Economic Impact Space for Geo-Information programme

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Client: Space for Geo-Information programme

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Content

1 Introduction

1.1 Background

The Space for Geo-Information innovation programme tries to stimulate innovative projects in the geo domain by providing subsidies in order to improve the value added by Geo-Information for the Dutch society. Some 45 projects have received subsidies so far. The progamme started in 2004 and is now halfway. For a mid-term evaluation, the Space for Geo-Information foundation would like to get more information on the economic impact of the various projects for the Dutch society. For this purpose, Space for Geo-Information has asked ECORYS to analyze the economic impact.
The main research question therefore is:

Provide insight in the economic impact/benefits of the projects for the Dutch society; taking into account the results to be delivered for the Mid-Term Evaluation (MTE), Bsik project 3003 Space for Geo-Information.

The report will start with a description of the methodology used to measure the impact of the various projects. In the second chapter, the various projects and their economic impact will be treated. The final chapter consists of the overall conclusion of the economic impact of the Space for Geo-Information programme.

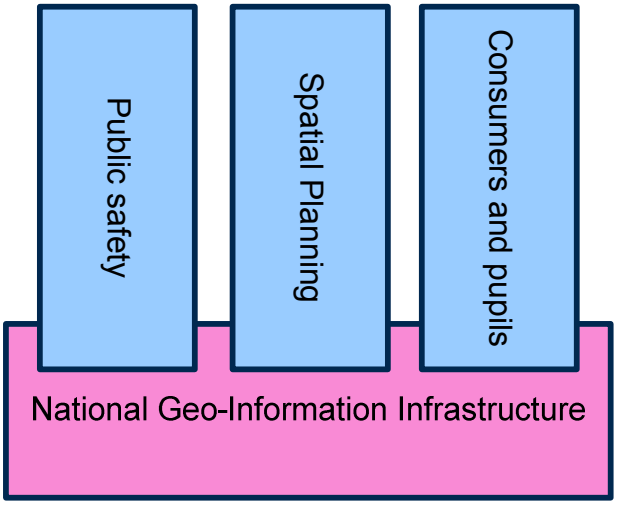
1.2 Methodology

The Space for Geo-Information programme distinguishes four themes:
- National Geo-Information Infrastructure
- Public safety
- Spatial planning
- Consumers and pupils

The theme National Geo-Information is the overarching theme of the programme (figure 1.1). In the selection of projects, this structure has been taken into account: five projects have been selected in this core theme, whereas in the other themes two or three projects have been chosen. Also, the status of the projects and the envisaged possibilities to measure economic impact have been taken into account.

The results of the impact analysis are treated separately, in order to be able to draw conclusions for each theme.

Figuur 1.1 Structure of the Space for Geo-Information Programme



The selected projects per theme are[1]:

National Geo-Information Infrastructure
006: GeoPortals
014: NODC-i – National Infrastructure for access to oceanographic and marine data and information
019: Feasibility study for a Dutch National Population Register
027: Mutatis Mutandis
117: Geo-data, from distribution to access

Public safety
128: Geo-information for risk-prevention
147: Real-time GI for rapid emergency response operations

Spatial planning
004+176: GEO Farmer
013: Virtual reality for spatial planning and safety

Consumers and pupils
022: EduGIS
102: Traffic Forecast
173: Sense of the City

Background information off all projects has been made available by the Space for Geo-Information programme, such as project proposals and annual reports. This information has been combined with in-depth interviews with the project owners. These interviews have provided more insight in the main goals of the project, the expected benefits for various groups affected by the project, and the economic impact.

[1] A list of all projects is presented in Annex 1.

To measure economic impact, several indicators are being used[2]. These indicators can be distinguished at different levels:

- Output: This is the direct result of an investment (the input). For example: a certain GIS-application.
- Result: A result is the consequence of the output realized during the project. A result of the GIS-application could be the use of this application.
- Impact: Impact is the logical consequence of the result. Impact is often not only influenced by the intervention but also by other (external) factors. The impact of the use of the GIS-application may be reduced time of processing data.

For every project the outputs, effects and impacts are worked out (see annex 2). For some of the projects the impact could be quantified. For these projects, the same steps have been followed: first, the type and number of beneficiaries (companies, citizens, etc.) has been estimated. Then, the value of the benefit, e.g. time saving, is approached by using references from earlier projects. Recently, a number of cost-benefit analyses has been carried out by ECORYS on projects in the *Streamlining Key Data Programme*, including *Basisregistraties ondergrond*, *Basis Bedrijvenregister* and *Basisregistratie adressen en gebouwen*. The effects of these projects are comparable to the Space for Geo-Information programme, so key figures could be used. The amount of time saved is multiplied by an hourly wage (€ 33 for administrative jobs), and finally multiplied by the number of beneficiaries. When available, use has been made of existing cost-benefit analyses carried out for projects of the Space for Geo-Information programme as well.

1.3 Context

The cost-benefit analyses carried out on projects in the *Streamlining Key Data Programme* all focus on the effects of the introduction of ICT. In these cost-benefit analyses, data streams within the government structure are being mapped, as a baseline study. Then, the consequences of the introduction of ICT on these projects are being determined. These analyses show that the impact of ICT-related programmes mainly consists of: increased efficiency, improved quality and development of new products (figure 1.2). The beneficiaries of the projects will mainly be data suppliers, data administrators, data users, and end-users of data. These effects are expected to occur in the Space for Geo-Information programme as well.

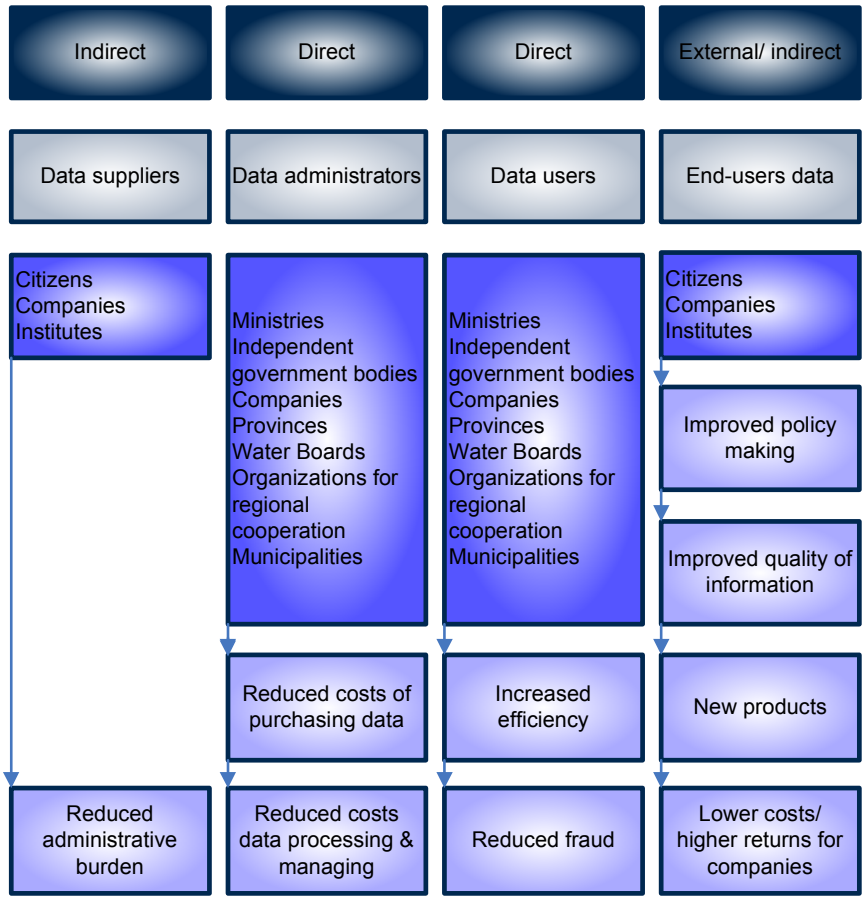
In 2001, a cost-benefit analysis for the Space for Geo-Information programme has already been carried out by Twijnstra Gudde and ECORYS. In this report, the costs for all activities needed to be able to carry out the Space for Geo-Information were compared to the estimated benefits for society. The most important effects described by then were:

- Efficiency advantages for citizens, companies and governments
- Diminishing purchase costs for data
- Avoided costs for processing and managing data
- Avoided costs by re-use of data

[2] Source: ECORYS, Leidraad voor kosten-baten analyses voor ICT-investeringen. To be published.

- Potential benefits of offering services

Figure 1.2 Type of effects of the Space for Geo-Information programme



And indirect effects:

- Lower administrative burden for data administrators
- Better decision-making for companies and governments
- Development of new products

In 2001, the total expected benefits were estimated at € 1.039 million + PM per year. As this research was based on a larger investment in the programme, the benefits are not directly comparable with the current research, however (see also Chapter 3).

In Chapter 2, first the economic impacts are presented by theme. The final Chapter 3 shows the expected total impact for the programme.

2 Economic impact by theme

2.1 Introduction

The projects selected for this study can be distinguished in several types:

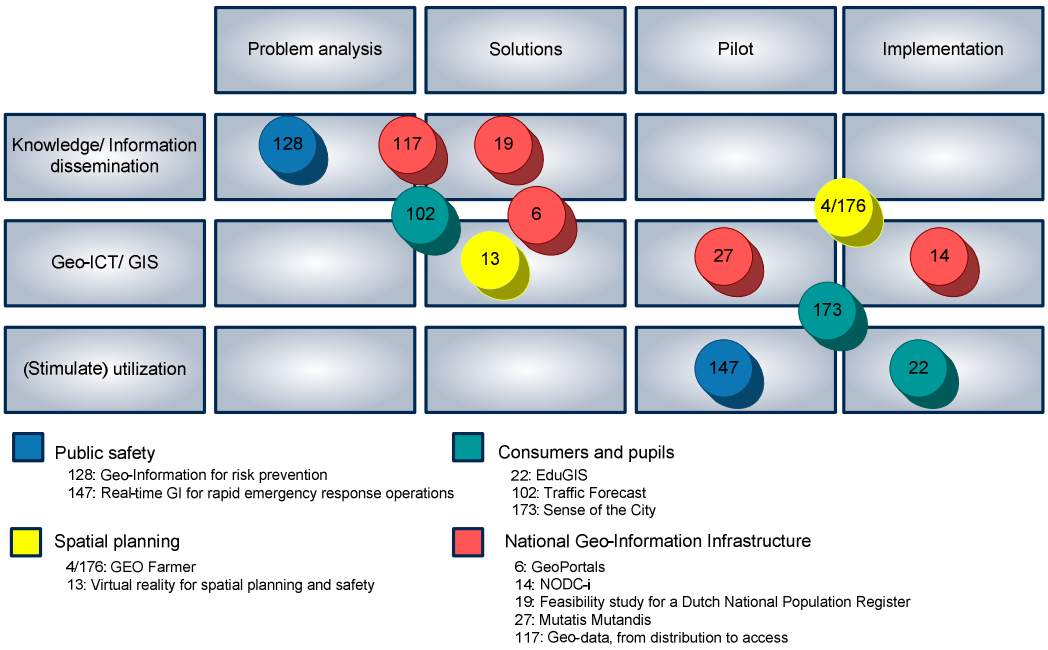
- *Problem analysis*: these types of projects focus on the analysis of a specific problem. Expected output basically consists of scientific articles.
- *Solutions*: these projects go one step further than problem analysis, as they also describe solutions. Output is still theoretical, however.
- *Pilots*: in pilot projects, a certain product is being tested, adjusted, and tested again to improve the product and to research its effectiveness.
- *Implementation*: some projects have actually designed a certain product or infrastructure, which will be implemented in the course of the project.

Another distinction can be made by the aim of the projects:

- *Knowledge/information dissemination*: projects may focus on knowledge or information dissemination through publications, workshops, etc.
- *Geo-ICT or GIS*: in these projects, applications will be developed.
- *(Stimulate) utilization*: the actual use of these applications or the development of demonstrators in order to stimulate utilization.

The projects selected for this study can be plotted in a matrix as shown in figure 2.1. Colours of the projects represent the four themes they apply to. The matrix shows that the projects of the different themes are more or less equally distributed. This has been the goal of the programme as well.

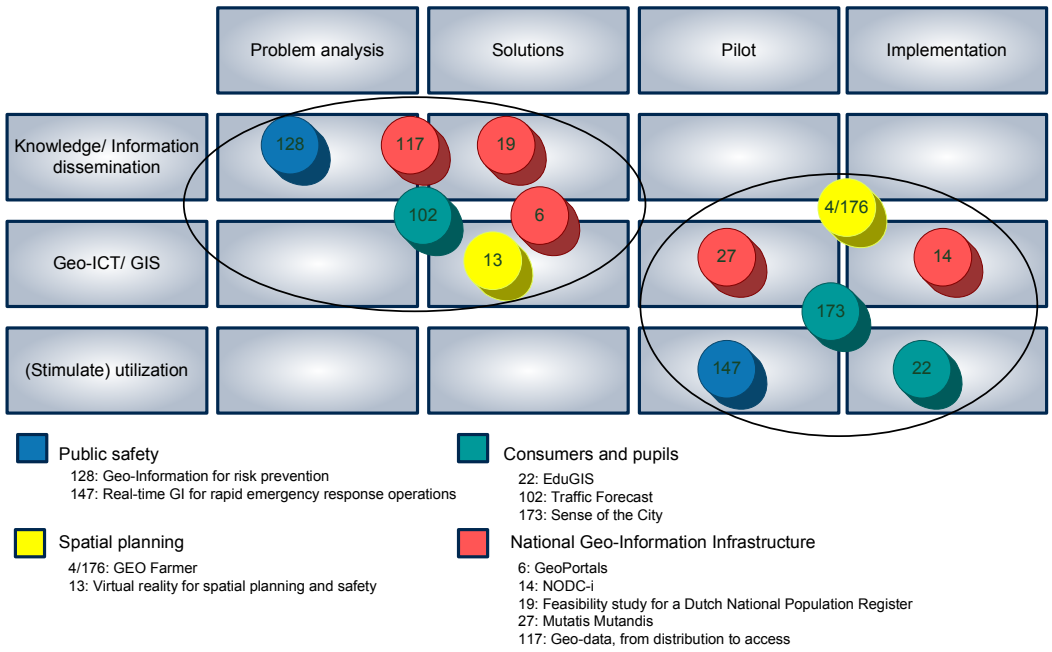
Figure 2.1 Selection of projects



Furthermore, it can be observed that two groups of projects arise (figure 2.2). This divide has implications for the way in which the economic impact can be measured. From projects in the top left corner the economic effects are hard to express in quantitative terms. Problem analysis and the description of solutions mainly leads to scientific articles, of which the direct economic impact is unclear. Publicity might lead to increased attention for a certain topic and eventually implementation of a solution, but these effects are highly uncertain. Therefore, the impact of these projects is usually described in a qualitative way.

Projects in the bottom right corner have led to development of a product, and through pilots or actual implementation the effects of the use these products may become visible. These projects are usually easier to express in quantitative terms. Figure 2.2 shows the two different clusters of type of projects.

Figure 2.2 Selection of projects: two groups



In the remainder of this chapter, the economic impact of the selected projects will be described per theme. If possible, the effects will be shown in a quantitative way. This can be done when the projects are in the pilot or implementation phase, and when effects are structural (such as efficiency gains). Furthermore, effects need to be able to be expressed in a monetary value. The effects of other projects will be described quantitatively. At the end of each paragraph, conclusions for the specific theme will be drawn.

This “typology” of projects is also the base for the estimation of the total impact of the programme in Chapter 3.

2.2 Theme: National Geo-Information Infrastructure

The total budget allocated to the theme National Geo-Information Infrastructure is € 17 million. All projects in this theme are listed in annex 1.

In table 2.1 the selected projects in this theme are presented, together with the costs[3] for the projects.

[3] Total costs are twice the amount of subsidy allocated to the project.

Tabel 2.1 Selection of projects and costs per project

Project	Costs
19: Feasibility study for a Dutch National Population Register	€ 89.500
6: GeoPortals	€ 2.000.000
14: NODC-i – National Infrastructure for access to oceanographic and marine data and information	€ 1.000.000
27: Mutatis Mutandis	€ 500.000
117: Towards Geo-Information access and sharing: Institutional obstacles	€ 422.456

2.2.1 Economic impact per project

Feasibility study for a Dutch National Population Register

In this project, research is carried out to show whether or not a National Population Register is feasible, and if yes, how it can be developed and implemented. This Register would provide information on safety risks, which could be used for spatial planning, but it would also provide real-time Geo-Information after a disaster such as a flood or explosion has occurred.

As this project is a feasibility study, effects cannot be measured quantitatively. The feasibility study should lead to insight and publicity, which may in turn lead to initiatives to actually develop this National Population Register. However, this development and its effects on improved efficiency in data gathering and improved quality of information, which may in turn lead to better decision making and decreasing damage after emergencies, is beyond the scope of the project itself.

GeoPortals

GeoPortals tries to improve the accessibility of Geo-Information used for spatial planning, mobility, economic development, water management, etc. Nowadays, data is being gathered by many different institutions, but access to this data is lacking, as is an orderly structure. By designing five different portals and, eventually, a central portal, the project gives insight in the way data could be presented to its users. It especially aims at improving the transparency of the conditions for the use of Geo-Information.

As the main output of the project consists of demonstrators and scientific publications, the effects of the project are not quantifiable. Actual implementation of a network of portals is not envisaged during the course of the project, but the demonstrators should cause increased awareness of the advantages of this network and, hopefully, lead to implementation of the portals after the project has ended.

This implementation will eventually cause advantages for governments, through reduced time for data gathering and increased re-use of data (which means that data gathered by one institute may be used by others as well). Moreover, the quality of data will improve because of the possibilities to combine data gathered by different institutes. Eventually, advantages will accrue to citizens, as governments will be able to make better-informed decisions. Finally, the portals will also benefit companies, as the information made available may be used to develop new products.

NODC-i – National Infrastructure for access to oceanographic and marine data and information

During this project, a national infrastructure for access to oceanographic and marine data will be developed. The project not only combines data gathered by different institutes, it also provides a uniform format through which data can be exchanged among various users and providers. By the end of the project, a 'catalogue' will be available, with an overview of all accessible data. The actual access to the data will be realized as well. Benefits will accrue to users of oceanographic and marine data (such as government organizations, shipping companies, etc.) as data gathering will become more efficient. On the one hand, data can be re-used by other institutes, which lowers the costs of measurements. On the other hand, by using a uniform format, data can be exchanged faster than before. This is especially advantageous, as data conversion is a very time-consuming process.

Furthermore, the NODC-i will improve the quality of information, as different data sets may be combined. In turn, this may affect decision-making, as new information may become available. Eventually, NODC-i may have its contribution in lowering the damage of disasters, as warnings regarding coastal defense, tsunamis, etc. can be made more accurately.

The main beneficiaries of the NODC-i will be companies or governments that are involved in (economic) activities at sea. This number is expected to be 1100[4]. It is estimated that these companies require oceanographic and marine data once a week. The time saved by central access and a uniform format is estimated at 0,6 hours[5], at an hourly wage of € 33,-[6]. Total annual benefits are therefore expected to be € 1 million.

Table 2.2 Benefits NODC-i

Type of benefits	Beneficiaries	Annual benefits (million)
Uniform format increases efficiency, improved quality by combining data sets	Governments, institutes, companies	€ 1
Total benefits		**€ 1**

Mutatis Mutandis

Mutatis Mutandis focuses on the automation of methods for signalling mutations and on the development of a model to present these mutations for a specific target. So far, a concept of this model has been developed. Demonstrations, workshops, etc. should convince potential users of the advantages of such a model.

Because of the amount of information on mutations, many governments have not been able to keep their data files up to date. Therefore, the quality of information diminishes.

[4] Source: CBS Statline.

[5] This effect is comparable with the effects that occurred in the cost-benefit analysis "Basisregistraties Ondergrond". Therefore, the same time saving has been calculated here.

[6] Standard hourly wage for administrative jobs, used in cost-benefit analyses "Basis Bedrijvenregister" and "Basisregistratie adressen en gebouwen".

The model would be a solution to keep this information up to date, at lower costs. 'Economies-of-scale' may arise as users of the information may indicate mutations to others users. This also causes lower costs and improved quality: alone, governments would never be able to track all mutations, whereas by cooperation they will.

This leads to several benefits. First of all, direct benefits may arise through diminishing costs compared to the current way of keeping the data files up to date. A cost-benefit analysis carried out by the consortium shows that these benefits are estimated at € 3 million in the period 2007-2011[7]. In the second place, indirect benefits may arise as a result of the value added by the web service. This means that companies may increase sales and hence profit because of increased quality of the products they sell. These benefits may be € 5,5 million in 2007 and € 2 million in 2011.
Moreover, by faster processing of the mutation signals by governments, more time can be spent on productive tasks. Faster detection of mutations will lead to increased tax revenue and reduced fraud (€ 10 million in 2007 and € 3 million in 2011). Total benefits are estimated at € 48 million in the period 2007-2011. On annual basis, the benefits are € 0,5 million (direct) and € 10 million (indirect).

Table 2.3 Benefits Mutatis Mutandis

Type of benefits	Beneficiaries	Annual benefits (million)
Direct: diminishing costs of keeping data up to date	Governments, institutes, companies	€ 0,5
Indirect: faster processing of mutation signals	Governments, institutes, companies	€ 10
Total benefits		**€ 10,5**

Towards Geo-Information access and sharing: Institutional obstacles
The project's aim is to provide insight in the organisational, financial and judicial constraints currently existing for access to Geo-Information. In the second phase, solutions for removing these constraints will be developed. By bringing together various parties in the field of Geo-Information and by active lobbying the importance of the topic should persuade policy makers to work on problem-solving.

According to the consortium's view, a geo-information infrastructure will not arise without removing the aforementioned constraints. Eventually, geo-information should be better accessible, and access procedures need to become more transparent. The project effectively brings together various parties involved in this infrastructure and has an important role in speeding up the process of better access to data. These effects are not quantifiable however, since the project does not try to implement this structure for better access.

2.2.2 Conclusions for National Geo-Information Infrastructure

The projects within this theme are all in the upper half of the matrix as shown in figure 2.2: they focus on knowledge dissemination or development of Geo-ICT/GIS. In only one

[7] Universiteit Utrecht, TU Delft & NEO (2005), Financiële Haalbaarheid van een webservice als mutatiemeldingssysteem.

project, NODC-i, infrastructure is truly implemented. All projects are aimed at improving the access to data that is currently managed by many different institutes. This involves not only the need to improve the transparency of the procedures for access to data, but also the way in which this data is presented and organized. Three out of five projects try to improve this access by developing a central portal or uniform formats to exchange data. This way, increased efficiency for data users and administrators will arise, i.e. faster procedures and lower costs.

Another effect that becomes visible in this theme is improved quality of data. By combining databases of different data administrators, new information may be generated. This may improve the quality of decision making as this data is often used by policy makers. Eventually, this will also have its effect on citizens.

The total quantified annual benefits for the theme National Geo-Information Infrastructure are estimated at € 11,5 million (table 2.4).

Table 2.4 Benefits theme National Geo-Information Infrastructure

Project	Annual benefits (million)
14: NODC-i	€ 1
27: Mutatis Mutandis	€ 10,5
Total benefits	**€ 11,5**

Qualitative benefits for projects in the theme NGII are:

- Better access to data, including more transparent procedures, central access to data and uniformity of data.
- Combining various files, leading to improved quality of decision-making.

2.3 Theme: Public Safety

The budget for the projects in the theme Public Safety is € 3,5 million. All projects in this theme are listed in annex 1. In table 2.5 the selected projects in this theme are presented, together with the costs for the projects.

Tabel 2.5 Selection of projects and costs per project

Project	Costs
128: Geo-Information for Risk Prevention	€ 481.506
147: Real-time acquisition of geo-information for rapid emergency response operations	€ 100.000

2.3.1 Economic impact per project

Geo-Information for Risk Prevention

The project's objective is to develop a conceptual model which provides insight in the use of Geo-Information in spatial planning regarding public safety. This research project

basically analyses the current use of Geo-Information, and then tries do draw conclusions and describe recommendations for further development and utilization of Geo-Information.

Because of the fact that the output of this project consists of scientific publications, direct effects are hardly quantifiable. Scientific articles in the right journals may lead to publicity, which eventually leads to increased awareness among policy makers. The actual use of Geo-Information in spatial planning may cause better decision making and diminishing damage after a disaster has occurred.

Real-time acquisition of geo-information for rapid emergency response operations
Testing the utilisation of a pilotless (remote controlled) helicopter for making aerial photos of a disaster area within several hours after a disaster, and making these photos available to the safety services is the aim of this project. The data that is generated by combining the aerial photos with geo-information will be accessible for all safety services via a network. The project is a pilot, in which the helicopter and its camera is being tested and improved. Eventually, the helicopter could be used throughout the whole country.

Advantages of the project are based on the fact that a pilotless helicopter can be made operational much faster than a police helicopter and that it has the ability to come much closer to the disaster area. Furthermore, the aerial photos that are taken by this helicopter can immediately be combined with other geo-information. This way, real-time geo-information is available within a few hours after a disaster has occurred. Better information on the area may eventually reduce the damage of the disaster.

The yearly number of outside fires and the average costs of the damage caused by these fires are used as proxy variables for the kind of emergency situations this project is designed for. The total number of fires in 2005 was 15.500 and the average damage € 6.500. The number of deaths of these fires is 67 per year, the number of wounded 1000[8]. It is assumed that in half of these fires a helicopter will actually be used. Increased efficiency and improved quality of the data may lead to a decrease of the average costs of the damage.

It is generally assumed that the first hour after a disaster has occurred is crucial for the possibilities of saving lives and reducing damage. The exact effect is unclear, but if it is assumed that the project could contribute to a decrease of 1 to 5%, benefits of reducing damage can be estimated at € 0,5 to 2,5 million a year. The benefits of reducing the number of victims a year would be € 4 to 20 million (considering the validation of human life of € 2,2 million[9] and a wounded person € 260,000[10]).

[8] Source: CBS Statline
[9] Source: Stichting Wetenschappelijk Onderzoek Verkeersveiligheid
[10] Source: Hakkert, S. & P. Wesemann (2004), Road Safety and Environmental Cont-Benefit and Cost-Effectivenss Analysis for use in Decision-making.

Tabel 2.6 Benefits Real-time acquisition of geo-information for rapid emergency response operations

Type of benefits	Beneficiaries	Annual benefits (million)
Reducing damage	Citizens, companies	€ 0,5 – 2,5
Reducing number of victims	Citizens	€ 4 – 20
Total benefits		**€ 4,5 – 22,5**

2.3.2 Conclusions for Public Safety

The projects in the theme Public Safety are in both extremes of the matrix (figure 2.2). Therefore only for one project quantitative effects can be described. The first project, Geo-Information for Risk Prevention, focuses more on the use of Geo-Information to prevent risks, whereas the latter, Real-time acquisition of geo-information for rapid emergency response operations, aims at lowering the damage caused by disasters. In this project, improved quality of information is an important aspect as well. Total benefits come to € 4,5 – 22 million.

Tabel 2.7 Benefits theme Public Safety

Project	Annual benefits (million)
147: Real-time acquisition of geo-information for rapid emergency response operations	€ 4,5 – 22,5
Total benefits	**€ 4,5 – 22,5**

Qualitative benefits for this theme are:

- Decreasing chance of risks to occur (by using geo-information in spatial planning).
- Diminishing damage of disasters (information is available faster and the quality improves).

2.4 Theme: Spatial planning

The total budget for projects in the theme Spatial Planning adds to € 6 million.
All projects in this theme are listed in annex 1. The projects selected for this report are and the costs per project are presented in the table below.

Tabel 2.8 Selection of projects and costs per project

Project	Costs
13: Virtual reality for spatial planning and safety	€ 670.000
4/176: GeoFarmer	€ 544.943

2.4.1 Economic impact per project

Virtual reality for spatial planning and safety

The aim of this project is to improve the utilization of virtual reality (VR) for communication by making an inventory and analysis of requirements for a VR environment and developing methods to develop faster and cheaper production of VR environments. This VR environment will eventually be used in the sectors spatial planning and safety.

Through pilot projects the tool developed for producing a VR environment will be tested and improved. This tool should decrease the costs for production for software companies, as nowadays, developing VR environments is labour intensive and hence expensive. By decreasing production costs, the demand for VR environments will rise. Benefits of this increased demand will accrue to the software companies producing these environments.

VR environments are mainly used by governments, in order to improve understanding of their plans for citizens. This will increase participation and improve democracy. These effects are not quantifiable, however.

GeoFarmer

GeoFarmer tries to develop a communication tool to exchange information on agricultural plots between farmers and government. Output is not only this tool, but also a protocol which describes the procedure of the digital communication between farmers and government.

Effects of the project involve the government, as processing of the data received from farmers will become more efficient. This is not only because the information is received digitally, but also because of the fact that the information will be more accurate. For farmers, the administrative burden will decrease. Finally, also software developers will benefit, but in the course of the project, effects will be measurable more in terms of goodwill and innovative image, than in increasing profit. These benefits are therefore not quantified here.

Currently, 60% of all farmers in The Netherlands possess a computer programme for farm management. It is envisaged that 50% of these farmers will eventually buy the module that is being developed. This means that from the more than 12.000 farmers[11] about 3700 will buy the module. Efficiency advantages that arise from using digital information instead of paper are estimated at one hour[12], with an hourly wage of € 33,-[13]. Governments will save 50% of the time allocated to processing the data[14] (which is now assumed to be one hour). Total benefits for farmers and government are estimated at € 0,5 million.

[11] Source: CBS Statline, 2005.

[12] These effects are comparable with the effects analyzed in: Ministerie BZK (2006), Werkmap administratieve lasten burgers.

[13] Standard hourly wage for administrative jobs, used in cost-benefit analyses “Basis Bedrijvenregister” and “Basisregistratie adressen en gebouwen”.

[14] These effects are comparable with the effects that have been analyzed in: Ministerie BZK (2006), Werkmap Administratieve lasten burgers.

Table 2.9 Benefits GeoFarmer

Type of benefits	Beneficiaries	Annual benefits (million)
Reducing administrative burden	Farmers	€ 0,2
Reducing costs processing and managing data	Government	€ 0,3
Total benefits		**€ 0,5**

2.4.2 Conclusions for Spatial Planning

In both projects, a GIS application is being developed and tested. By the end of the project, these applications should be finished and made available for commercial use. Both projects try to increase efficiency, although in the virtual reality project the benefits will mainly accrue to software designers, whereas in GeoFarmer governments and farmers will benefit of this efficiency. Total quantifiable annual benefits for the theme Spatial Planning are expected to be € 0,5 million.

Tabel 2.10 Benefits theme Spatial Planning

Project	Annual benefits (million)
4/176: GeoFarmer	€ 0,5
Total benefits	**€ 0,5**

Qualitative effects of this theme are:

- Increased efficiency for:
  - Citizens (administrative burden).
  - Governments (costs of data processing and management).
  - Software developers (profit).

2.5 Theme: Consumers and Pupils

The theme Consumers and Pupils has a total budget of € 7,5 million. All projects in this theme are listed in annex 1. Selected projects and the costs per project are presented in table 2.11.

Table 2.11 Selection of projects and costs per project

Project	Costs
22: EduGIS	€ 800.000
102: Traffic Forecast	€ 498.540
173: Sense of the City	€ 100.000

2.5.1 Economic impact per project

EduGIS

The project EduGIS consists of designing, testing and implementing a portal in order to stimulate the use of Geographical Information Systems in secondary education. Both pupils and teachers will get acquainted with Geo-Information and its possibilities for analyzing spatial planning issues. This way, the project hopes to contribute to solving the lack of students with GIS skills.

Furthermore, the project provides one portal for access to maps used in secondary education, whereas the pupils had to turn to different organisations before. This causes advantages in efficiency.

Effects that may occur by introducing geo-information in education are for example:

- More people will be educated (full time studies as well as courses).
- People will choose a different study than they would have chosen if they had never used EduGIS or similar programs.
- By disseminating the new technology and information, it can be used in the existing curriculum. This will have its influence on the current pupils: their awareness of the advantages of geo-information will rise.

These changes may in turn lead to increased productivity of the labour force because of improved skills, or improving the innovative character of the Dutch economy. However, these changes will only become visible in the long run and it is yet still very unclear whether these effects will truly occur. Therefore, these effects are not quantified.

Traffic Forecast

The aim of the Traffic Forecast project is to combine two databases, which will form the basis of a weather – traffic forecast. This way, the relation between weather and possible traffic jams will be made. The project starts with a pilot on the highway between Utrecht and Wageningen, but by the end of the project a format is expected to developed which may be applied in the rest of The Netherlands as well. By providing detailed information on expected traffic jams, considering the weather forecast, the reliability of travel time rises. Moreover, motorists may adapt their behaviour, which can reduce travel time. Expected benefits therefore accrue to motorists, but also to traffic centers that need this information to direct traffic flows.

For the calculation of benefits it is expected that the format developed by the project to provide a weather – traffic forecast will really solve the current 'problems', and lead to reduced travel time and a decline of the economic and societal loss caused by traffic jams. Of course, this can only be applied to traffic jams that are caused by 'extreme' weather circumstances such as rain and snow. Overall, the economic loss caused by traffic jams was € 630 million in 2006[15], and the societal loss is estimated to be € 700 million in 2006[16]. The amount of traffic jams caused by weather conditions is estimated to be 4%[17].

[15] Source: EVO & TLN (2006), Economische *Weg*wijzer 2006.
[16] Source: Rijkswaterstaat (2006).
[17] Source: Rijkswaterstaat (2005), Filemonitor 2004.

A traffic forecast would reduce this loss by a certain percentage. From research on the effects of a 'National Data Warehouse' (which would store all valuable information for better traffic management) it is estimated that better information would reduce the loss caused by traffic jams with 5 to 10%. Hence, the annual benefits of the project are estimated at € 2,5 to 5,5 million.

Table 2.12 Benefits Traffic Forecast

Type of benefits	Beneficiaries	Annual benefits (million)
Reducing economic and societal damage of traffic jams	Citizens	€ 2,5 – 5,5
Total benefits		**€ 2,5 – 5,5**

Sense of the City

Sense of the City tries to develop a new, positive instrument to involve citizens in the government of their city. GIS is used as a means to provide insight and knowledge about the way citizens 'sense' the public space of their city. This information is gathered by the city residents themselves and is then communicated to the local government.

The effects of this project cannot be captured in quantitative indicators. Its basic aim is to provide a new tool to improve the communication between citizens and government. This will hopefully lead to increased participation and eventually to better informed decision-making by governments. Moreover, the images created by the participants may be an effective tool for city branding.

2.5.2 Conclusions for Consumers and Pupils

Obviously, the benefits of these projects will mainly benefit consumers and pupils. A traffic forecast reduces travel time, Sense of the City tries to provide a tool to involve citizens in government policy making in a new, positive way and EduGIS has an educational goal.
Generally, all three projects are specifically aimed at improving the quality of information, may it be for governments, pupils or motorists. Furthermore, they also try to increase the awareness of citizens and professionals. Total quantifiable annual benefits for this theme are estimated to be € 2,5 – 5,5 million.

Table 2.13 Benefits theme Consumers and Pupils

Project	Annual benefits (million)
102: Traffic Forecast	€ 2,5 – 5,5
Total benefits	**€ 2,5 – 5,5**

Qualitative benefits for this theme are:

- Improved quality:
  - Educational material for pupils.
  - Information on traffic jams for consumers.
  - Communication tools for citizens and government.

3 Total impact

3.1 General impression

The most important impact of the Space for Geo-Information programme is its catalytic function. The programme enables governments, private sector parties, research institutes, etc. to cooperate. This way, developments in the field of geo-information are accelerated. This impact is hard to quantify.

Benefits of the programme are comparable to effects that occur in other ICT-related programmes. These can be divided in two types: increased efficiency and improved quality of information. Eventually, new products may be developed as well. The main beneficiaries are data suppliers, data administrators, data users and data end-users. These benefits are realized in increased efficiency and improved quality of information.

Per theme, the qualitative benefits of the Space for Geo-Information programme are:

National geo-information infrastructure

- Better access to data, including more transparent procedures, central access to data and uniformity of data.
- Combining various files, leading to improved quality of decision-making.

Public safety

- Decreasing chance of risks to occur (by using geo-information in spatial planning).
- Diminishing damage of disasters (information is available faster and the quality improves).

Spatial Planning

- Increased efficiency for:
  - Citizens (administrative burden).
  - Governments (costs of data processing and management).
  - Software developers (profit).

Consumers and pupils

- Improved quality:
  - Educational material for pupils.
  - Information on traffic jams for consumers.
  - Communication tools for citizens and government.

3.2 Quantified benefits

The total quantified benefits of the selected projects are presented in table 3.1

Table 3.1 Total benefits of selected projects, by theme

Theme	Annual benefits (million)
National Geo-Information Infrastructure	€ 11,5
Public Safety	€ 4,5 – 22,5
Spatial Planning	€ 0,5
Consumers and Pupils	€ 2,5 – 5,5
Total benefits	**€ 19 - 40**

The total quantified annual benefits of the selected projects are € 19 to 40 million. The largest benefits can be calculated in the themes National Geo-Information Infrastructure and Public Safety.

These benefits are based on calculations for 5 selected projects. In order to calculate the total benefits of the programme, the projects have been divided into two types[18], according to the matrix as shown in figure 2.2 in Paragraph 2.1:

- A group consisting of projects that work on problem analysis and solutions, and
- A group of projects that work on pilots and implementation.

The project Traffic Forecast belongs to the first group, while NODC-i, Mutatis Mutandis, Real-time acquisition of geo-information for rapid emergency response operations and GeoFarmer are in the second group. It must be noted that total effects of the projects in group one are only based on one project.

The benefits of these two groups of projects are extrapolated in the same proportion as the costs. This means: the costs for the selected projects are compared to the costs for the total number of projects within the group (table 3.2). Assuming a fixed cost benefit ratio[19], an impact for society of approximately € 210 to € 450 million might be expected.

Tabel 3.2 Benefits of the Space for Geo-Information programme (in million €)

Type of project	Costs selected projects	Total costs	Annual benefits selected projects	Total annual benefits
Problem analysis/ solution	€ 0,5	€ 15	€ 2,5 – 5,5	€ 75 – 170
Pilot/ implementation	€ 2	€ 18	€ 16,5 – 34,5	€ 135 – 280
Total	**2,5**	**€ 33**	**€ 19**	**€ 210 - 450**

[18] Not all projects have been plotted in the matrix, as for some projects it was unclear to which cell of the matrix they belong (nine projects in total). Therefore, total costs add up to € 33 million instead of € 34 million in reality.

[19] In practice the cost benefit ratio will differ between projects, the presented figures are therefore rough estimations.

3.3 Comparison with the CBA

The estimated benefits are lower than the € 1.039 million expected in the cost-benefit analysis (CBA) in 2001. This can be attributed to the fact that:

a. Calculations in this CBA were based on an optimistic scenario in which all possible benefits would be realized. In reality, this has not been the case.
b. Furthermore, the amount of money invested in the Space for Geo-Information programme is lower than expected in 2001, which also causes less economic impact than expected.
c. Finally, a substantial part of the quantified benefits calculated in the CBA was based on the expected impact of the implementation of authentic registrations, such as the Authentic Registration for Companies. After all, these projects haven not been implemented within the Space for Geo-Information programme.

As a result, in this report, other benefits of the programme are studied, which are not comparable with the effects described in the CBA. Besides, this impact analyses is based on a "bottom-up" approach, starting with the benefits of a (small) selection of projects. The impact analyses made in 2001 was based on a "top-down" approach, which is common for Ex-Ante evaluations, as projects are not implemented at that time.

Annex 1 Projects per theme

Public safety

	Project	Leading party
RGI-123	The fire brigade entirely mobile	Haarlem fire service
RGI-128	Geo-information for risk prevention	Wageningen UR
RGI-239	Geographical Data Infrastructure for Disaster Management (GDI4DM)	VU Spinlab

	Innovation pilot	Leading party
RGI-001	Geographical dimensions of risk management	Wageningen University
RGI-026	Location Based Services 24-7 (LBS-24-7)	TU Delft – OTB
RGI-147	Real-time acquisition of geo-information for rapid emergency response operations	MIRAMAP
RGI-149	Geo-info to-go - Geoinformation supply on the spot	TU Delft
RGI-203	Flood forecasting on the basis of satellite and radar information	EARS
RGI-210	Symbolset for Disastermanagement and Large Scale Operations	dIMAGINE
RGI-251	Using earth observation techniques at Water boards to prevent damage as a result of droughts	WL | Delft Hydaulics

Spatial planning

	Project	Leading party
RGI-002	Generation and use of base maps for integrated querying of digital physical development plans	ITC
RGI-008	Handle uncertain plan objects to facilitate monitoring and spatial analyses of spatial policy	Alterra
RGI-013	Virtual reality for urban planning and safety	ITC
RGI-017	Geo-information requirement for agri-environmental policy	Wageningen University, Laboratory of Geo-Information Science and Remote Sensing
RGI-031	GI Support for Regional Planning	Utrecht University, Faculty of Geosciences
RGI-101	Play Area with Simlandscape (PAS)	Eindhoven University of Technology, Department of Architecture, Building and Planning
RGI-254	LUMOS	VU Amsterdam, FEWEB-RE
RGI-307	A geo-informatics tool for supporting the planning of office development	Eindhoven University of Technology

	Innovation pilot	Leading party
RGI-003	Virtual Netherlands	VU Amsterdam / ESI
RGI-023	LUMOS definition study	VU Amsterdam, FEWEB-RE
RGI-106	Geo-Forest: Sensitivity in geo-variation of forests to climate change	FutureWater
RGI-160	People in Motion: Planning mobility on a landscape	Alterra
RGI-180	Market research DURP Portal	Grontmij
RGI-314	Publishing DURP plans in Flamingo, powered by Google	Grontmij

National Geo-Information Infrastructure

	Project	Leading party
RGI-004	Geo Farmer	Alterra
RGI-005	Development of Framework to Assess National Spatial Data Infrastructures	Wageningen University
RGI-006	GeoPortals, Liberty United	Alterra
RGI-010	Cross-border Water Management Initiative (supporting the implementation of European Water Framework Directive between The Netherlands and North Rhine-Westphalia, Germany)	Netherlands Institute of Applied Geoscience TNO
RGI-011	3D Topography	TU Delft OTB Research Institute for Housing, Urban and Mobility Studies
RGI-014	NODC- National Infrastructure for access to oceanographic and marine data and information (for short: NODC-i)	MARIS B.V.
RGI-027	Mutatis Mutandis	NEO BV
RGI-028	Degradation of archaeological values in the Dutch subsoil	National Service for Archaeology, Cultural Landscape and Built Heritage
RGI-029	Geo-information Management for Civil Engineering Infrastructure (GIMCIW)	Netherlands Institute of Applied Geoscience TNO
RGI-116	Exploration of innovations in geo-standards for SDI	Ravi
RGI-117	Towards geo-information access and sharing: Institutional obstacles	BGI
RGI-150	3D positioning infrastructure within built environment	TU Delft OTB Research Institute for Housing, Urban and Mobility Studies, GISt section
RGI-154	Access to BRON	Alterra
RGI-162	National geodata model for sewers	Stichting Rioned
RGI-166	Innovations in archaeological prospecting	VB Ecoflight
RGI-172	The subsurface as a reaction vessel: geochemical characterization of the Netherlands for monitoring and forecasting	Netherlands Institute of Applied Geoscience TNO
RGI-176	GeoFarmer: Exchange of fieldgeometry with the government	Agrovision
RGI-184	Atmospheric Data Access for the Geospatial User Community	KNMI Royal Netherlands Meteorological Institute
RGI-189	Sensors as data sources at the geo-information infrastructure	Netherlands Institute of Applied Geoscience TNO
RGI-232	GeoInfoNed , A multimedia geo-database infrastructure	TU Delft / OTB
RGI-255	Experimentation Environment Geo Information Projects	NCGI / Ravi
RGI-401	Transition monitoring for RGI	DRIFT / Erasmus University Rotterdam

	Innovation pilot	Leading party
RGI-019	Feasibility study for a Dutch National Population Register	Bridgis
RGI-025	RGCI: Space for GeoChemical Information	Netherlands Institute of Applied Geoscience TNO
RGI-111	The National Atlas as access mechanism to the geo data infrastructure	International Institute for Geo-Information Science and Earth Observation ITC
RGI-182	Real-time automatic interpolation of early-warning monitoring data	Utrecht University
RGI-190	SIMCLIMATE - Climate simulations and natural archives GIS: a key to the future	Netherlands Institute of Applied Geoscience TNO
RGI-228	Simulation and GIS: the OpenMI framework for access to spatial temporal data and the linking of models	PCRaster Environmental Software
RGI-231	Georeference of nature observations using a mobile telephone	Dutch Butterfly Conservation / De Vlinderstichting
RGI-245	Automatic monitor changes through aerial photographs and laser altitude data for municipal maintenance	Council 's-Hertogenbosch
RGI-305	The added value of GIS for Science Disciplines	VU Amsterdam / SPINlab-ESI
RGI-313	On-line coupling of spatial optimization tools and spatially distributed simulation models	Utrecht University
RGI-331	Promoting the use of geo-information in the humanities	DANS

Consumers and pupils

	Project	Leading party
RGI-022	Educational GIS portal (EduGIS)	Geonovum
RGI-024	GEOGOV	Tilburg University
RGI-102	Combined	Meteo Consult BV
RGI-137	Use of geographic information for assessment of human exposure to air pollution	Utrecht University
RGI-156	DIGITAL DOWSING ROD: location dependent information service in educational tourism	Wageningen UR
RGI-164	Geography Awareness Week	Royal Dutch Geographical Society
RGI-168	Prevention of slippery roads with local meteorology, thermal mapping and GPS data	Meteo Consult BV
RGI-208	A playful contribution to solving the world climate crisis or how to reach the next generation of climate managers	Games Factory Online.nl BV
RGI-233	Usable (and well scaled) mobile maps for consumers	TU Delft OTB Research Institute for Housing, Urban and Mobility Studies, GISt section
RGI-240	geoMAX: Maximizing awareness of the Dutch subsurface and its dynamics: virtual excursions, games and living-environment	Netherlands Institute of Applied Geoscience TNO
RGI-246	Naturally healthy from day to day: a national interactive website for monitoring, forecasting, managing and communicating health risks from nature in space and time.	Foundation for Sustainable Development
RGI-335	The Year of Geo-Information 2008	Netherlands Institute of Applied Geoscience TNO

	Innovation pilot	Leading party
RGI-129	CycloCity: Panoramic Virtual Reality	Cyclomedia
RGI-153	GI-competencies for GI-education and GI-practice	Nieuwland
RGI-169	Art-o-Pedia	Digicare Foundation
RGI-173	Sense of the City	CityWorks
RGI-206	CitizenGIS	Municipality of Tilburg
RGI-209	Opportunity maps for Housing, Care and Welfare	Object Vision BV
RGI-243	FalkMobile – planner for bikers	Falkplan BV
RGI-253	UMTS VideoCall 2 Help	IceMobile BV
RGI-310	Extension HISGIS Friesland	Fryske Akademy
RGI-324	The future of this place	Veen Magazines
RGI-330	Innovation in Geographical education	Geofort

Annex 2 Output, results and impact per project

Category	Project	Output	Results	Impact
Public Safety	128: Geo-information for risk-prevention	Scientific articles (e.g. conceptual model, conclusions & recommendations)	Publicity	Better use of GI in decision making
	147: Real-time acquisition of geo-information for rapid emergency response operations	Pilotless helicopter with camera Aerial photos of disaster area	Deployment at calamities Utilization of real-time geo-info by safety services	Increased efficiency compared to police helicopters Better reaction to disasters, diminishing damage
Consumers and Pupils	022: EduGIS	EduGIS portal	Increased familiarity with GIS Combining various map layers	Better use of GIS in spatial policy More efficient use of data
	102: Traffic Forecast	Traffic forecast via text messages/media/ navigation systems, etc.	Use traffic forecast in planning	Decrease amount of traffic jams
	173: Sense of the City	Communication tool citizens – government	Improved communication citizens – government on public space	Improved quality of geo-information in spatial policy Increased participation

Category	Project	Output	Results	Impact
National Geo-Information Infrastructure (NGII)	019: Feasibility study for a Dutch National Population Register	Feasibility study	Publicity	Developing NPF
	006: GeoPortals	Demonstration portals, eventually: central portal Catalogue (what & where) Improved access to data	Data easier retraceable Combination of data Increase latent demand	Improved quality of geo-information in spatial policy Improved efficiency
	014: NODC-i	Uniformity oceanographic and marine data Catalogue (what & where) Improved access to data	Data easier retraceable Combination of data	Improved quality of geo-information for policy-making (safety) Improved efficiency Development of new products Increased transparency of data
	027: Mutatis Mutandis	Model for observation of mutations	Information exchange between users Track mutations	Improved efficiency Improved quality of geo-information in spatial policy
	117: Geo-data, from distribution to access	Conferences, publications	Publicity	Initiatives to improve access to data
Spatial planning	004+176: GEO Farmer	Communication tool	Adaptation technology (software developers & farmers)	Increased efficiency
	013: Virtual reality for spatial planning and safety	Tool for 3D models (communication tool citizens – government)	Utilization VR in spatial planning and safety More efficient production 3D models	Increased understanding of government plans, increased participation Increased utilization of 3D models