being finalized for delivery to publishing team, while the published version is targeted for 2006.

Cost-Benefit Analysis in the context of eGovernment

eGovernment is the use of information and communication technology, combined with organizational change and new skills to improve public services, increase democratic participation and enhance public policy making. Ideally, transformation should occur jointly at European, national, regional and local levels.

Since 1990's, a significant amount of time and money have been spent on turning the eGovernment visions into reality. There is no standard way of tracking IT spend across government as a whole, or of assessing its impact. However external estimates suggest that in the UK in 2004 around £14 billion was spent by government on IT. An average of 25% of IT spend is on new projects. The rest is devoted to maintaining legacy systems. As the chart (Figure 14) shows, UK spending on public sector IT amounts to about 1.2 % of GDP and, compared with other countries, is in the upper part of the range. It has also risen in real terms over the last decade.

Figure 14: e-government spending

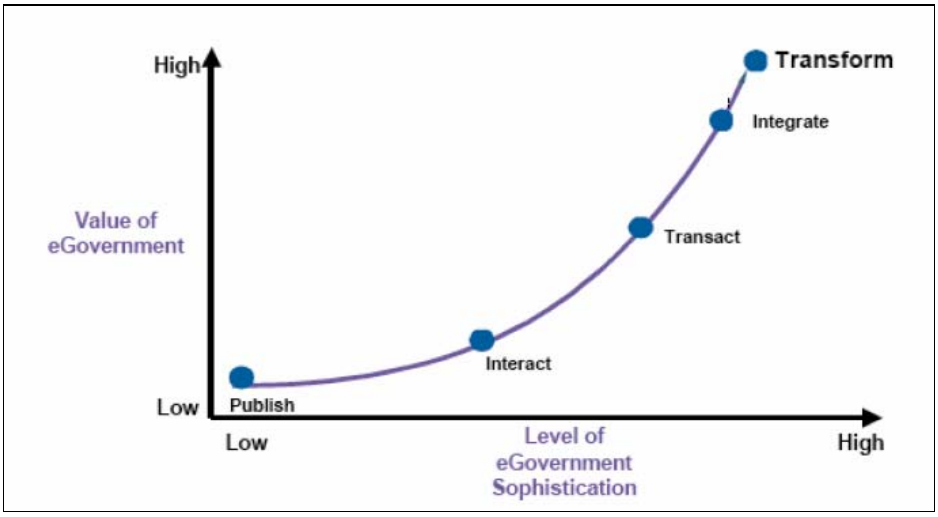


Source: http://www.cio.gov.uk/documents/pdf/transgov/strategy-workfile.pdf Page 16

However, realizing the visions has proven to be far more difficult than most people imagined. Technology alone does not transform government, but government cannot transform to meet modern citizens' expectations without it.

For instance, former U.S. eGovernment director Mark Forman considered eGovernment a method by which governments can "transform the way it does business with citizens". And transformation comes not from moving services online, but from fundamentally restructuring the public administration's organization and integrating work processes across agencies to put the citizen at the center and simplify interaction, reduce cost and improve service.

Figure 15: Stages of e-government



Source: Value Creation in eGovernment projects. Danish Government. Page 7
http://e.gov.dk/uploads/media/Value_Creation_in_eGovernment_projects_01.pdf

As in the context of SDIs, measuring the impact of e-government is not easy as recognized in the US General Service Administration (GSA) report High Payoff in Electronic Government - Measuring the Return on E-government Investments (2003), which concludes: “These assessment methodologies have been used around the world, to a greater or lesser extent in different jurisdictions … There is no uniform “cookie cutter” approach to determining the E-Gov program that will have the highest payoff for a jurisdiction. Accordingly, there is no single measurement method that will apply as well for one government or agency as for another.” (page 4)

In the UK, e-government has featured highly in the political agenda of the Government aimed at modernising and transforming public services. An initial document setting out ambitious targets for all government services to be available on line by 2005 was published in 1999 (NAO, 1999) and revised in 2005 (CIO, 2005). The strategy for local e-government was published in 2002 (ODPM, 2002) with an investment of 675 million pounds over a five year period. Implementing E-Government programme, makes it mandatory for local authorities to publish their returns on their web-site. An example is the one posted by Brighton & Hove City Council[2] containing a self-assessment of progress based on a system of flags as indicated below:

Black = Not part of current local e-government strategy or not applicable

Red = Preparation & planning – to include projects that are being planned or being piloted

Amber = Implementation stage – roll out of approved projects

Green = Fully implemented – projects completed & implemented.

Figure 16: Example of self-assessment of Implementing E-Government, Brighton and Hove City Council

	e-consultation included within this. New Consultation pages on our website at http://www.brighton-hove.gov.uk/site01.cfm?request=b1135902. We are planning to deliver the next-but-one Citizen's Panel online.			
G4 Establishment of multimedia resources on local policy priorities accessible via public website (e.g. video & audio files).	Red 01/09/2005	Red 01/09/2005	Amber 01/10/2005	Green 31/03/2006
	Comment: Will utilise video streaming software we already have in place, which is currently being used to webcast weddings.			
If already 'green' on R5, R6, G3 & G4 above please comment on **E3** Agreed baseline and targets for e-participation activities, including targets for citizen satisfaction. Otherwise you may leave this row blank.	**Comment:**			
R7 Online public reporting/applications, procurement and tracking of environmental services, includes waste management and street scene (e.g. abandoned cars, graffiti removal, bulky waste removal, recycling).	Amber 01/07/2005	Amber 01/07/2005	Amber 01/07/2005	Green 31/03/2006
	Comment: This will be integrated into the first tranche of our CRM implementation programme.			
R8 Online receipt and processing of planning and building control applications.	Green 31/03/2005	Green 31/03/2005	Green 31/03/2005	Green 31/03/2005
	Comment: Currently through the Planning Portal; from 09/05 will be part of our EDRM implementation.			
G5 Public access to corporate Geographic Information Systems (GIS) for map-based data presentation of property-related information.	Green 31/03/2005	Green 31/03/2005	Green 31/03/2005	Green 31/03/2005
	Comment: See www.citystats.org			
G6 Sharing of Trading Standards data between councils for business planning and enforcement purposes.	Amber 01/10/2004	Amber 01/10/2004	Green 31/12/2005	Green 31/12/2005
	Comment: Trading Standards department currently exchanging electronic information with OFT Consumer Regulation website and Patents Office website. Also partners in local 'Buy with Confidence' approved traders website and will shortly be active in project to exchange information on itinerant traders with East and West Sussex, via National Anti-Fraud network website.			

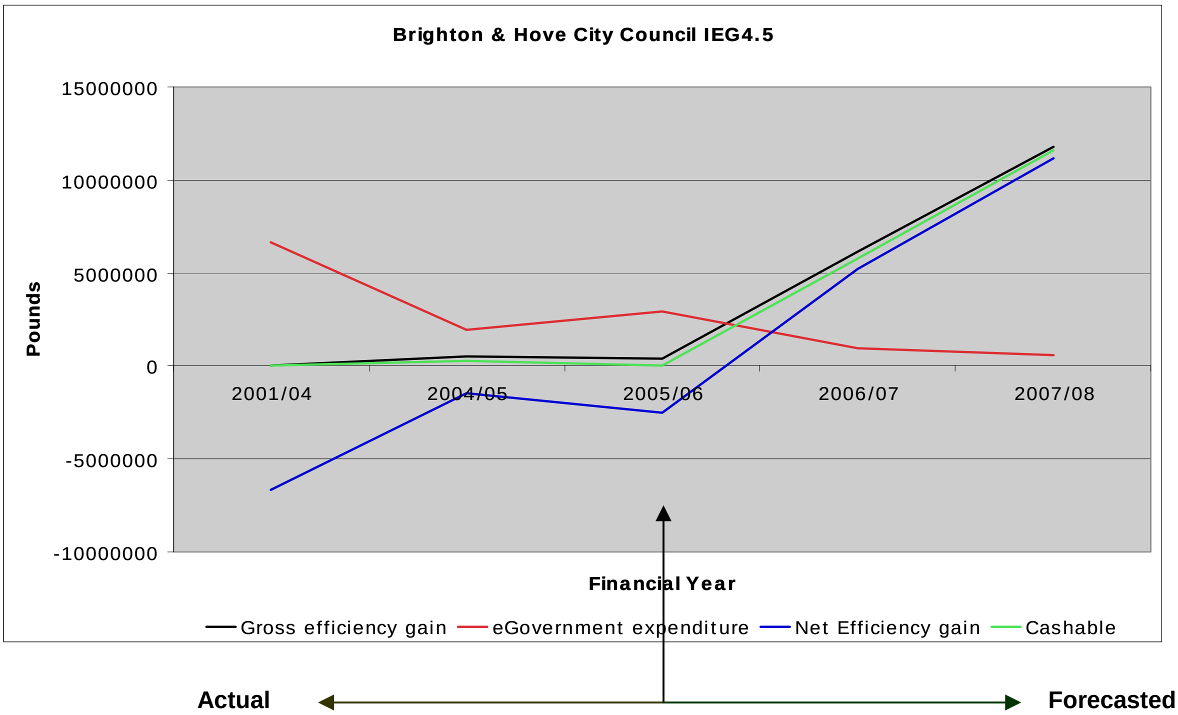
6

Source: Brighton and Hove City Council

2 http://www.brighton-hove.gov.uk/downloads/bhcc/egov/IEG_statement_2005.pdf

Cost-Benefit Analysis is undertaken based on the methodology published by the Treasury in its "Green Book" *Appraisal and Evaluation in Central Government*, 2003 (http://greenbook.treasury.gov.uk/)

Figure 17: Cost-Benefit Analysis at the organisational level based Brighton and Hove City Council on the HM Treasury Green Book methodology



Excludes cyclical costs (ongoing maintenance)

Source: Corbin 2006.

The definition of Cashable and non-cashable gains is provided by the Office of the Deputy Prime Minister Efficiency Technical Note[3] as follows (pg 8):

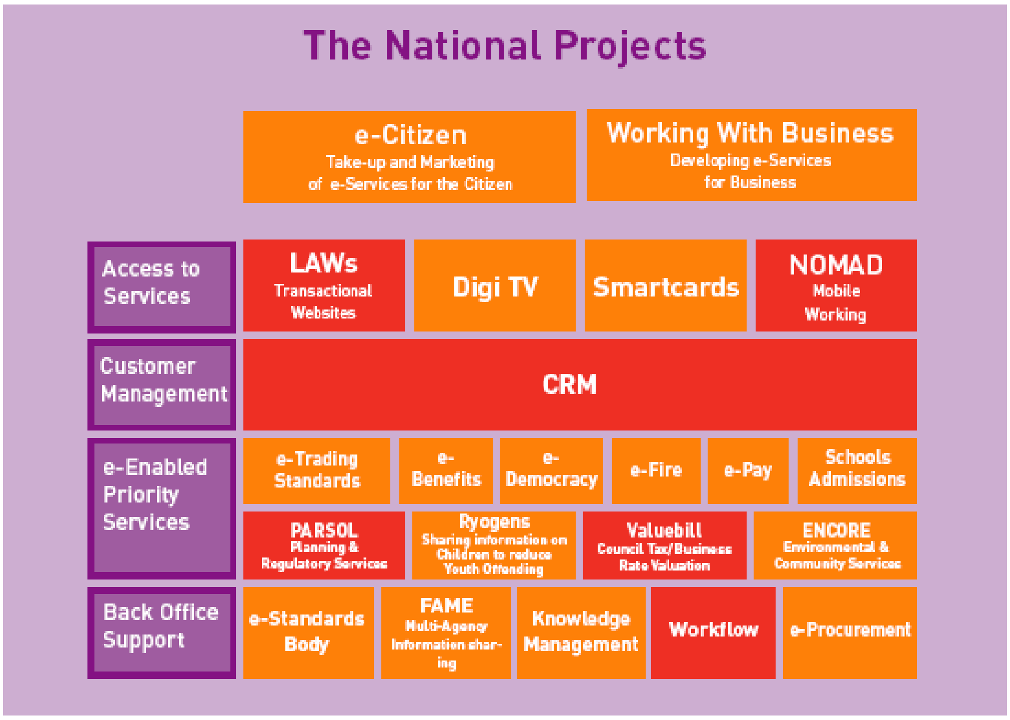
> Cashable gains represent the potential to release resources for reallocation elsewhere. By contrast, non-cashable gains are achieved through such means as improved quality or additional outputs for the same level of resources. For the Gershon[4] workstreams, this implies the following:
> ● *Procurement* efficiency gains realised through greater economies of scale or lower prices are cashable. This includes instances where prices have been negotiated to below the level of inflation. Where higher quality goods and services are procured for the same prices (after allowing for inflation), gains are non-cashable;

[3] http://www.odpm.gov.uk/pub/532/EfficiencytechnicalnoteforlocalgovernmentPDF336Kb_id1135532.pdf
[4] Sir Peter Gershon's undertook a review of public sector efficiency in 2004 as part of UK HM Treasury spending review. Ref: http://www.hm-treasury.gov.uk/spending_review/spend_sr04/associated_documents/spending_sr04_efficiency.cfm

● *Corporate services* will be cashable for those cases of less expenditure for the same outcomes, non-cashable where better outcomes are achieved for the same expenditure;
● *Transactions* follows the same approach as corporate services. In the case where improved output is claimed, it must be clear that the improved output is genuinely beneficial to the end user;
● *Productive time* cashable gains include those where input costs have decreased. Increased input levels (such as through reduced absenteeism) or increased output levels represent non-cashable gains.

The ODPM's 22 National Projects[5] aim to create the building blocks to help English local authorities deliver local e-government - meeting their Priority Outcome requirements and tackling the Gershon efficiency review along the way. Underlying the National Projects is the principle 'build once, use often'. The National Projects Programme was therefore established to supplement the communication activities of individual National Projects in highlighting the successful products and services that they have developed.

Figure 18: Summary of the 22 national projects to support local e-government



Source: National Projects: Page 3
http://www.localegovnp.org/webfiles/Benefits/Benefits%20Guide%20Folder%20web.pdf

Independent reports by Capgemini on the benefits that six of the National Projects can deliver to English councils provide a substantive case for widescale implementation. The estimated average annual values of these benefits (across all English local authorities, for the six projects) are: cost savings: £320m, increased revenue: £60m, service improvement: £1,300m.

Capgemini's findings are based on the experiences of the local authorities engaged in implementing these solutions. Their experiences have provided a sample for analysis from

[5] http://www.localegovnp.org/webfiles/National%20Projects/NP%20Summary%20(final).pdf

which reasoned conclusions have been drawn and validated with local authorities and their suppliers.

The table below illustrates how the six projects can directly impact the performance of authorities in these areas. The full Benefits Guides[6] demonstrate how the projects impact on other key performance areas, such as achievement against the Priority Service Outcomes.

Figure 19: Comparison of Key Benefits

	Comparison of Key Benefit Areas				
	Cost Reduction		Added Value / Service Improvement		Strategic Intangible Benefits
	Transactional / Process	Other Cost Reduction	Increased Revenue	Service Improvement	
CRM	Reduced cost per resolved transactions	More cost effective use of channels		More effective production and use of management information Improved customer satisfaction and response time	Improved public perception and awareness of services Catalyst for organisational change
Workflow	Reduction in time to process end to end applications to council	Reduction in paper costs, storage space and office space required	Faster processing of council tax payments	Easier organisation change Reduction in errors and rework Customer satisfaction More responsive systems Reduced backlogs	Consistency of service quality Transparency of processes
LAWs		No software licence fees or maintenance of individual category list		Reduction in web development costs Increased availability of online services	Consistency and connectivity across local authorities Shaping software market for local authorities Aid to compliance to DDA
NOMAD	Increased field officer productive time Quicker assessments & transactional services		More effective revenue collection	Improved data quality Customer satisfaction Asset rationalisation	Catalyst for joined up service delivery Increased customer convenience Increased staff satisfaction
PARSOL	Access to info/services out of hours Speedier self-assessment	Reduced application and consultation costs (Fast Track applications)		Reduction in errors and rework Greater accuracy of info Customer satisfaction Speedier responses to applications	Transparency of info leads to better monitoring of applications
Valuebill	More accurate identification of households liable to pay Improved internal services		More households identified for collection Reduced uncollected rates	Improved accuracy of LLPG data and property valuation cycle Reduction in number of valuation appeals; faster responses to queries	Better visibility of information Improved staff confidence in data

KEY Size of benefit

Source: National Projects: Page 2
http://www.localegovnp.org/webfiles/Benefits/Benefits%20Guide%20Folder%20web.pdf

The National e-Procurement Project (NePP) has published research[7] confirming that £1.1bn of cost savings plus the equivalent of 3,300 full-time staff can be saved nationally by local authorities. The e-Pay National Project[8] has prepared a report which suggests that, in total over the next five years, e-payments could save local authorities £708m.
From the review of current experiences in the UK, it would appear that CBAs are carried out mainly at the project level, and in some instances at the organizational level, with assumptions not always very transparent to independent scrutiny. Very little appears to be undertaken or published at the broader sector or national framework level, but it is questionable whether CBA would be the appropriate methodology anyway at these levels.

These problems are not confined to the UK but are apparently quite common. A European-funded project, the e-Government Economic Project[9], part of the eEurope MODINIS programme, has undertaken a comprehensive survey of 64 e-government projects both within and outside the EU.

The main result of this survey is that the overwhelming majority of the reports focus on supply-side indicators (# of services available online) and/or e-readiness (presence/absence of structural and institutional conditions for the development of eGovernment and more in

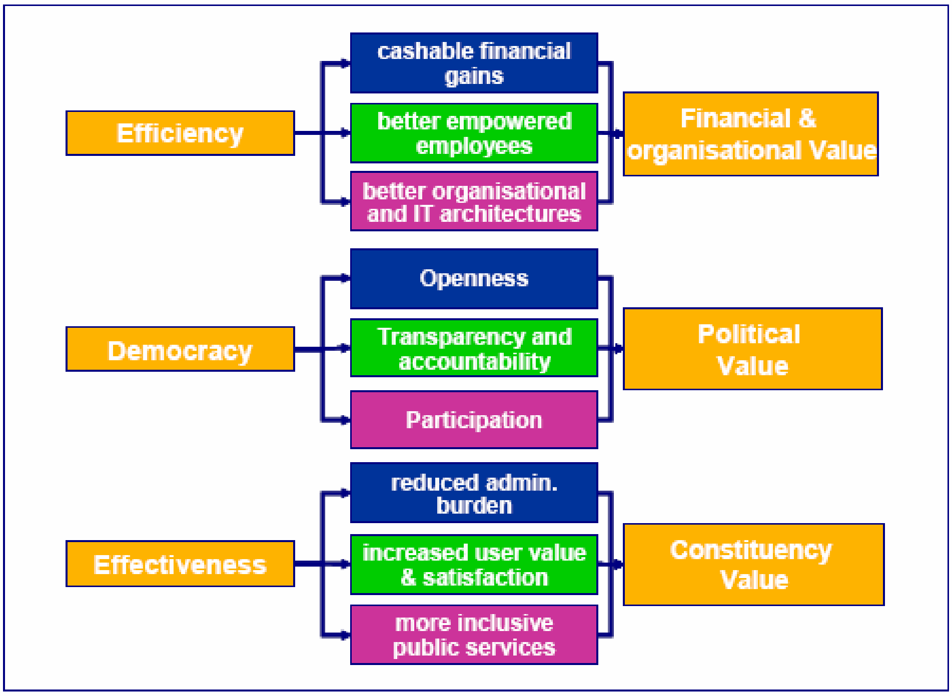
6 http://www.localegovnp.org.uk/webfiles/Benefits/Benefits%20Guide%20Folder%20web.pdf
7 http://www.localegovnp.org.uk/default.asp?sID=1103458649625
8 http://www.localegovnp.org.uk/webfiles/Benefits/epay%20ben%20statement.pdf
9 http://217.59.60.50/eGEP/Static/E_Interim.asp?ST=0

general of the Information Society), while an increasing, but still limited number, considers the demand side (i.e. take-up and satisfaction with services).

A total of 24 entries of the 64 screened deal to some degrees with the topic of measuring eGovernment concrete impacts. More precisely of these 24 entries: in 5 cases eGovernment impacts is only an additional topic discussed briefly with no measurement indicators; 8 reports are devoted to impacts but contain no sustained analysis of measurement indicators, while only 11 reports provide some insights into actual measurements mainly presenting micro-oriented business cases methodologies. Moreover, very few go as far as moving beyond the identification of impacts into the elaboration of an exhaustive list of concrete indicators and of an implementation methodology. Finally no study has attempted so far to produce a measurement framework, which includes also elements from an in-depth analysis of costs and which is based on an economic theoretical model of eGovernment impacts
(Source: Boccardelli, Leone and Codagnone, 2006, pg. 13)

The framework to measure the impact of e-government put forward by the eGEP project is particularly interesting because whilst on the cost side it predictably considers the costs of set-up, operation, provision, and maintenance of e-government services, on the benefits side it attempts to capture both economic and social/political values, and puts forward a set of measurable indicators together with a methodology to undertake the measurements. The overall framework of impacts is shown below.

Figure 20: eGEP Measurement Framework Benefits



Source: Codagnone, Boccardelli and Leone, 2006, pg. 15

Some 90 indicators to measure the impacts of e-government are proposed by the eGEP project, based on a range of available data sources summarized in the table below:

Table 10: Available data sources for assessing e-government projects

Data Sources	Relevance	Cost	Comparability
Official statistics	Low	Low	High
Internal administrative records	High	High	Low
Standard Cost Model estimates	High	High	Medium
Internal self-assessment	Medium	High	Low
Users satisfaction surveys [a]	High	Medium	High
Pop-up survey [a]	Medium	Medium	High
Web metrics and crawlers [a]	High	Medium	Medium-high
Third party web assessment [a]	Variable	Medium	High

[a] Cost to Member States is assessed here considering the involvement in terms of the definition of a common methodology and of a comparable panel of services to be measured.

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Source: Codagnone, Boccardelli and Leone, 2006, pg. 20.

The project does not suggests that all 92 indicators should be used but leave the selection of indicators to the users of their framework based on what seems best suited to their needs. All indicators are standardized as distance from the mean (actual value/mean value)X 100 to account for the different units of measurement of each indicator. A small subset of indicators is also put forward as candidates for benchmarking e-government projects across the EU25, linked to the five priorities of the 2010 eGovernment Action Plan:

- No citizens left behind
- Effective and Efficient government
- High Impact Services
- Electronic ID
- e-Democracy

Figure 21: Proposed benchmarking indicators, eGEP project

Sign-posts	INDICATORS
1	1.1 Usage of eGovernment services by socially disadvantaged groups
	1.2 Public websites degree of compliance with international accessibility standards
2	2.1 Users' satisfaction with eGovernment services
	2.2 Amount of information requested from citizens and businesses
	2.3 Number of transactions fully completed online
3	3.1 % of public procurement above the EU threshold available electronically
	3.2 % of public procurement above the EU threshold carried out electronically
4	4.1 Number of transactional public services with legally binding and mutually recognised eID
	4.2 Number of functioning pan-European online services
5	5.1 eParticipation sophistication index
	5.2 Number of Unique Users of Online Forum

Source: Codagnone, Boccardelli and Leone, 2006, pg. 29.

Two issues make this project particularly interesting in the context of SDIs: first, that the eGEP project identifies for each indicator the relevant source of data, and how to operationalise the measurement, and second, that many of the indicators proposed may also be relevant for SDIs. As an example, the table below shows the proposals in respect to Indicator 2.2: Amount of information requested from citizens and businesses.

Figure 22: Example of eGEP proposed indicators

Indicator 2.2: Amount of information requested from citizens and businesses

This indicator measures the eGovernment contribution to the reduction of administrative burden and the decision to include it arises from the availability of a new, very relevant and feasible methodology currently applied in the Netherlands: ***Monitor: Multiple Use of Information***[50]

Joint EU & MS Operationalisation: Define the panel of public services to be considered.

eGEP suggestions: Start with the 20 basic public services.

Source of data: Web based assessment of the amount of information requested in online forms.

Implementation by : EU contractor.

Note: 50 http://www.minbzk.nl/contents/pages/65347/monitor.pdf

Source: Codagnone, Boccardelli and Leone, 2006, pg. 34.

For other indicators proposals include adding specific questions to existing questionnaires such as that by EUROSTAT on 'ICT usage in households and by individuals' or collaborating with the European Internet Accessibility Observatory (EIAO, http://www.eiao.net/).

Examples of indicators proposed that may also be of relevance to a framework for measuring SDIs impacts, and that would benefit from piggy-backing on e-government measurements are shown in the table below. For a full list of indicators see Codagnone et al. (2006).

Table 11: Subset of eGEP indicators for e-governent potentially suitable for SDI impact measurement

EFFICIENCY		
Impact	Indicator	Source (see fig 23)
Cashable Financial Gains	Δ % case handled per processing full time equivalent Δ % K€ in maintenance costs Δ % economies of scale gains	ADRE ADRE ADRE
Better empowered employees	Δ % in number of employees re-trained Δ % in improved job content score Δ % in employees' satisfaction score	ISA ISA ISA
Better organisational and IT architectures	Δ % in number of internal protocols needed for cross-agencies services Δ % in number of integrated services available in main Government Portal Δ % in improved inter-operability score	ADRE ADRE/TPA ISA

DEMOCRACY		
Impact	Indicator	Source
Openness	Δ % in number of policy drafts online for consultation t Δ % increase in number of government websites providing platforms for digital interaction and consultation (online forum, e-petitioning, etc) Δ % in number of government websites providing two-way interaction with users	TPA TPA ADRE/WMET
Transparency and accountability	Δ % in overall volume of administrative and legislative documentation online Δ % in online public information clarity and accuracy score % Δ in externally assessed transparency score	TPA/WCR TPA TPA
Participation	% increase in queries submitted online % increase in online forum interaction % increase in policy drafts downloaded	WMET WMET WMET

EFFECTIVENESS		
Impact	Indicator	Source
Reduced Administrative burden	Δ % K€ cost savings for citizens (travel, postage, fees to intermediaries) Δ % K€ cost savings for businesses (travel, postage fees to intermediaries) Δ % users reporting e-service saved time over traditional methods for a standard bundle of services	SCMC SCMC POPS
Increased user Value and Satisfaction	Δ % in off-hours service usage/info downloads Δ % in number of unique users cross-using services in Government Portal Δ % in number of users reporting eGovernment services to be useful	WMET/POPS WMET RSS
More inclusive Public services	Δ % of Internet penetration by age/ income/ educational attainment Δ % increase of eGovernment usage by socially disadvantaged groups Δ % in usage of government portals for businesses	RSS RSS WMET

Figure 23: Description of data sources

Table A.1 Legend of Indicators Data Sources Acronyms	Full Description of Source
OS	Official Statistics
ADRE56	Administrative Records Data, for instance: ⑨ Personnel costs; ⑨ Material costs; ⑨ Volumes of output (files, cases, transaction processed); ⑨ Description of standard procedures and business processes and of corresponding working times; ⑨ Other
SCMC57	Standard Cost Model Calculations
ISA58	Internal Self-Assessment based on qualitative Scale
RSS59	Random sample survey for user Satisfaction and usage Data and index construction60
ESUR	Employee Surveys
POPS61	Pop-up Surveys.
TPA62 .	Third Party Assessment
WCR63	Automatic Web Crawler Software
WMET64 .	Web Metrics Data: ⑨ Number of hits or user contact sessions; ⑨ Number of document downloads; ⑨ Amount of time users spend on a site; ⑨ Number of transactions completed; ⑨ Web analytics (click streams, repeat use, cross-usage)

Source: Codagnone, Boccardelli and Leone, 2006, pg. 53

The indicators shown in Table 11 is only an arbitrary sub-section of the ones proposed by eGEP, and could be modified to reflect more accurately the spatial dimension of the data and services offered via an SDI. They are offered however as an element of discussion on the value of defining indicators for benchmarking SDI development in an international context. The next Section discusses more fully the findings of the workshop and recommendations for further work.

Summary of Key Issues and Future Directions

The previous section has highlighted some examples of good practice in the three related areas of SDI, GIS, and e-government. In respect to SDI-specific studies:

The INSPIRE Assessment, shows the value of using expert groups for estimating likely impacts. The method was relatively quick and inexpensive and delivered useful results, confirmed by other studies like the one in the Netherlands. This method however must be based on clearly stated assumptions, and public scrutiny to allow for feedback on the estimates made by the experts. Transparency of assumptions and simplicity of method, also allow for easy validation and revisions as the SDI gets implemented. The study also shows the value of small surveys, like the one conducted among firms undertaking Environmental Impact Assessments and Strategic Environmental Assessments. Grounding the estimates with firm evidence, particularly in processes that are undertaken thousands of times is critically important. Such value is also evident from the micro-studies undertaken in Catalunya. Firm evidence of benefits on processes repeated many times.

The Geo- Value Measuring Methodology deployed for the NASA study also used expert opinion to elicit measures of values and assign weights. It is a particularly useful framework in respect to its structured approach, and clarity in comparing two comparable programmes one with, and one without the dimension under study, in this case the value of interoperability based on open standards. This is an ideal scenario and most methods presented in this report rely on a comparison, implicit or explicit, between a do-nothing and do-something scenario. The difficulty often is that both scenarios have yet to develop fully, and so too many assumptions may be required. The NASA study is particularly useful because it is based on two existing and on-going programmes that could be measured, and for which risk adjustments could also be made.

The value of the modeling approach taken by the CBA of The National Map (and the GOS Initiative) rests in particular on its ability to account for the dynamic nature of the diffusion process both in respect to the number of users, and their increasing range and level of sophistication of applications. Moreover, through this model, it is possible to conduct sensitivity analysis of different assumptions, which then may be subject to further work. As in the preceding case, comparison is made between an hypothesized with and without programme scenarios. Whilst this modeling approach has numerous strengths, it is clear that the more sophisticated the internal workings of the model, the more opaque the model becomes to non-experts, potentially limiting the open scrutiny and feedback. Furthermore, there is a risk that the many assumptions made to set the model up become obscured by its apparent computational rigor.

The Dutch experiences have also several useful lessons. The framework used was originally developed for physical infrastructures, and seems to adapt well to digital infrastructures like SDIs. A particular feature here, compared to the experiences discussed above, is that in this framework there is an explicit attempt to include not only direct economic benefits, but also indirect and external benefits, thus potentially capturing the wider social dimension of an infrastructure project. As the case-study of aligning the basic registers has shown, the social benefits are difficult to monetize and there is also a lack of enough information to build upon. Nevertheless, this social view of CBAs is an enormously valuable framework, and the guidelines recommend the use of a range of both qualitative (interviews, surveys, case-studies) and quantitative methods (macro-economic function, and models), to capture the indirect benefits.

In respect to the more GIS-focused studies, the previous section has identified a number of studies taken over the last 15-20 years. (See Table 1 for example). However, the assumptions made appear difficult to ascertain, there is a lack of consistency in methodologies, and above all, no validation studies appear to have been made. For this reason, the outcome of the GITA project to develop a coherent methodology for business case development is particularly welcome. Once the outcome of that project, and its case-studies is released later this year, it will also possible to assess the extent to which the assumptions made, outcome measured, and the lessons learned can also be extended to SDIs.

In respect to e-government, it is interesting to note that even here relatively few impact assessments have been carried out despite the large investments made world-wide in this field. Similarly to the case of SDI, lack of consistent methodology, and narrow focus of the benefits seem to characterize the few assessments made. On the positive side, particularly in Europe, governments have committed themselves to e-enabling their processes, CBA or not, and have agreed targets to meet against which they now need to measure their performance. This is not something we have seen yet in the SDI arena, although the INSPIRE Directive may change that in the future. The need to develop agreed monitoring indicators has spurred dedicated projects like eGEP from which several lessons can be learned in respect to SDI monitoring. Moreover, if indicators of SDI implementation and impacts were to be agreed, there would be benefits of synergy in undertaking joint measurement work, including surveys, with e-government programmes, and more generally in seeing an increased integration of SDIs into e-government frameworks.

From the review of these cases of good practice, several issues arise that are explore below.

Why so few impact assessments?

The dearth of impact assessments in the field of SDIs (but also of e-government) may be rather surprising considering the large number of SDI initiatives taking place worldwide, but may be explained by the changing nature of SDI. The first generation of SDIs was largely driven by public sector mapping agencies with an emphasis on specific products such as the creation or completion of a spatial database, their diversification in multiple products, the creation of metadata as part of the production process, the development of clearinghouses, the emergence of web map publishing and so on. Multiple projects took place which contribute towards an SDI but can be delivered through dedicated project funding often internal to an organization or part of existing operational practices. If estimations of costs and benefits were made, particularly to access grants or other types of funding, they appear not to have been published or validated in the light of post-project experience. There is a definitional aspect here: we consider all of these projects under the SDI umbrella but it is a very fragmented type of SDI, leading to multiple interpretations of what an SDI is, and difficulty in developing meaningful comparisons. Nevertheless, as the diffusion of SDI has gathered momentum and social networks of SDI practitioners have contributed to greater shared understanding and exchange of practice, (the so-called second generation of SDIs) the internal/project characteristic of earlier developments has moved towards wider coordinated efforts among multiple stakeholders. This opening of SDIs to external partners may be now contributing to greater demands for impact assessments, exposing the dearth of existing studies more clearly. This reading of SDI evolution is consistent with the Levels 1 and 2 of the typology of Maturity levels put forward by Lance (2006) and shown in Table 2 of this report.

General trend towards measuring policy impacts

On the positive side, the growing awareness of the need to more formally and openly account for the impact of SDIs emerges clearly from this report. In Europe, the political process associated to the INSPIRE proposal has required to undertake an extended impact assessment, which has also contributed to similar assessments in the Member States and more generally to the recognition of SDIs and of the need to measure their impacts. It is worth here to note that the need to assess policy impacts is not specific to SDIs. For example, the European Commission Communication requiring an impact assessment on all new policy proposals having potential social, economic, and environmental impacts or regulatory in nature is dated 2002 and the system became operational in 2004/05 (CEC, 2002) So the need to improve the quality and coherence of public policy is generic, and impact assessment is but one instrument contributing towards this improvement. It just so happened that one of the very first proposals to be subject to an extended impact assessment was INSPIRE, which is good because it also indicates a recognition of the importance of SDIs. Similar policy trends towards more open and integrated assessment appear visible also in Canada and the U.S.A.

When to assess?

If here is a convergence between the requirement to assess the impacts of public policies, and the growing level of maturity of SDIs, then we are likely to see more and more SDI assessments being required. This brings of the issues of when to do such assessments, and how. Looking at the timing, it would appear that the experiences so far have mainly focused on ex-ante studies, i.e. on impact assessments at a very early stage of the process, when funding is requested. This seems to have been the case not only for INSPIRE, but also for all the studies undertaken in the Netherlands, and for the National Map and the Geoportal in the US. There is little doubt that funding requested is a critical milestone at which impact assessment studies are needed. Nevertheless, it should not be the only time to assess impacts. If from a political/strategic point of view, the decision to fund is crucial, from a research point of view these ex-ante studies are of limited value if the assumptions upon which they are based are then not verified. So it is equally important, at least in research terms, but also to develop the collective knowledge that would strengthen the initial impact assessments, that further analyses are undertaken during the life-time of the SDI development to verify the assumptions made, ensure that the project is still on course to meet its objective, or steer it in the light of new external developments in either policy or technology, or both. We have yet to see enough of these mid-term impact assessments done or published, but there is little doubt that they stand to provide very useful feedback on the real impacts of SDIs, and not just their assumed impacts.

Frameworks for Assessment

There are multiple frameworks available as shown in this report. In general, we are likely to need more formal types of assessment, e.g. cost-benefits analysis at critical milestones of the development of an SDI (funding request, mid-term evaluation, end of grant) and less formal types during the lifetime of the project. These include self-assessment, and the use of indicators collected as automatically as possible for monitoring and reporting purposes. In this respect the indicators being developed for e-government are well worth analyzing in greater detail as discussed later.

Throughout this report, we have seen different terms being used: cost-benefit analysis, return on investment, impact assessment, and so on. Whilst impact assessment is in principle more generic, and may include assessment of social, economic, and environmental impacts, cost-benefit analysis (CBA) and return on investment (RoI) are more specific tools for project or investment appraisal where the results maybe presented either as rate of return or net present values. Whilst economists may have more precise distinctions between different tools, based for example on the distinction between deterministic and non-deterministic models, i.e. the handling of uncertainties, in practical terms the choice of assessment tool may depend on the scope of he analysis i.e. whether the focus is primarily financial (RoI), or tries to give monetary values to goods and services with no or only partial market value (i.e. public goods, market failures/market power, missing markets), and "externalities" (CBA), or tries to include even more explicitly non-monetary values as advocated for example in the "social CBA" in Netherlands (but see also HM Treasury 2003). Therefore, the choice of tool depends on the focus of the assessment, but also of course on time and resources available.

What to assess?

Notwithstanding the consideration above that different assessments may have different focus and therefore approach, there seems to be a consensus emerging from the review of this report that the measurement of *costs* should include set-up costs (including planning, and development, acquisition and implementation), operation, and maintenance (see for example eGEP, and NASA study). Worth however also considering other potentially important costs like internal organisational costs (disruption, reassignments, and so on), coordination and consultation, and legal adaptation (if required) as in the case of the Dutch study of alignment of the basic registers (see Table 7).

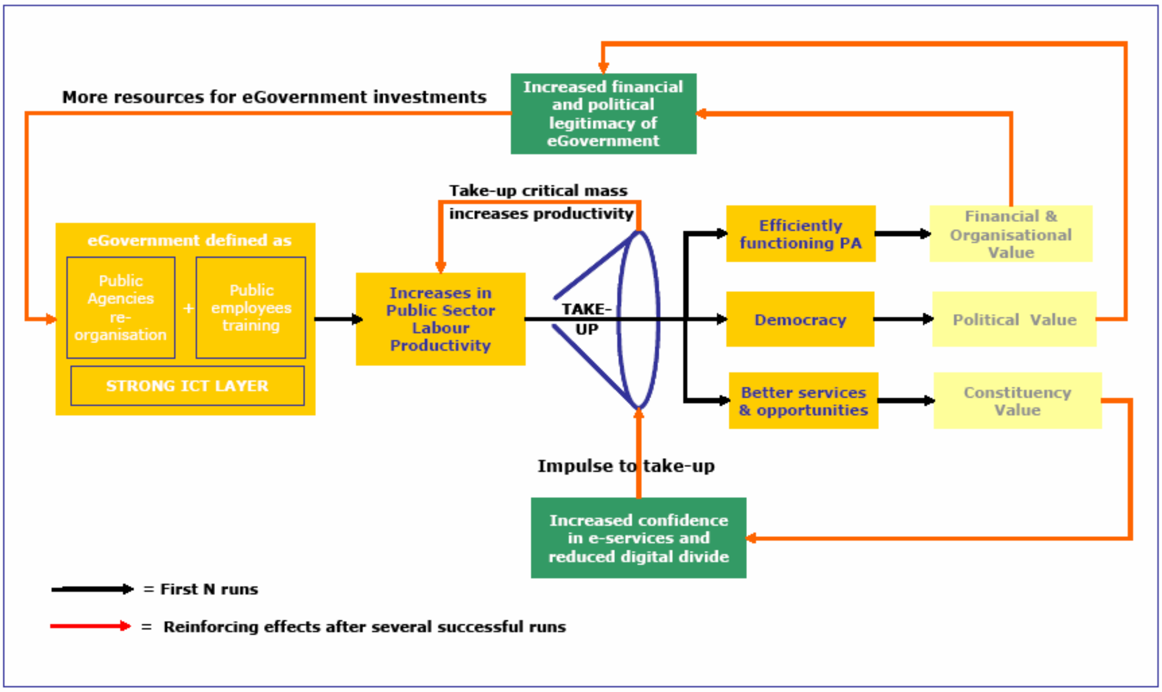
On the *benefit* side, the three main categories are:

- efficiency benefits (for example time and or money saved by direct users internal or external to the organisation, reduced maintenance or purchase costs, redeployment of staff to other services, and so on),
- effectiveness benefits (better integration data and IT platforms, increased tax recovery, improved policy monitoring and evaluation),
- social-political benefits. This latter category would include:
  - Benefits to citizens (for example greater access to information, more transparent and accountable governance, greater empowerment and participation)
  - Benefits to government (for example improved collaboration with other stakeholders within and outside government, greater political legitimacy)
  - Benefits to business (for example increased innovation and knowledge spill over, increased concentration of and quality research, new business opportunities and applications, job creation).

Two main issues arise from the review undertaken in this report. Firstly, that the few studies presented have all been able to identify costs much more easily than benefits, but only because they have focused on staffing and set-up costs rather than the less immediately visible indirect and organisational costs. Similarly, among the benefits, the focus has been primarily on the short term efficiency benefits rather than the other two categories. This means that in future much more effort needs to be spent in the identification and measurement of a wider range of costs, and of benefits, particularly those that appear to be more intangible and difficult to assess (effectiveness and social-policy). Secondly, different studies seem to identify different benefits and assign them to different categories, making comparison more difficult. Whilst there are clearly differences that depend on the type of application (e.g. environmental, land and property, and so on) and of infrastructural project (e.g. linking of existing databases, or documenting and publishing) there is also a degree of confusion that arises from lack of a clear and agreed definition of what is an SDI, what are its components, and its functional relationships, and a theoretical model that underpins the identification of benefits (both positive and negative).

As an example, the eGEP Measurement Framework is underpinned by a theoretical perspective based on an institutionalist approach to regional economic development and politics, and economic model centred on the contribution of e-government to public sector labour productivity, and GDP growth (see Corsi, Gumina, and D'Ippoliti, 2006). A schematic representation of this Theoretical perspective is shown in Figure 23.

Figure 23: Theoretical perspective underpinning the eGEP project



Source: Codagnone, Boccardelli and Leone, 2006, pg. 15

What would be the equivalent model underpinning an evaluation of SDIs? Clearly there are similarities between e-government and an SDI in respect to the public sector orientation, the physical infrastructure (internet) supporting both e-government and SDIs, and some components like standards, metadata catalogues, web publishing and so on. There are however also some noticeable differences, namely that most e-government services are based around administrative procedures required by legislation, for which there needs to be an interaction between citizens, business or other public sector organisations with one or more government agencies. For citizens for example, many e-government services are built around key life events like registering a birth or a death, getting married, paying car or other taxes, getting benefits, or renewing a passport and so on. These are well understood interactions that pre-existed the e-government infrastructure and have recently been made available via the Internet. There are therefore clear user groups, prior understanding of the procedure and the expected outcomes, and an information flow which is bi-directional, from the e-government web site and to it (depending on the level of maturity of the site in question). The case of SDIs is somewhat different, because at least until recently the user community is less clearly defined, and the emphasis is on providing access to data, to be downloaded and processed by specialised software and individuals, rather than in providing information or services. One-directional, from the infrastructure to the user, rather than bi-directional. Of course this is a generalisation, and there are integrated spatially-enabled e-government services like Geospatial One-Stop, but they tend to be the exception rather than the norm. Moreover, SDIs by their nature focus on the access and delivery of spatial information, which may underpin many business processes or citizens needs, but is more multi-purpose than the narrower channels of administrative forms.

There is therefore a greater challenge in the SDI context to define more clearly user communities and their requirements, and then measure the added value of SDIs. E-government frameworks and experiences are of undoubted help, but the specificity of SDIs ought to be considered and reflected both in a theoretical construct, and in the dimension of benefits expected. Only then, one ought to consider the variables that are relevant and feasible to measure such benefits, and the methods appropriate to do so. In this respect, the list of e-government benchmarking indicators shown in Table 11 is meant more to stimulate a reflection of what would be relevant theoretical and practical dimensions to assess, than an invitation to add geo- to any of the indicators listed. So for example, it would be worth to consider whether the geographical nature of the information addressed by SDIs provides also a spatial connotation to the benefits. In other words, is there a territorial dimension or spatial concentrations to the benefits of SDIs not visible in generic e-government applications? Do SDIs contribute to localised innovation and spill-overs? Might they contribute to the clustering of innovative firms as posited by Porter (2003). These are clearly questions at least worth asking but that cannot have an immediate answer unless one develops a research programme to test such hypotheses.

One possible route to make progress, is to conduct studies of SDIs at the regional (sub-national) level focused on specific thematic areas and applications. This could have several advantages: firstly, the sub-national (or small nation) focus could make it easier to identify stakeholders and user communities; secondly, the thematic and application-driven focus could allow a clearer identification of benefits as expressed by user groups; thirdly, it might be possible to test hypotheses on the contribution of SDIs to regional economic development and innovation by comparing similar regions, initially in the same country, and then across countries with and without SDIs.

Limits of Impact Assessment
Impact assessment is important to inform policy, but it is no substitute for policy-making. In particular it is worth highlighting that the major studies reviewed in the previous section (INSPIRE, NASA, Dutch Basic Registers, The National Map) have all estimated positive benefit to costs ratios or return on investments. Nevertheless, they also have consistently shown that investing in SDIs is very heavily front loaded, with returns that may start to become positive after 10-15 years. At times of financial prudence by many governments, there may be reluctance in investing on such long-term projects, with relatively low political visibility compared to health, education, law and order. Hence it should come to no surprise that several of the SDI projects reviewed did not get the funding requested in spite of positive CBAs or RoIs. Assessment may increasingly become a necessary but it is by no means a sufficient condition for funding!

Recommendations and Directions for Future Work

The workshop from which this report arises was the first specifically dedicated to assessing the socio-economic impacts of SDIs. It brought together experts directly involved in such studies to share experience and develop a network of good practice. The initial contacts need to be developed and the network expanded to develop a programme of evidence based research on the impacts of SDIs. In particular, the following is recommended:

1. To develop a shared portfolio of studies at different levels of granularity: the micro level (e.g. time saving, expenditure reduced or avoided within organisations), meso-level (cross organisational, regional, sectoral), and macro-level (national or international comparative studies, cross-sectoral studies) and build the knowledge base of assumptions made, assessment methods, and outcomes.

2. To develop a clearer and shared definition of SDI components and their interactions, so that studies of such components (e.g. geo-portals) can also be assessed for their contribution to the overall SDI framework.
3. To give priority to longitudinal studies of SDIs in progress, for which an initial assessment was made, to validate the assumptions made, and identify the risk factors involved. This may include self-assessment but the more it is shared and open to scrutiny, the more cumulative knowledge can be developed.
4. To develop a theoretical framework underpinning the identification of SDI benefits (i.e. what kind of benefits, both positive and negative, would we expect and why from an SDI)
5. To pay particular attention to identifying user communities, and eliciting their assessment of value deriving from an SDI
6. To pay particular attention to regional SDIs, and to application-driven approaches as ways to identify more easily stakeholders, user communities, and potential benefits.
7. To regularly exchange experiences with related fields, particularly in the GI technology, and utilities sectors, and e-government to share results, and find synergies for undertaking joint assessment studies including surveys.
8. To develop greater understanding of total geo-spatial investments across government programmes and develop a baseline against which additional SDI costs can be related to.

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