EuroSDR-Project

Commission 3: Production Systems and Processes

„Virtual Globes"

Final Report June 2010

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CONTENTS

Note: Chapters of this report are numbered using roman numbers (I, II.I. etc.). The sections of the questionnaire of phase I are numbered using Latin numbers so that the references to the different sections can easily be told apart.

ABSTRACT / MANAGEMENT SUMMARY

In their few years of existence, Virtual Globes such as Google Earth or Microsoft Bing Maps 3D have already received an enormous attention, both in general mass media and in the geospatial community itself. Virtual Globes have raised public awareness for geospatial data and applications like no other technology before. However, the enormous public attention has also raised the question whether Virtual Globes are just nurturing hype or whether they offer substantial and long-term business opportunities – for providers of geospatial data, technology and services alike.

The goal of the EuroSDR (European Spatial Data Research) project on Virtual Globes was to determine the state-of-the-art and critical issues concerning Virtual Globes (VG), to establish a network of users and providers and – in a second phase – to investigate selected core issues and to come up with recommendations for further action. In the first phase a comprehensive on-line survey was carried out with a target audience of experts from National Mapping Agencies (NMCAs) and the geospatial industry. The goal of this survey included the collection of facts and opinions with respect to technologies, geospatial contents, economic and political impact, challenges and opportunities for the geospatial industry. In the second phase, a EuroSDR workshop was held addressing a number of core issues identified by the survey results. The details and results of these two phases are reported here.

The main findings of the survey can be summarised as follows:

- Virtual globes have had a generally positive impact on NMCAs – from an economical and political perspective and also with respect to the organisation's corporate image.

- Virtual globes also have a positive impact on GI industry in the respective geographical areas and have led to numerous changes in business strategies.

- Participants of the survey also report that the emergence of virtual globes has a positive effect on education in GI technology and on number of students.

- While NMCAs see few threats by virtual globes, they identified several challenges for their own organisations, namely: training and know-how in 3D geoinformation, increasing demands on data and production (update rates, capacities, quality), and further adaptation of licensing and business models of NMCAs.

- Virtual globe technologies are believed to offer numerous opportunities, e.g. for reaching new markets and customer groups and for raising the awareness for new geospatial applications requiring high quality geospatial base data.

- The participants of the survey identified the establishment of (National) 3D geoportals, geospatial collaboration, rapid updating and further improvement of geometric and semantic quality of geospatial contents as important future trends.

The first EuroSDR workshop on National 3D Geoportals and Virtual Globes held on September 21st, 2009 (Nebiker et al., 2010) provided an excellent platform to discuss the current state-of-the-art and state-of-technology, to identify existing and emerging requirements and to recommend further action in terms of research, development and standardisation. The main findings and recommendations of the workshop are:

- A strong demand for further standardisation in the domain of 3D geoinformation, covering the aspects of data modelling and exchange, 3D scene portrayal, 3D content access and delivery etc.

- It was recognised that 3D geo web services will play a particularly important role in facilitating the exploitation of 3D geodata by a broad range of users and applications.

- It is finally proposed that a testbed for 3D geo web services should be established as part of future EuroSDR activities.

I INTRODUCTION

In their few years of existence, Virtual Globes such as Google Earth (Google 2010) or Microsoft Bing Maps 3D (Microsoft 2010) have already received an enormous attention, both in general mass media and in the geospatial community itself. Virtual Globes have raised public awareness for geospatial data and applications like no other technology before. However, the enormous public attention has also raised the question whether Virtual Globes are just nurturing hype or whether they offer substantial and long-term business opportunities – for providers of geospatial data, technology and services alike.

Project goals

The aim of the EuroSDR (European Spatial Data Research) project on Virtual Globes was to determine the state-of-the-art and critical issues concerning Virtual Globes (VG), to establish a network of users and providers and to investigate selected core issues. The project was divided into two phases with the following specific goals:

Phase I: State-of-the-art and Establishment of a Network

- Implementation of an on-line survey with the target audience of experts from NMCA's and the geospatial industry

- Collection of facts and opinions with respect to technologies, geospatial contents, impact, challenges, opportunities for the geospatial industry etc.

- Identification of 1-2 core issues to be further addressed in Phase II

- Detailed analysis and report

Phase II: (National) 3D Geoportals and related Core Issues

- Assemble experts to discuss issues related to the establishment and operation of (National) 3D Geoportals, including strategies, technologies, standards and applications

- Provide for an exchange between experienced users and interested parties

- Raise awareness among scientists for NMCA's demands and requirements with respect to Virtual Globes in general and National 3D Geoportals in particular

Structure of the report

Project Phase I

The online survey, its goals and dissemination are introduced in Section II.I. A complete summary of the questions and answers of the survey can be found in Section II.II. Readers desiring in-depth information about all the questions and answers of the online survey should consult this Section. An analysis and discussion of selected key issues can be found in II.III. It should be consulted by readers interested in the discussion of the main issues raised in the survey. Those readers interested in conclusions only can skip these two Sections and proceed directly to Section II.IV with the key findings of project Phase I.

Project Phase II

Section III contains a summary of the 1st EuroSDR Workshop on National 3D Geoportals and Virtual Globes which was held on the 21st of September 2009 at FHNW in Muttenz. It provides a summary of the discussions and outcome of the four break-out sessions on Interoperability & Standards, Strategies and Business Models, Technology and Architectures, and (Potential) Applications.

In Section IV the report offers a number of conclusions, identifies future trends and provides recommendations for future activities.

II PHASE I: QUESTIONNAIRE ON VIRTUAL GLOBES

II.I Questionnaire design and dissemination

In Phase I of the project on Virtual Globes an online questionnaire was developed, implemented and subsequently evaluated. The questionnaire consisted of some 88 questions divided into 9 subject sections covering the topics shown in Table 1. (The complete questionnaire can be found in appendix A1.)

Main Questionnaire Topics	Sub-Topics
Organisational and Personal Information	
T 1 – Virtual Globe (VG) Technologies & Platforms	Virtual Globe (VG) Technologies
	(National) 3D Geoportals
	Terminology
T 2 – Applications of Virtual Globes	In-house Applications of Virtual Globes
	Third Party Applications of VGs
T 3 – Economic und Political Impact	Impact of VGs on your organisation
	Impact of VGs on GI Industry in your Geographical Area
	Impact of VGs on Education and Research in your Geographical Area
	Challenges and Opportunities
T 4 – Geospatial Base Data (Imagery, Map and Elevation Data)	Imagery Base Data (Orthoimagery)
	Map Base Data
	Elevation Data
T 5 – Geospatial Contents	3D Contents (building models etc.)
	2D Vector Layers
	Raster Layers
	POI
T 6 – General Quality Issues	
T 7 – Standardisation and Extensibility	Standardisation & Harmonization
	Extensibility and Extensions
T 8 – Outlook and Trends	
T 9 – EuroSDR Contacts to Providers of Virtual Globes	

Table 1: Main topics (T1 – T9) and sub-topics of the online questionnaire on Virtual Globes

The main target group of the questionnaire consisted of geospatial experts from the geospatial / mapping industry (NMCA's or private industry). The goal of the comprehensive survey was to obtain representative high-quality answers by as many EuroSDR member countries as possible, instead of a maximum number of (possibly unqualified) answers.

EuroSDR member organisations were invited by the EuroSDR secretariat to participate with the call for participation included in appendix A2. The survey was online from the 28th of June 2008. Based on the positive feedback at the 113th EuroSDR steering committee meeting in Cardiff, Oct 15-17, 2008 the call for participation was extended to member organisations of EuroGeographics and the survey was closed on the 15th of December 2008.

II.II Data description and analysis

The 21 completed questionnaires covering 11 European countries (Figure 1) and about 12'000 of staff in the answering organisations show the considerable interest in the issues surrounding Virtual Globes.
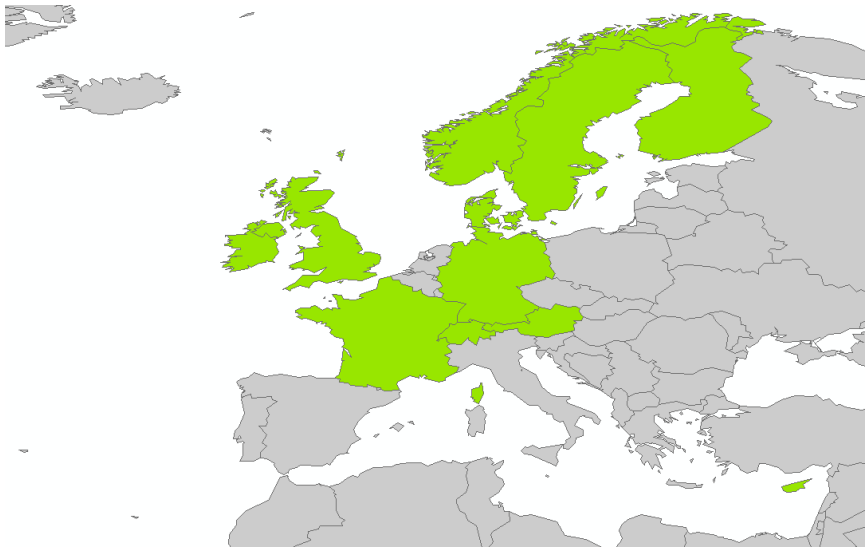
Figure 1. European countries (green) where the questionnaire was answered at least once

The questionnaire answers are given for the following types of geographical areas:
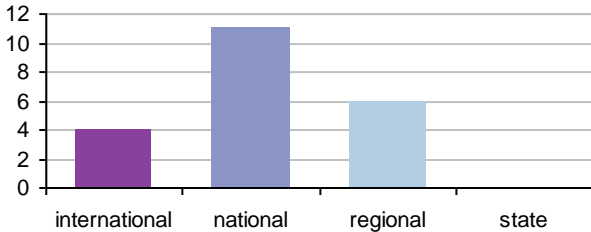
The following sections (numbered according to the questionnaire topic numbering) show the collected data for each of the questionnaire topics and subtopics. The additional participant's comments for each section are summarised in a short paragraph. The results are discussed in Section II.III .

T 1 Virtual Globe (VG) Technologies & Platforms

T 1.1 Virtual Globe (VG) Technologies

Relevance of VG technologies?

Legend (column 1): N/A, very strong, strong, medium, weak, very weak / irrelevant

Legend (column 2): N/A, very high, high, medium, low, very low / irrelevant

Legend (column 3): N/A, very high, high, medium, low, very low / irrelevant
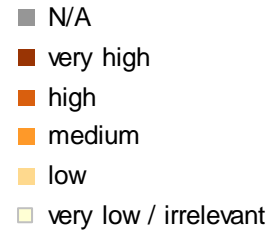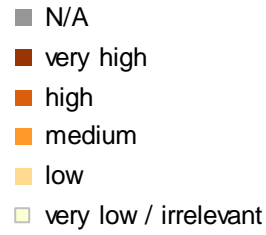
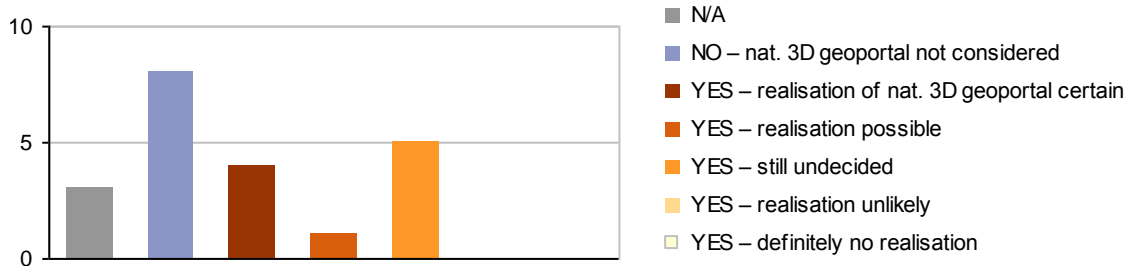|	*How do your rate the market presence of each of the following VG technologies in your geographical area?*	*How do you rate the relevance of the following VG technologies for your own organisation?*	*How do you rate the relevance of VG technologies for third party organisations in your geogr. area?*
a) Google Earth			
b) Microsoft Virtual Earth 3D / Bing Maps 3D			
c) NASA World Wind			
d) ESRI ArcGIS Explorer			
e) Leica Virtual Explorer / ERDAS TITAN			
f) Skyline TerraExplorer (incl. géoportail.fr)			
g) Other GRIFINOR, Second Life, Norge i 3D (Norkart), pagesjaunes.fr, GAIA M-V			
h) Other Norkart Virtual Globe, Michelin			
not a), b) or d) together NASA World Wind, Leica Virtual Expl./ERDAS Titan, Skyline Terra Expl. (incl. géoportail.fr), GRIFINOR, Second Life, Norkart, pagesjaunes.fr, GAIA M-V, Michelin	N/A = 53	N/A = 49	N/A = 54

Terms of use for different virtual globe technologies and number of users in your organisation?

- N/A
- endorsed – standard installation
- endorsed – installation upon request
- informal use
- not used

N/A ■ 0 - 10% ■ 11 - 20% ■ 21 - 30% ■ 31 - 40% ■ 41 - 50% ■ 51 - 60% ■ 61 - 70% ■ 71 - 80% ■ 81 - 90% ■ 91 -100%

What are the terms and conditions of VG usage in your organisation from an IT policy point of view?

What is the estimated number of VG users in your organisation? (in % of your total staff)
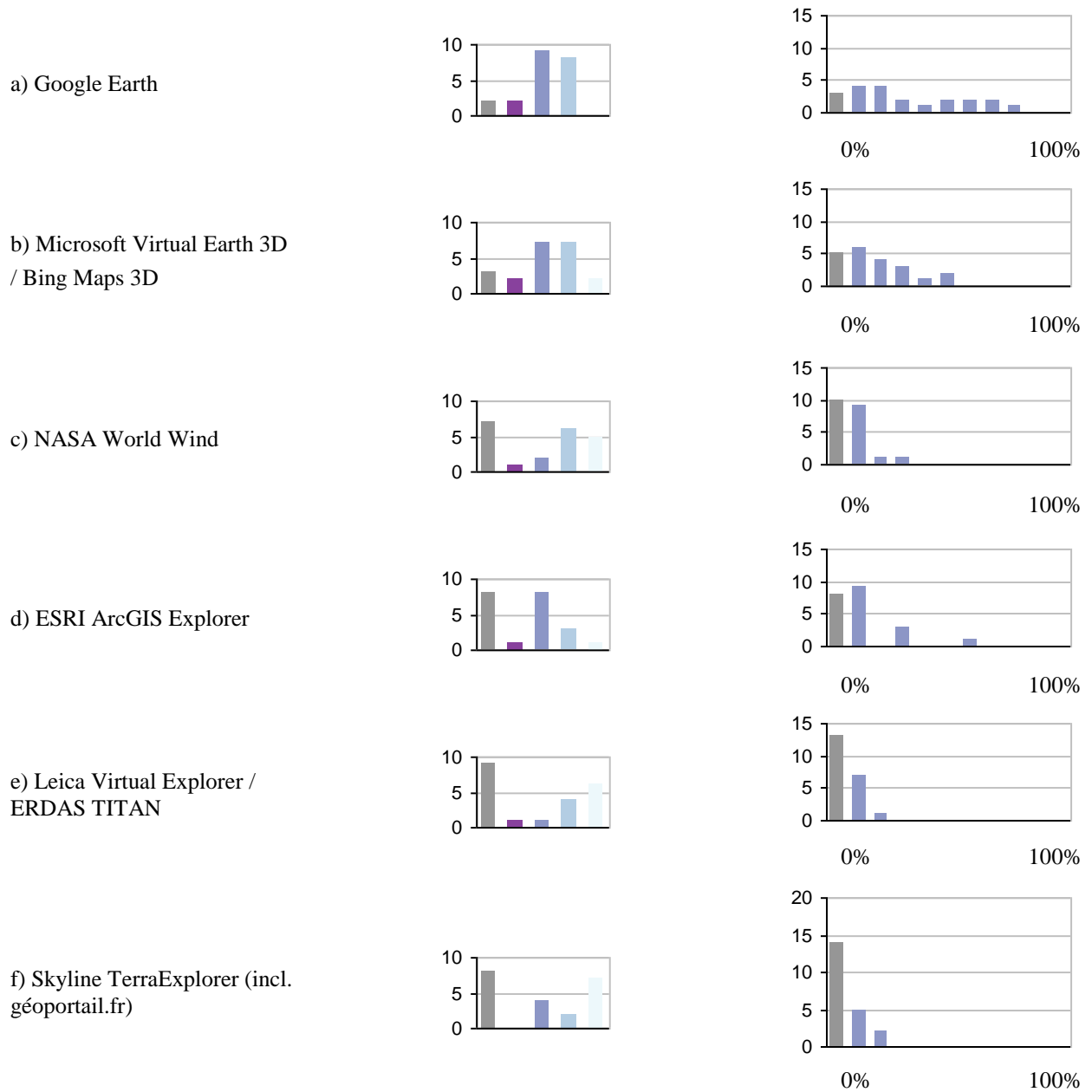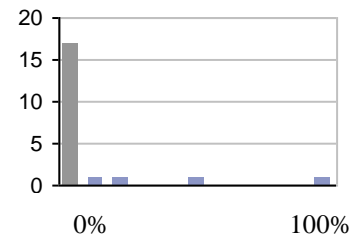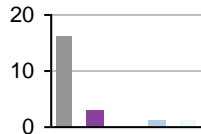
a) Google Earth

b) Microsoft Virtual Earth 3D / Bing Maps 3D

c) NASA World Wind

d) ESRI ArcGIS Explorer

e) Leica Virtual Explorer / ERDAS TITAN

f) Skyline TerraExplorer (incl. géoportail.fr)

g) Other
GRIFINOR
Second Life
Norge i 3D (Norkart)
pagesjaunes.fr
GAIA M-V

h) Other
Norkart Virtual Globe
Michelin
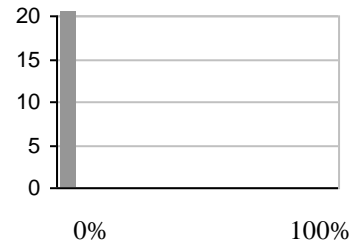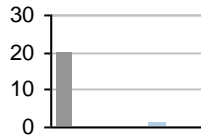
not a), b) or d) together
- NASA World Wind
- Leica Virtual Expl./
  ERDAS Titan
- Skyline Terra Expl.
  (incl. géoportail.fr)
- GRIFINOR
- Second Life
- Norkart
- pagesjaunes.fr
- GAIA M-V
- Michelin
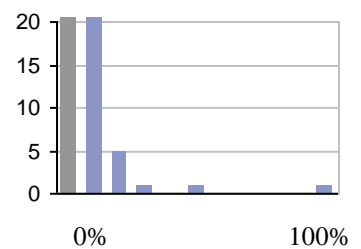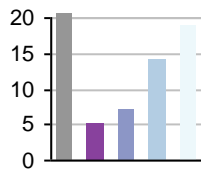
T 1.2 (National) 3D Geoportals

Have you considered establishing a national 3D geoportal and if yes, what is the probable outcome?

- ■ N/A
- ■ NO – nat. 3D geoportal not considered
- ■ YES – realisation of nat. 3D geoportal certain
- ■ YES – realisation possible
- ■ YES – still undecided
- ■ YES – realisation unlikely
- ■ YES – definitely no realisation

T 1.3 Terminology

Similar to other new and rapidly evolving technological areas, we also observe a certain variety and evolution of terminology in the case of 'Virtual Globes', which is influenced by commercial factors (e.g. product and company names) and by the evolution and establishment of scientific domains. EuroSDR would like to determine the preferred or predominant terminology.

How do you rate the suitability of each of the following terms for representing the above listed technologies and services as a whole?

Legend: -- very negative   0 neutral   ++ very positive   N/A not applicable / no answer / don't know

a) Virtual Globes

b) Digital Globes

c) 3D Globes

d) Virtual Globe Environments

e) 3D Virtual Environments
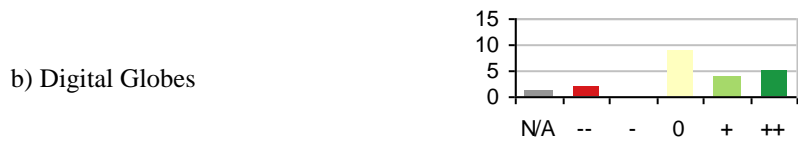
f) Other
- Digital Earth
- Virtual Earth

T 2 Applications of Virtual Globes

T 2.1 In-house Applications of Virtual Globes

Types and purpose of use of Virtual Globes within NMCA's or mapping companies:

- a) What are the current primary types and purposes of use?
- b) What are the future primary types and purposes of use?
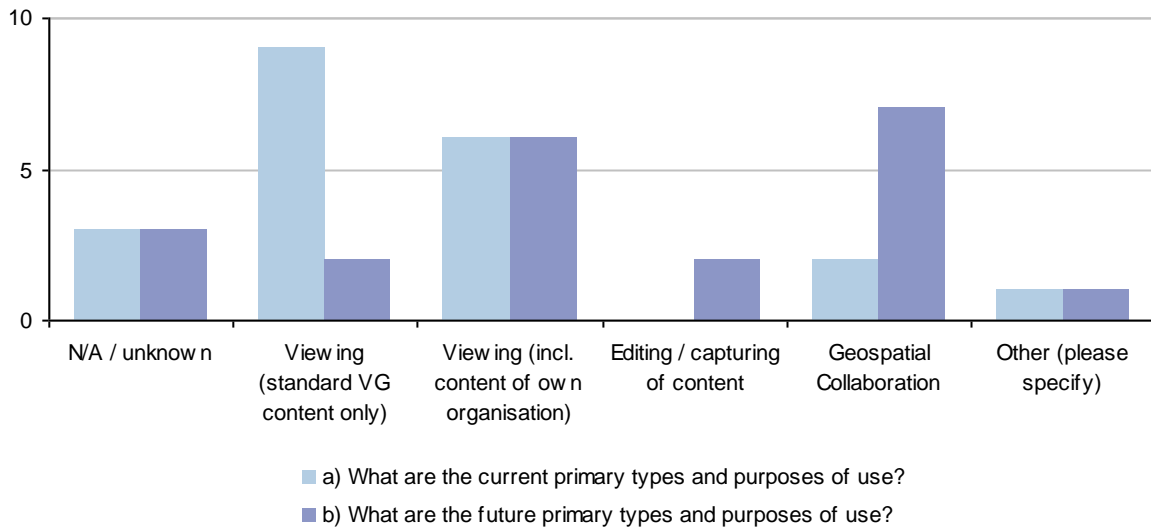
T 2.2 In-house and third Party Applications of VGs

Application areas of VG technologies?

■ N/A   ■ None   ■ Operational   ■ Under construction   ■ Planned

	Please specify the application areas of VG technologies in your organisation	Please specify the application areas in which VG technologies are used or will be used by third parties in your geographical area (e.g. by customers of your organisation)
a) Agriculture		
b) Defence		
c) Disaster management		
d) Flood prevention		

e) Forestry

f) Logistics management

g) Media (TV, Web)

h) NGDI / Geo-Metadata Services (data discovery, visualisation etc.)

i) Public Planning

j) Security / monitoring

k) Transportation

l) Other

Information, Coastal management, Energy consumption, Data maintenance, Radar satellite products, 3D city models, Public utility for editing of located information, viewing of geo base data, Land Registration

m) Other

City modelling, background for viewing of own data (e.g. flight trajectories, building models), House price statistics

T 3 Economic und Political Impact

T 3.1 Impact of VGs on your organisation

Legend: -- very negative   0 neutral / no effect   ++ very positive   N/A not applicable / no answer / don't know

*How do you assess the **economic impact** of VGs on your organisation? (effects on sales, budgets and staffing)*

Comments: Mainly in development (own technologies and tools) and supplying data.
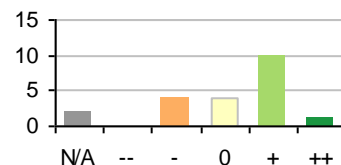
*How do you assess the impact of VGs on the **political backing and support** of your organisation? (e.g. effects on GI-related legislation)*

Comments: Improves the awareness of the value of spatial information and services.
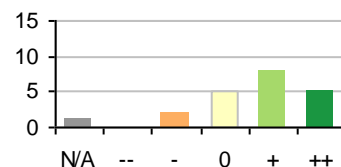
*How do you assess the impact of VGs on the **corporate image** of your organisation?*
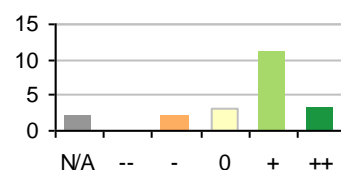
*Have VGs led to changes / adaptations in the **business strategy** of your organisation?*

Comments: A national geoportal is planned. Issues include professional and lay users. It is not only VG but 3D data in general.
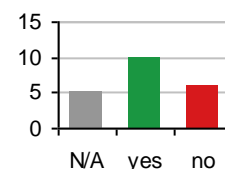
*Have VGs led to **new products or services** within your organisation?*

Comments: Geographical data is published in national or commercial VGs. Several new geodata and also metadata services are offered. The widespread use of VGs has led to additional demand for satellite imagery.
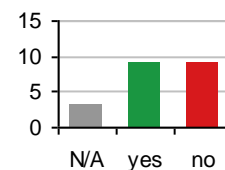
Have VGs led to the discontinuation / abandonment of existing products or services?

Comments: Digitisation efforts may decrease demand for traditional services and sales (e.g. archive visits, map sales). The tools used so far may be used less often.
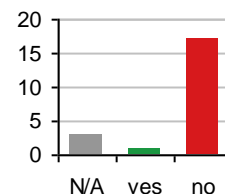
T 3.2 Impact of VGs on GI Industry in your Geographical Area

Legend: -- very negative   0 neutral / no effect   ++ very positive   N/A not applicable / no answer / don't know

How do you assess the general economic impact of VGs on the GI industry in your geographical area?

Comments: Private mapping agencies supply the VGs with data sets what is good publicity. Members of the public are encouraged to focus on GI and discover it.
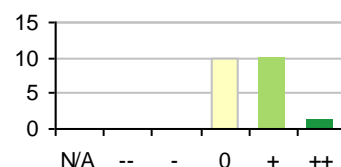
How do you assess the impact of VGs on the (public) image of the GI industry in your geographical area?

Comments: One statement assumes that the 'Google effect' is not relevant for the image of the GI industry as people do not see the relation. Others state that now spatial information is more easily understood and the GI is made more visible to a large audience. GI gets into daily life and may increase people's use of GI services in general.
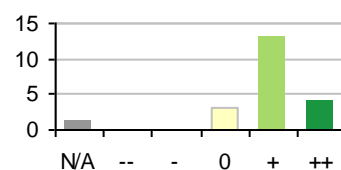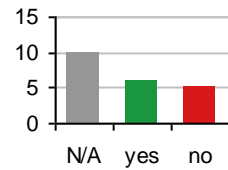
Have organisations of your national / regional GI industry changed their business strategy due to VGs?

Comments: It is difficult to distinguish between VG and general digital/internet strategy.
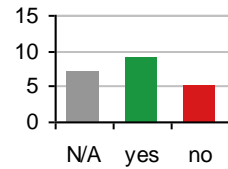
Have VGs led to new business models?

Comments: Geoservices need different business models than selling or licensing data. The Google model (advertising tsunami and use free of charge) may not be sustainable.
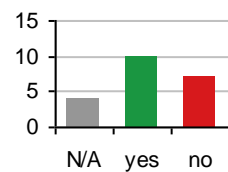

*Have VGs led to the founding of new businesses in your geographical area?*
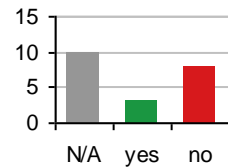
Have VGs led to new products and services offered by members of your national / regional industry?

Comments: Many data sets are now available for free. New tools are designed and services offered but most of them for free.

Have VGs led to the discontinuation or closing of businesses or business units?
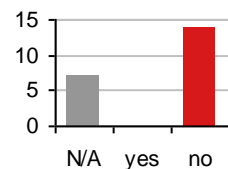
T 3.3 Impact of VGs on Education and Research in your Geographical Area

Legend: -- very negative   0 neutral / no effect   ++ very positive   N/A not applicable / no answer / don't know

How do you assess the impact of VGs on education in GI technology and sciences (in your geographical area)?

Comments: Most comments mention the positive effect of VG in encouraging geo spatial learning, education and training. The easy to handle tools make GI more accessible. But the positive effects would need a more systematic assessment.
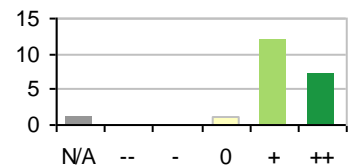
Have VGs had an influence on the founding of new study programs in GI technology and sciences (in your geographical area)?

Comments: VG is used for teaching and easier data access and data display at universities. It is used for 3D city modelling (Google Sketchup) and for courses such as information logistics. Others mention that the new developments need to be integrated into the curricula.
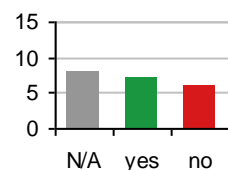
How do you assess the impact of VGs on the future number of students in Geoinformation technology and sciences (in your geographical area)?

Comments: There is increased awareness of GI, easier use and thus potential for GI being more appealing to potential students. Other aspects mentioned include that future users or supporters of VG may not study GI topics as VG is not only a domain of GI. Additionally, rather contents of courses may be changed than student numbers increased.
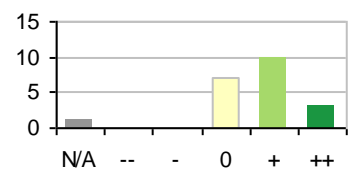
T 3.4 Challenges and Opportunities

What are the main threats and challenges of VGs for your kind of organisation?

Challenges: The main challenges are the increased demands on data quality and sufficient metadata to assess it, the data currency and the development of new business models that take into account the needs of businesses and clients. Other challenges mentioned include the possibility of getting data published in VGs (PR), building partnerships and networks, the development of interfaces, qualified presentations of data sets and 3D objects and combinations with traditional Web-GIS.

Threats: Regarding threats the answers range from no threats to several issues such as that 3D coordinate systems are more difficult to handle than 2D systems, that the data needs to be published in VGs and that freely available data is a moderate threat to licensed data. Additionally, there are concerns regarding the incorrect use VGs and data and the question of how duplicate and/or contradictory data acquisition can be avoided.

What are the main opportunities of VGs for your kind of organisation? (i.e. how could your kind of organisation take advantage of VGs)

Opportunities: Most often mentioned is the aspect that VGs are a powerful global tool for data distribution. They allow widespread use and visibility of GI and thus it is potentially possible to reach new markets and customers. There is also potential for new applications and research and it is easier to present planning projects. More demanding users may potentially give better feedback on data quality and there is potential for geospatial collaboration.

T 4 Geospatial Base Data (Imagery, Map and Elevation Data)

Important Notice 1: The following questions apply to the most relevant VG technologies in your geographical areas. Please choose the most relevant VG technology (VG1) and optionally the second most relevant VG technology (VG2) before answering the following questions.

a) Most relevant Virtual Globe Technology (VG1)?
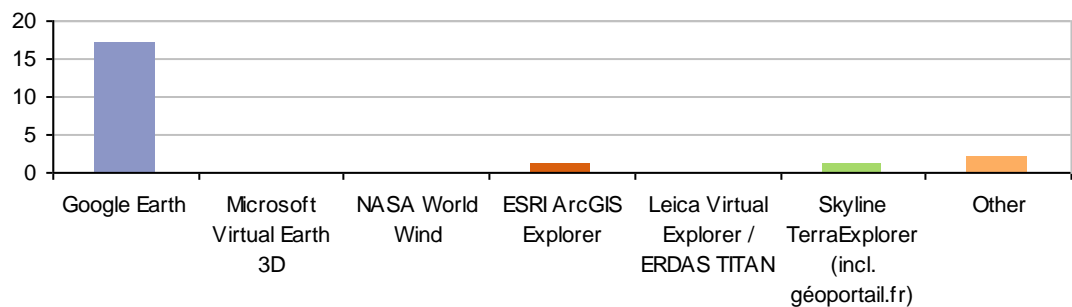
b) Second most relevant Virtual Globe Technology (VG2)?
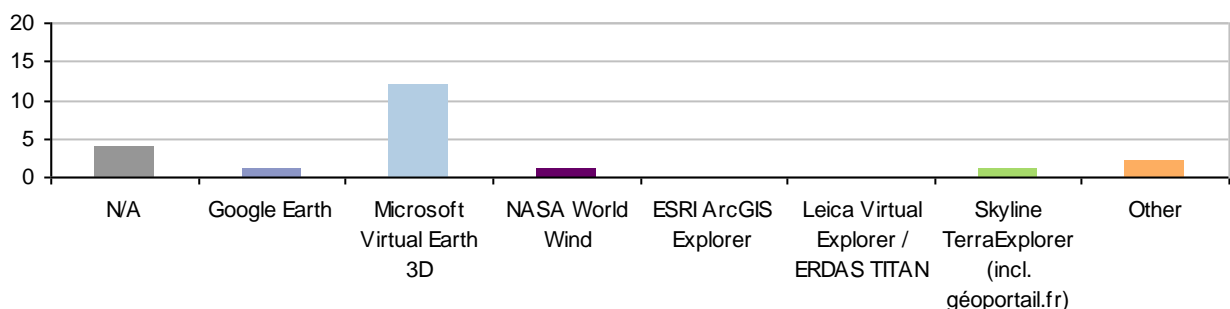
The following data displays are for the two most often mentioned virtual globe technologies - VG1 stands for Google Earth and VG2 stands for Microsoft Virtual Earth 3D (today Bing Maps 3D).

T 4.1 Imagery Base Data (Orthoimagery)
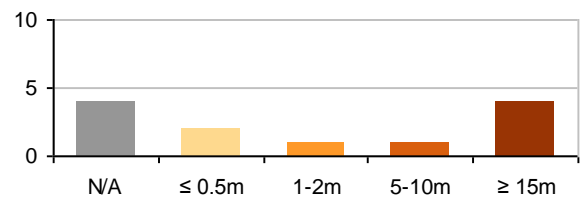
Standard Resolution Imagery Data

Important Notice: If the virtual globe technology VG1 or VG2 contains a SINGLE imagery data set of your geographical area with a homogeneous geometric resolution: proceed directly to the section on "High-resolution Imagery Data".

Standard-resolution imagery data –What is the estimated lowest (i.e.) poorest geometric resolution (GSD) of imagery data in your geographical area? (e.g. 15m satellite imagery)
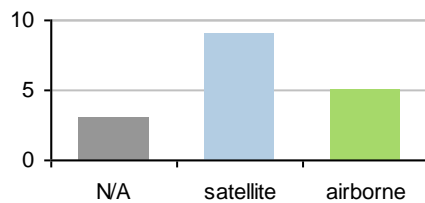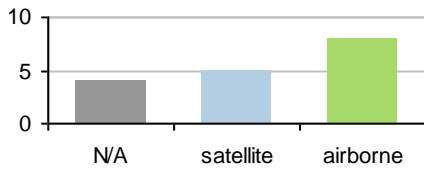
Google Earth
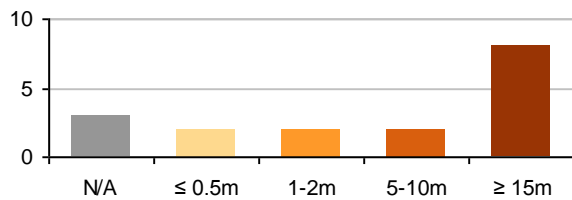
Microsoft Virtual Earth 3D / Bing Maps 3D

Which type of imaging platform was used in the acquisition of the standard-resolution imagery?

Google Earth

Microsoft Virtual Earth 3D / Bing Maps 3D
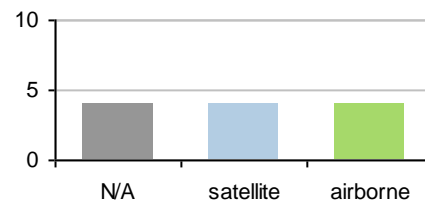
Up-to-dateness of standard-resolution imagery data *– What is the estimated current age of the standard-resolution imagery data (at the time of this study)?*
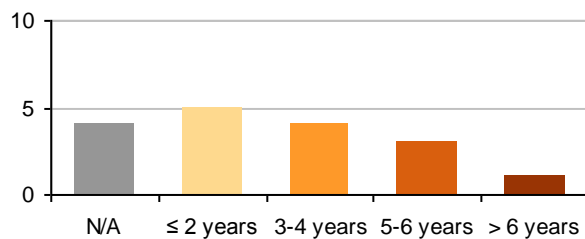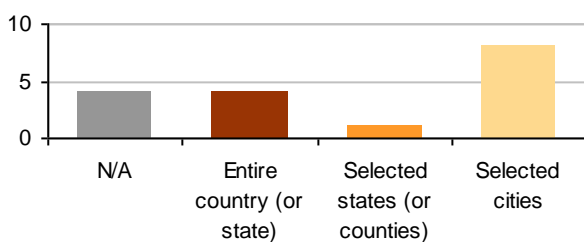
Google Earth

Microsoft Virtual Earth 3D / Bing Maps 3D
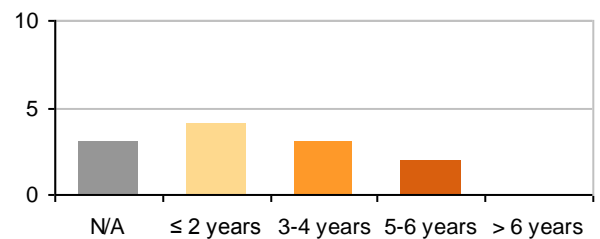
*What is the **source** of the standard-resolution imagery data?*
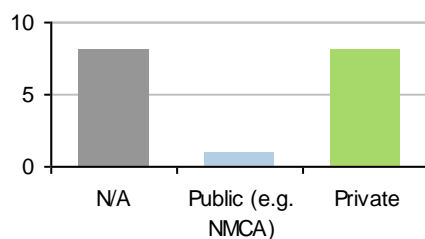
Google Earth

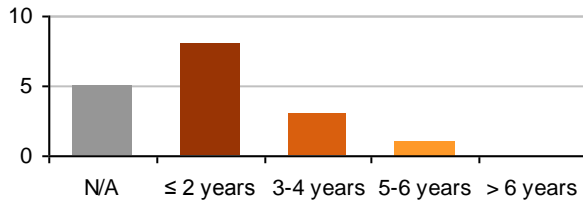Microsoft Virtual Earth 3D / Bing Maps 3D
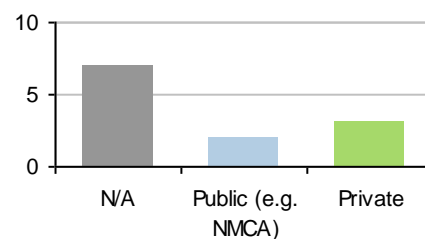
What are the likely reasons for the current data source of standard-resolution imagery data?

Google Earth

10	
5	
0	

Price | Availability | IP Rights / Copyright | Policy | Quality

Microsoft Virtual Earth 3D / Bing Maps 3D

10	
5	
0	

Price | Availability | IP Rights / Copyright | Policy | Quality
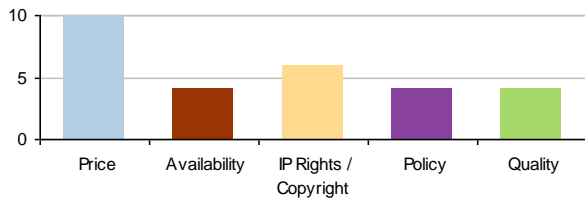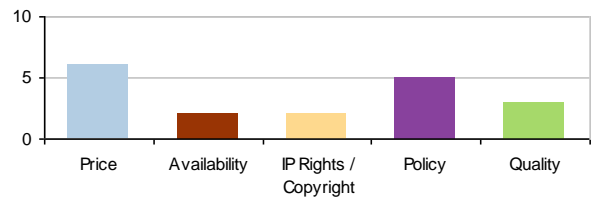
High-resolution Imagery Data

High-resolution imagery data *– What is the estimated highest / best geometric resolution (GSD) of imagery data in your geographical area?*

Google Earth

10	
5	
0	

N/A | ≤ 0.5m | 1-2m | 5-10m | ≥ 15m

Microsoft Virtual Earth 3D / Bing Maps 3D

10	
5	
0	

N/A | ≤ 0.5m | 1-2m | 5-10m | ≥ 15m
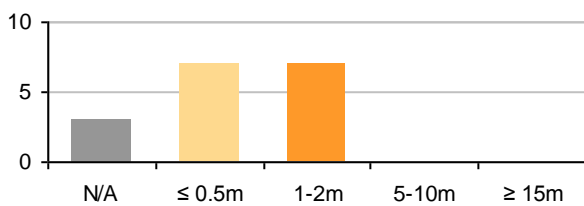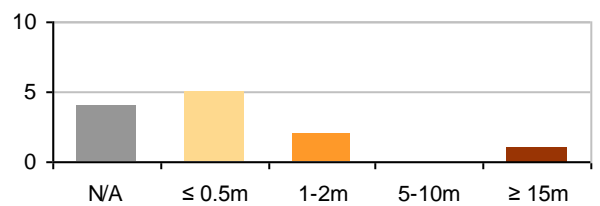
From which type of imaging platform was this imagery obtained?

Google Earth

10	
5	
0	

N/A | satellite | airborne

Microsoft Virtual Earth 3D / Bing Maps 3D

10	
5	
0	

N/A | satellite | airborne
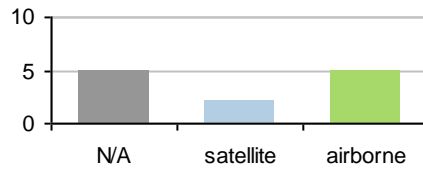
*What is the **coverage** of the high-resolution imagery data sets?*

Google Earth

10	
5	
0	

N/A | Entire country (or state) | Selected states (or counties) | Selected cities

Microsoft Virtual Earth 3D / Bing Maps 3D

10	
5	
0	

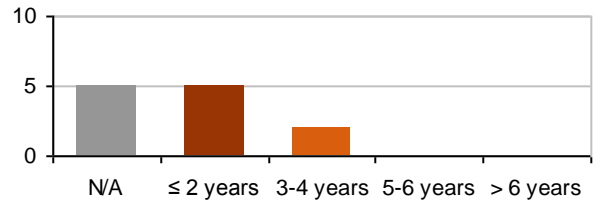N/A | Entire country (or state) | Selected states (or counties) | Selected cities
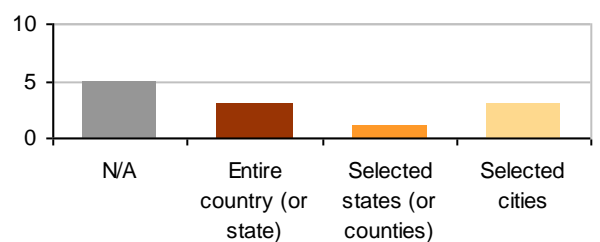
Up-to-dateness of high-resolution imagery data – *What is the current age of the high-resolution imagery data (at the time of this study)?*
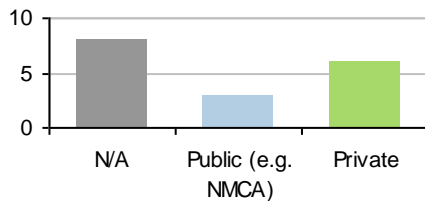
Google Earth
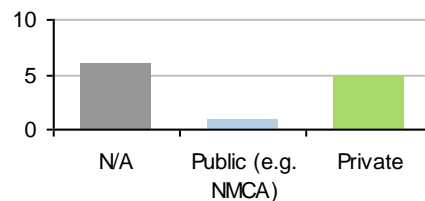

Microsoft Virtual Earth 3D / Bing Maps 3D

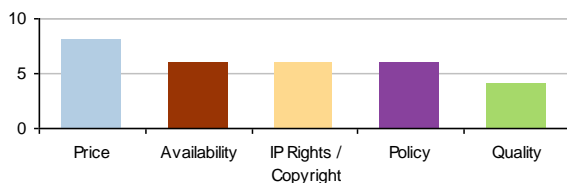*What is the **source** of the high-resolution imagery data?*

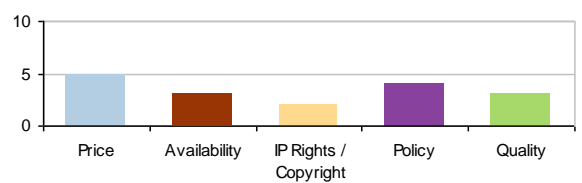Google Earth

Microsoft Virtual Earth 3D / Bing Maps 3D

What are the likely reasons for the current data source?
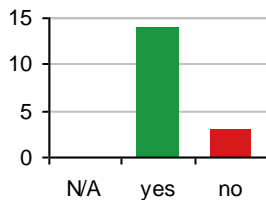
Google Earth

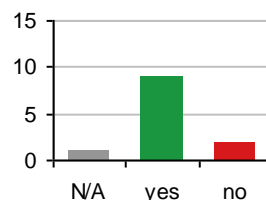Microsoft Virtual Earth 3D / Bing Maps 3D

T 4.2 Map Base Data

Some VGs also provide standard base map layers which can be used in combination with or as an alternative to the above mentioned base (ortho-) imagery.

Does the VG technology contain base map data layers for your geographical area?
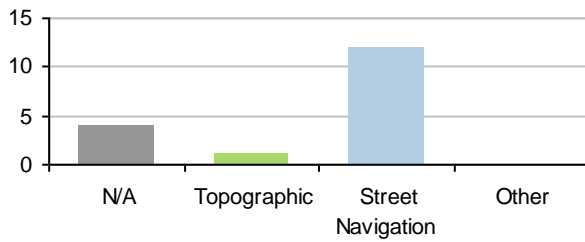
Google Earth

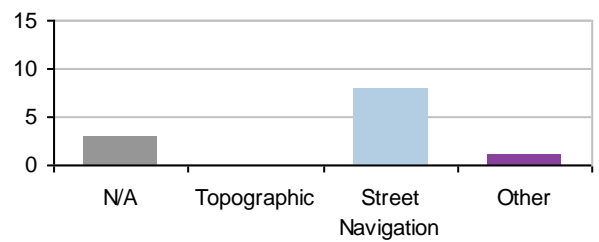Microsoft Virtual Earth 3D / Bing Maps 3D

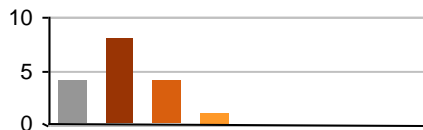*If yes, please answer the following: What base map type is used?*

Google Earth

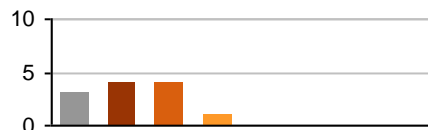Microsoft Virtual Earth 3D / Bing Maps 3D

What is the estimated largest scale of the used base maps?
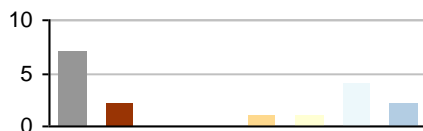

Google Earth
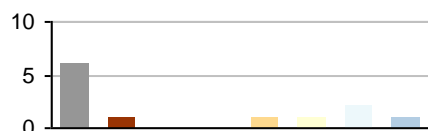
Microsoft Virtual Earth 3D / Bing Maps 3D
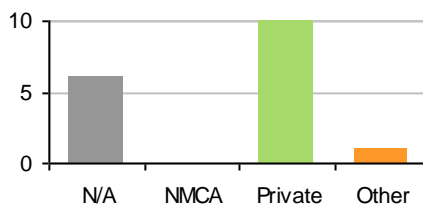
■ N/A   ■ < 1:25'000   ■ 1:25'000   ■ 1:50'000   ■ 1:100'000   ■ 1:200'000   ■ 1:500'000   ■ >=1:1'000'000

What is the estimated smallest scale of the used base maps?

Google Earth

Microsoft Virtual Earth 3D / Bing Maps 3D

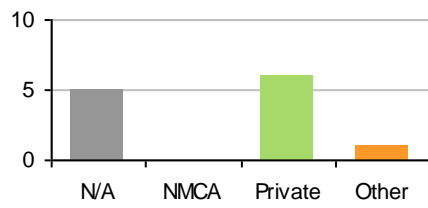■ N/A   ■ < 1:25'000   ■ 1:25'000   ■ 1:50'000   ■ 1:100'000   ■ 1:200'000   ■ 1:500'000   ■ >=1:1'000'000
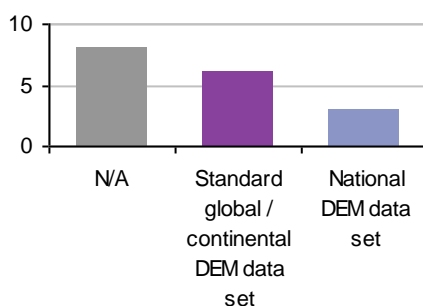
What is the base map data source?

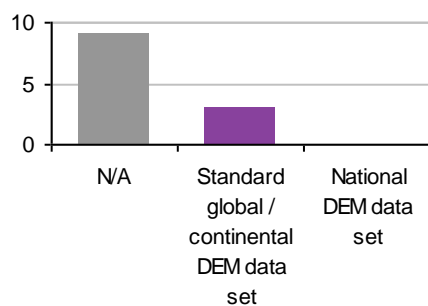Google Earth

Microsoft Virtual Earth 3D / Bing Maps 3D

T 4.3 Elevation Data

What kind of digital elevation data is used in your geographical area?

Google Earth

Microsoft Virtual Earth 3D
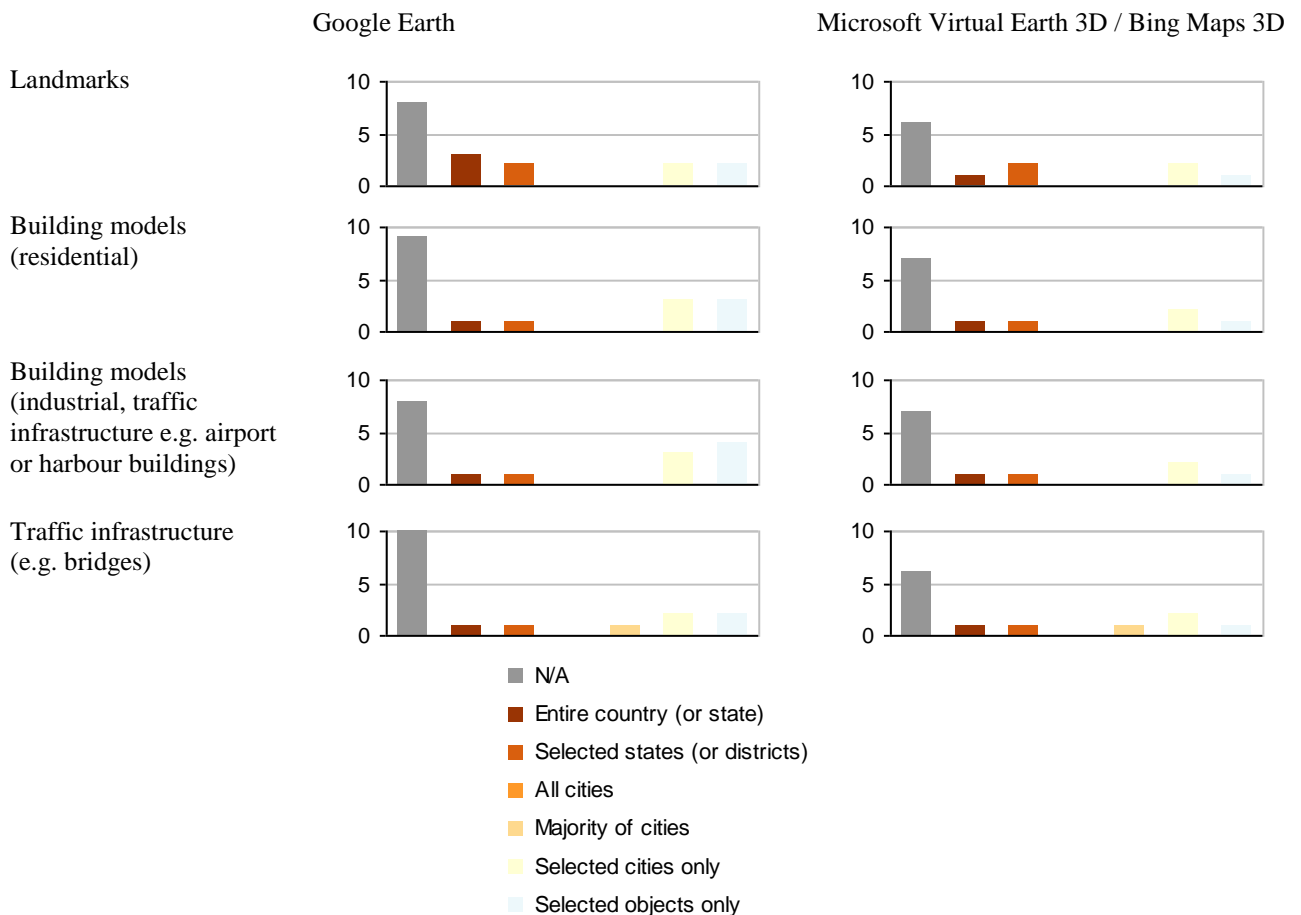
T 5 Geospatial Contents

Other than the 'base data sets' treated in the previous chapter, 'geospatial contents' are not necessarily provided by the owner or operator of the VG technology but are often offered and added by third parties, such as regional authorities or even private individuals. Geospatial contents are not restricted to topographic (geo-) objects and could also include spatially related abstract information such as labels, points of interest etc.

In the following, we will distinguish between the following geospatial content types:

- 3D Contents (building models etc.)
- 2D Vector Layers
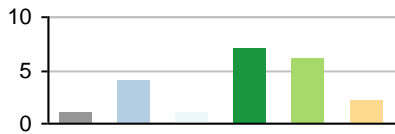- Raster Layers
- Points of Interest (POI)

T 5.1 3D Contents (building models etc.)

*For your geographical area: which **types of 3D geospatial content** are present in the most relevant Virtual Globes and what is their actual **coverage?***
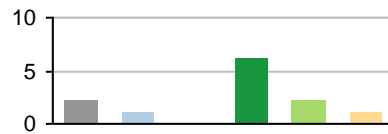
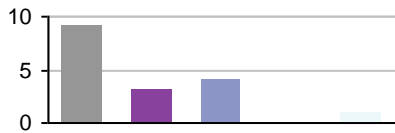## What are the main *sources* of the 3D contents?

Google Earth

Microsoft Virtual Earth 3D / Bing Maps 3D

- N/A
- Public (geospatial / mapping agency)
- Public (non-geospatial e.g. nat. meteo service)
- Private (geospatial business)
- Private (non-geospatial)
- Public Domain

How are the 3D contents integrated into the VG?

Google Earth

Microsoft Virtual Earth 3D / Bing Maps 3D
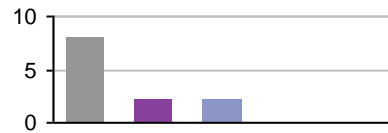
- N/A
- 3D data sold to VG provider; streaming by VG provider
- 3D data given to VG provider free of charge; streaming by VG provider
- 3D data linked into VG; streaming from separate server
- 3D data integrated as static sub-scenes (e.g. KML files); no streaming

What are the likely reasons for the current data source of 3D contents?

Google Earth

Microsoft Virtual Earth 3D / Bing Maps 3D

T 5.2 2D Vector Layers

*For your geographical area: which **2D vector layers** from national or regional information providers are published in VGs and what is the coverage of these layers?*

Google Earth
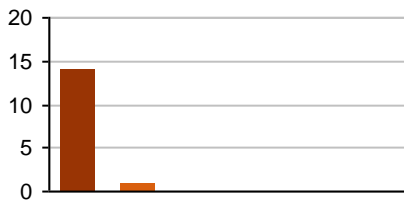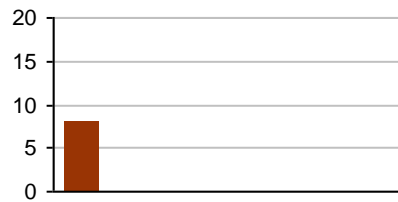
Layers mentioned: 5x Roads, 2x Addresses, Buildings, 2x Borders, Traffic network, Water, Administrative limits, Names, Street names

Microsoft Virtual Earth 3D / Bing Maps 3D

- ■ Entire country (or state)
- ■ Selected states (or districts)
- ■ All cities
- ■ Majority of cities
- ■ Selected cities only
- ■ Selected objects only

*What are the main **sources** of the 2D vector layers?*

Google Earth
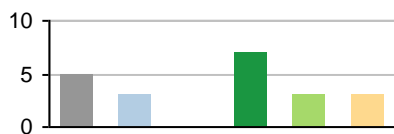

Microsoft Virtual Earth 3D / Bing Maps 3D

- ■ N/A
- ■ Public (geospatial / mapping agency)
- ■ Public (non-geospatial e.g. nat. meteo service)
- ■ Private (geospatial business)
- ■ Private (non-geospatial)
- ■ Public Domain

How are the 2D vector layers integrated into the VG?
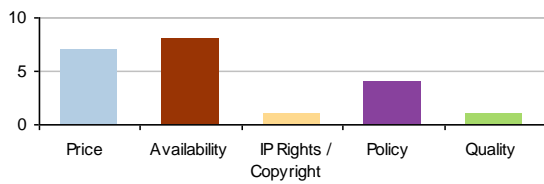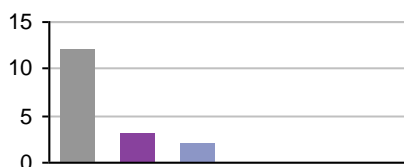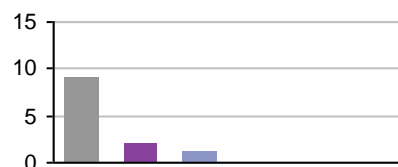
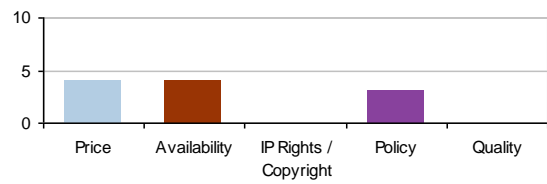Google Earth

Microsoft Virtual Earth 3D / Bing Maps 3D

- ■ N/A
- ■ Data sold to VG provider; streaming by VG provider
- ■ Data given to VG provider free of charge; streaming by VG provider
- ■ Data linked into VG; streaming from separate server
- ■ Data integrated as static sub-scenes (e.g. KML files); no streaming
- ■ Data integrated via Geo Web Services (e.g. WFS)

What are the likely reasons for the current data source of 2D vector layers?

Google Earth
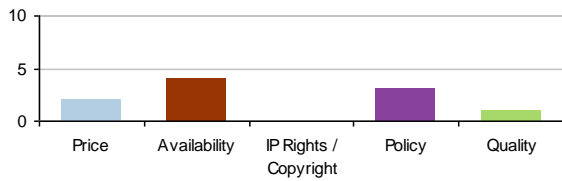
Microsoft Virtual Earth 3D / Bing Maps 3D

T 5.3 Raster Layers

For your geographical area: which raster layers from national or regional information providers are published in VGs and what is the coverage of these layers?

Google Earth
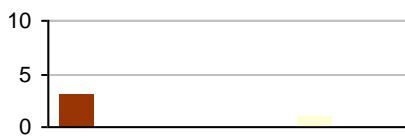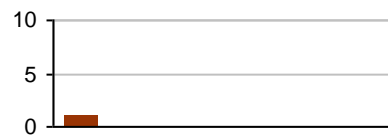
Layers mentioned: 2x Aerial photos, Clouds, Satellite imagery

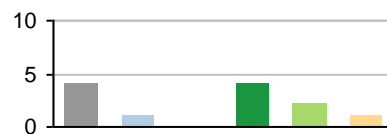Microsoft Virtual Earth 3D / Bing Maps 3D

- Entire country (or state)
- Selected states (or districts)
- All cities
- Majority of cities
- Selected cities only
- Selected objects only

What are the main sources of the raster layers?

Google Earth
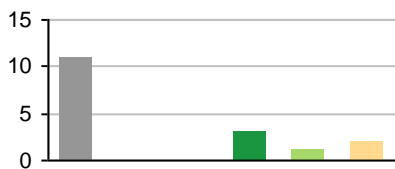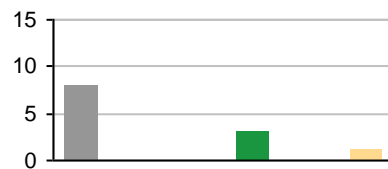

Microsoft Virtual Earth 3D / Bing Maps 3D

- N/A
- Public (geospatial / mapping agency)
- Public (non-geospatial e.g. nat. meteo service)
- Private (geospatial business)
- Private (non-geospatial)
- Public Domain

*How are the raster layers integrated into the VG?*
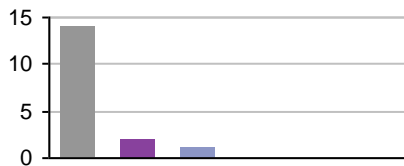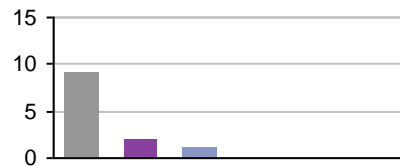
Google Earth

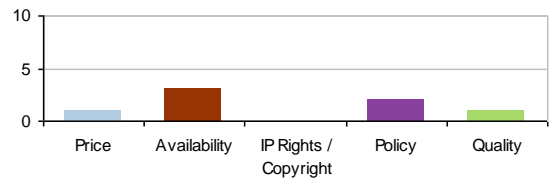Microsoft Virtual Earth 3D / Bing Maps 3D

- ◼ N/A
- ◼ Data sold to VG provider; streaming by VG provider
- ◼ Data given to VG provider free of charge; streaming by VG provider
- ◼ Data linked into VG; streaming from separate server
- ◼ Data integrated as static sub-scenes (e.g. KML files); no streaming
- ◼ Data integrated via Geo Web Services (e.g. WFS)

What are the likely reasons for the current data source of raster layers?

Google Earth
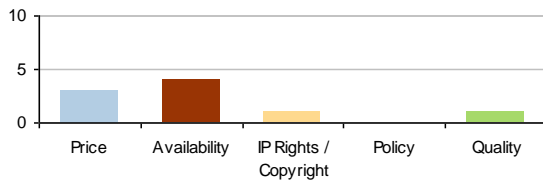
Microsoft Virtual Earth 3D / Bing Maps 3D

T 5.4 POI

For your geographical area: which point of interest (POI) data sets from national or regional information providers are published in VGs and what is the coverage of these layers?

Google Earth
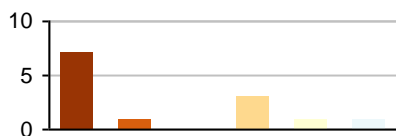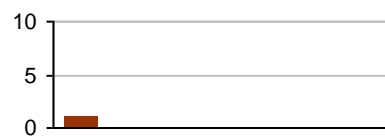
Layers mentioned: Landmarks, Wikipedia, Private slides, 2x Touristic places, UNESCO sites, Place names, Hospital and clinics, Banks/Cash dispensers, 2x Hotel, Cafe/Coffee Shops, Restaurant, much other without exhaustivity warranty

Microsoft Virtual Earth 3D / Bing Maps 3D


- ◼ Entire country (or state)
- ◼ Selected states (or districts)
- ◼ All cities
- ◼ Majority of cities
- ◼ Selected cities only
- ◼ Selected objects only

*What are the main **sources** of the POI data sets?*

Google Earth
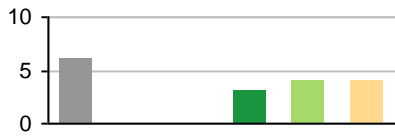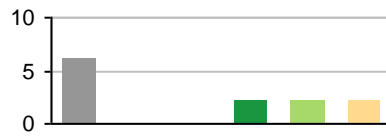

Microsoft Virtual Earth 3D / Bing Maps 3D

- ■ N/A
- ■ Public (geospatial / mapping agency)
- ■ Public (non-geospatial e.g. nat. meteo service)
- ■ Private (geospatial business)
- ■ Private (non-geospatial)
- ■ Public Domain

*How are the POI data sets integrated into the VG?*
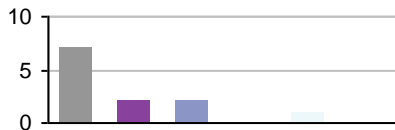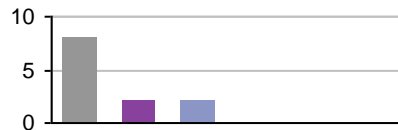
Google Earth

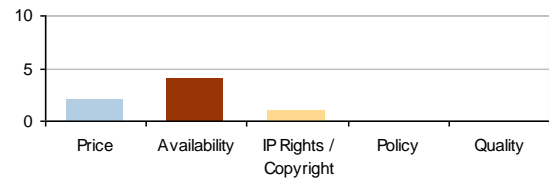Microsoft Virtual Earth 3D / Bing Maps 3D

- ■ N/A
- ■ Data sold to VG provider; streaming by VG provider
- ■ Data given to VG provider free of charge; streaming by VG provider
- ■ Data linked into VG; streaming from separate server
- ■ Data integrated as static sub-scenes (e.g. KML files); no streaming
- ■ Data integrated via Geo Web Services (e.g. WFS)

What are the likely reasons for the current data source of POI data sets?

Google Earth
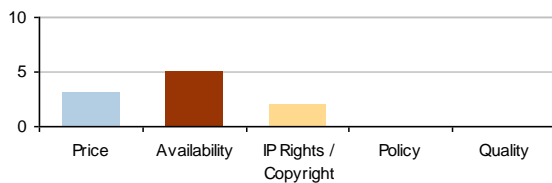
Microsoft Virtual Earth 3D / Bing Maps 3D
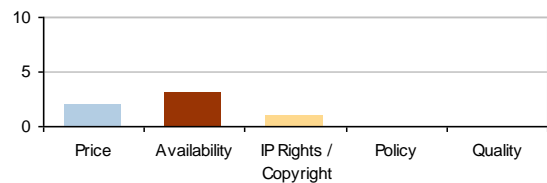
T 6 General Quality Issues

Are there know quality issues with VG contents in your geographical area?

Comments: The most often mentioned issues are out-of-date data sets, low resolution especially of imagery data, geometric quality and place name quality (language, spelling errors, incorrect data). Other issues mentioned are the coordinate system and the inconsistency across layers. National geoportals should be able to overcome most of these problems.
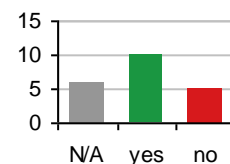
How do you assess the short-term effects of VGs on the quality of geospatial data?

Comments: Widespread use of VGs and thus public pressure may contribute to the improvement of geodata quality.
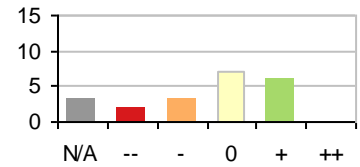
How do you assess the long-term effects of VGs on the quality of geospatial data? (For example, in view of the increasing integration of VGs into 'everday life applications' and in view of technologies and trends such as Web 2.0 and Mashups?)

Comments: Quality is important. Even more important is metadata which allows assessing quality and distinguishing validated and official information from crowd sourced data of varying quality.
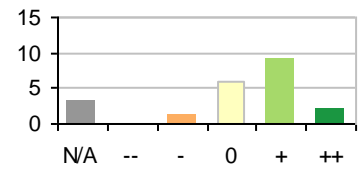
T 7 Standardisation and Extensibility

T 7.1 Standardisation & Harmonization

How do you assess the effects which VGs have had on geospatial standardisation so far?

Comments: Important, they foster discussion and as their main goal is sharing GI the need for standardisation grows. Example KML which is now a standard.
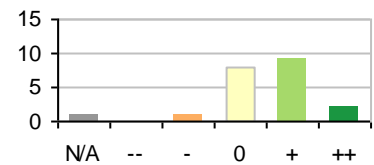
How do you assess the long-term effects of VGs on geospatial standardisation?

Comments: They will improve interoperability and a better access to data might also increase the pressure for more standardisation.
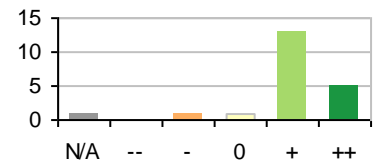
How do you rate the importance of standardisations in the context of Virtual Globes and related issues (e.g. KML as OGC and ISO standards) from the perspective of your organisation?
(-- irrelevant, 0 nice to have but not essential, ++ very important)

Comments: Additionally, also the training to employ the standards is important.
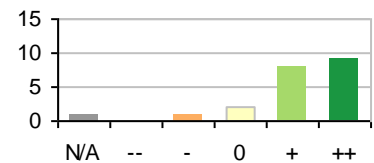
Should EuroSDR play an active role in the standardisation process for Virtual Globes (and related issues)?

Comments: EuroSDR could play a role in linking the various GI related European projects (in terms of technical matters and standards), and in helping a shared and practical view of Digital globes emerge. The combined European activities should also be forwarded to international standardisation organisations, e.g. OGC which is considered important. Others remark critically if EuroSDR is at all able to do this and if large VG distributers such as Google or Microsoft would adhere to such standards. The issue should be taken up and discussed more detailed in a EuroSDR workshop.
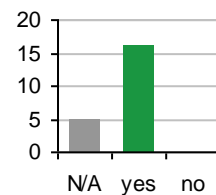
T 7.2 Extensibility and Extensions

Has your organisation used extension mechanisms (APIs) of VGs – other than content files such as KML – for extending or customizing the functionality of VGs?

The comments mention Grifinor, API Geoportail and file formats such as shape or dxf.
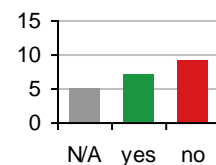
How do you assess the importance of extension mechanisms – other than content files (such as KML) – for VGs in the long term from the perspective of your organisation?

(-- irrelevant, 0 nice to have but not essential, ++ very important)

Comments: KML is the first basic way to share GI information. To develop more integrated GI services, OpenLayers is quite powerful and will become a standard within the next few months.
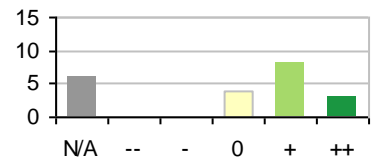
Do you know of add-ons to specific VGs which are being developed or which are already available? (An 'add-on' in the context of a VG could be compared to a browser 'plug-in', which enhances the host application, in this case the VG, with additional functionality.)

Comments: A tool for the definitions of interoperable objects for Grifinor and a plugin for temporal aspects. Also www.openlayers.org is mentioned.
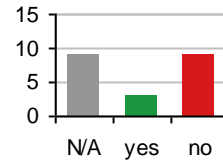
Has your organisation used such add-ons?

Comments: They are developed internally e.g. during phd research.
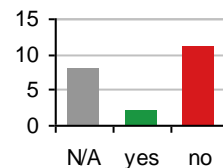
Does your organisation use tools or utilities which are primarily designed to be used in conjunction with Virtual Globes. (e.g. for generating or editing VG contents etc.)

The comments name the following tools: Grifinor, Sketchup, OpenLayers, JavaScript, Talend for the data management, J2EE, Ajax and Ruby. Others ask for a recommendation of a tool or utility.
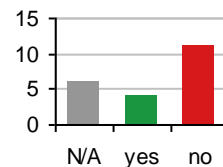
T 8 Outlook and Trends

The last set of questions should help to identify future demands and trends in the development and application of Virtual Globes. Which of the following factors do you consider important in further increasing the usefulness and in establishing a long-term economic sustainability of Virtual Globes?

How do you rate the importance of the following issues?

a) Development and availability of domain-specific add-ons (e.g. for selected geospatial analyses)
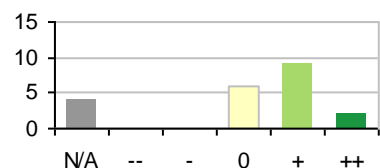
b) Simple and efficient support for the inclusion, display and analysis of geostatistical data.
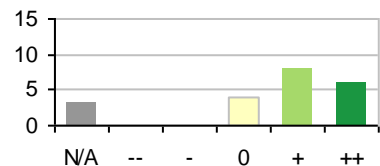
c) Support for real-time contents (e.g. display of dynamic objects or live geosensor data)
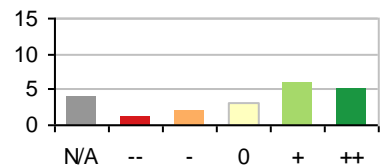
d) Support for geospatial collaboration
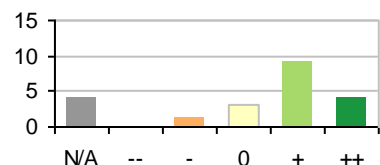
e) Support for rapid updates to the geospatial base data.
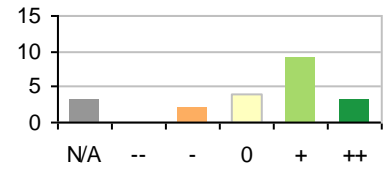
f) Support for rapid updates / corrections to the other geospatial contents
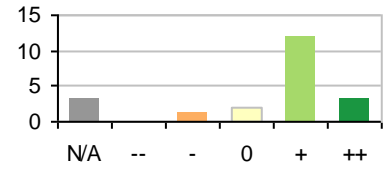
g) Support for content provided by users.
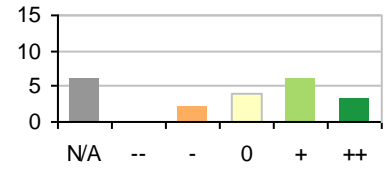
h) Completeness of geospatial content
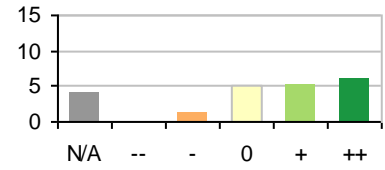
i) Up-to-dateness of geospatial content
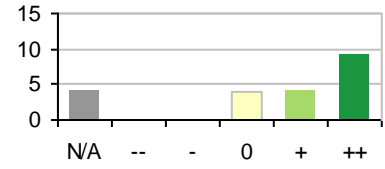
j) Geometric quality of geospatial content
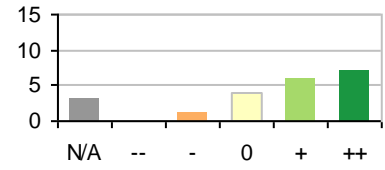
k) Semantic quality of geospatial content
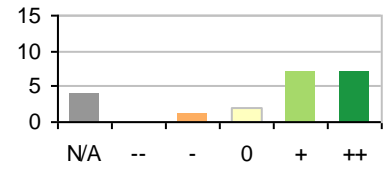
l) Establishment of a national 3D geoportal supporting the simple integration of all national geospatial and geospatially related data sets
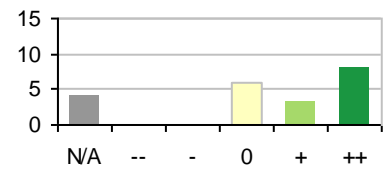
Comments received: National Virtual Globes are very important for the administration and public services. Some of the issues above are already addressed by internal R&D efforts.

T 9 EuroSDR Contacts to Providers of Virtual Globes

Does your organisation have contacts to the high-level management of a VG provider?

The comments give information about contact persons. The contact information is not published in this report.
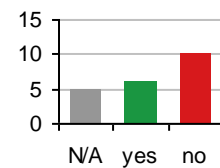
II.III Analysis and Discussion of Selected Key Issues of the Questionnaire

In this section we highlight and discuss key issues which were identified by the survey.

Market presence and (professional) relevance (see Questionnaire Topic T 1.1)
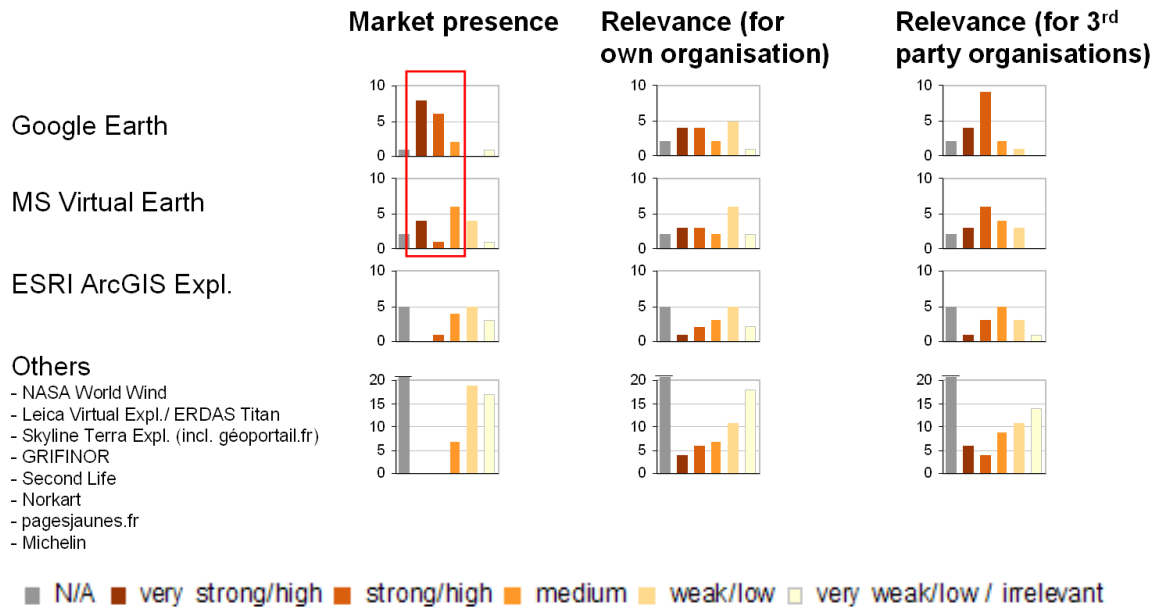
The answers underline the dominance of the main commercial Virtual Globe technologies Google Earth and Microsoft Virtual Earth (now Microsoft Bing Maps 3D) at the time of the survey. They were the only technologies rated with a 'very strong' market presence and they account for 19 strong or very strong ratings as opposed to just 1 strong rating for any of the competitor technologies. Out of the 21 participants 8 (38%) in case of Google Earth and 6 (29%) consider the relevance of these two VG technologies for their own organisations as high to very high. It is also interesting to note, that the relevance of VG's for 3rd party organisations was rated significantly higher (62% for GE and 43% for VE) than that for the own organisation.

Terms of use and number of users (see Topic 1.1)
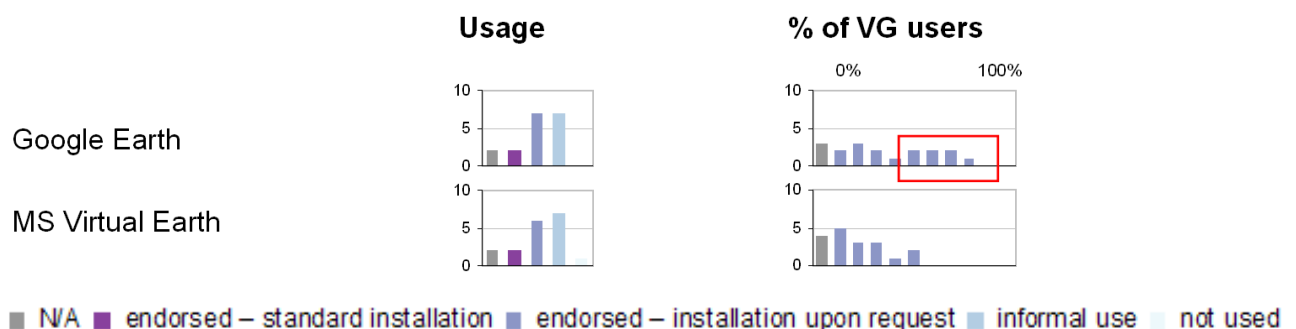
The answers concerning the usage of virtual globe technologies show that at the time of the survey even the two main technologies were installed by default in only 2 out of 21 organisations (approx. 10%). However, the use of these two technologies was officially endorsed in 9 out of 21 (43%) in the case of GE and 7 out of 21 (38%) in case of MS VE. Furthermore, it is interesting to notice, that 1/3 of the organisations estimated the percentage of their staff using Google Earth at 50% or higher.

Virtual Globe Technologies & Platforms – (National) 3D Geoportals (Topic 1.2)

Legend:
- ■ N/A
- ■ NO – nat. 3D geoportal not considered
- ■ YES – realisation of nat. 3D geoportal certain
- ■ YES – realisation possible
- ■ YES – still undecided
- ■ YES – realisation unlikely
- □ YES – definitely no realisation

~ 50% Yes (3D Geoportal considered or planned)
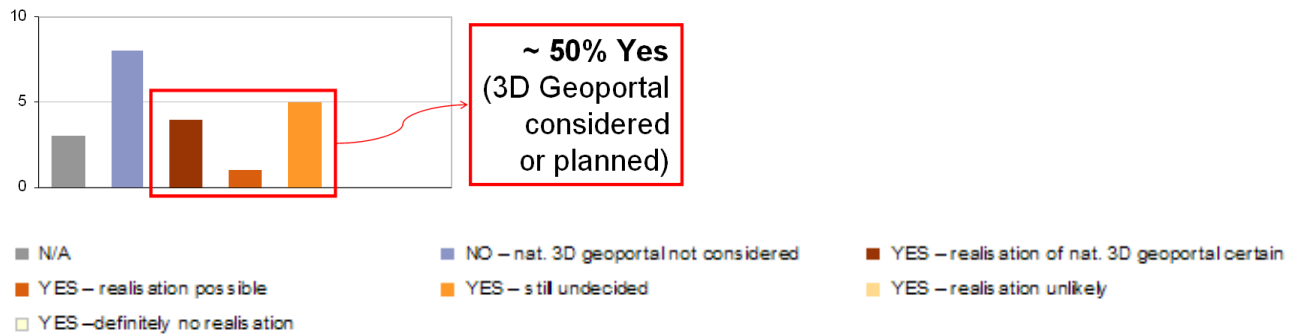
This question tried to determine, whether commercial virtual globes had triggered initiatives for complementary or competitive national 3D geoportals. More than 50% of the survey participants were considering or already planning the implementation of a national 3D geoportal. In the comments the issue of licensing was raised and two critical remarks concerning the real need for promoting the existing 2D data to 3D were made. Generally, 3D geoportals are considered important and several participants voiced their interest in participating in a coordinated effort.

In-house Applications of Virtual Globes (Pos. 2.1)

Future issues for NMCAs **and** Academia

- ■ a) What are the current primary types and purposes of use?
- ■ b) What are the future primary types and purposes of use?
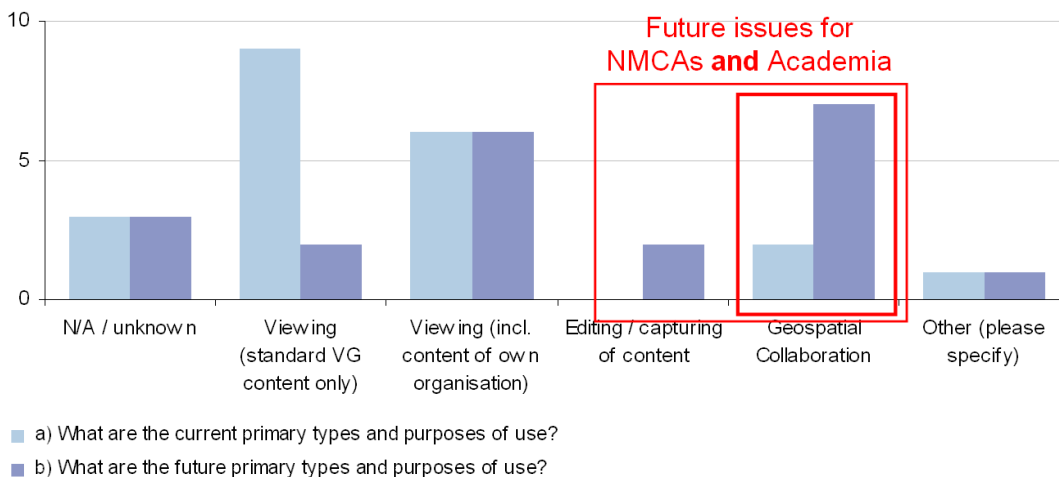
This question tried to identify current and future types and purposes of use of virtual globes. It is interesting to note the current dominance of viewing standard contents and contents of the own organisation. This could also be summarised as a current dominance of the *consumption scenario*.

In the future, viewing of standard contents is expected to decrease significantly while new types of use such as editing / capturing and in particular geospatial collaboration are expected to gain in importance. This seems to indicate a transition from the currently prevailing *consumption* paradigm towards a *production and interaction* paradigm. Recent releases of virtual globes, such as ERDAS Apollo, already incorporate geospatial collaboration as one of their features.

Economic and Political Impact of Virtual Globes ...

... on own organisation (Topic 3.1)
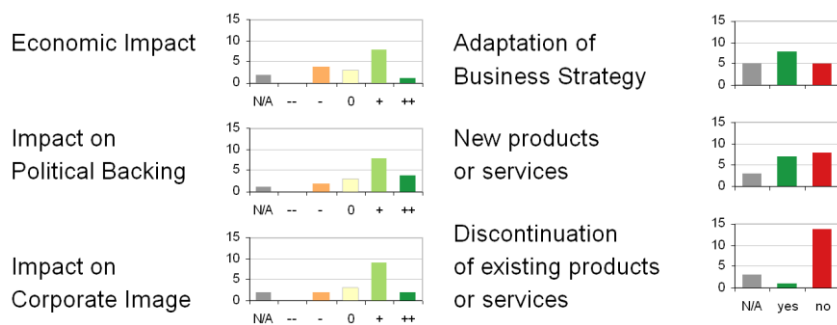
The purpose of the questions under Topic 3 was to assess if and how virtual globes have influenced strategy, reputation, business and products of NMCA's. The answers indicate a clearly positive impact of virtual globes. It is very interesting to notice that this positive effect includes the economical and the political dimension as well as the organisation's corporate image. The latter two appear to be particularly important in view of public funding of NMCA's in times of budget limitations or even reduction.

In terms of consequences, over a third of the participants reports that the emergence of virtual globes has led to an adaptation of the business strategy in their organisation. A third of the organisations also indicate that they had launched or are about to launch new products or services due to virtual globes. On the other side, only one out 21 organisations reports the discontinuation of a product or service due to the establishment of commercial virtual globes.

... on GI Industry in your Geographical Area (Topic 3.1)

The assessment of the impact of virtual globes on the local or regional GI industry also reveals a clearly positive trend, in this case even without any negative responses. With respect to consequences on strategy, business models and services there seems to be no clear trend. However, the majority of the answers indicate that regional GI industry has in fact adapted its business strategy and has also created new products and services. In three cases, the founding of new GI businesses has been reported while no business closings were observed. The latter one somewhat contradicts the experience of the EuroSDR project team which lists a number of new GI businesses in Europe which had been negatively affected by the emergence of the currently dominating commercial virtual globes.

Challenges, Threats and Opportunities (Topic 3.4)

The individual answers to the questions addressing challenges, threats and opportunities of virtual globes are listed in the previous section under topic T 3.4. In summary, virtual globes are not considered as a threat to NMCA's. However, the survey revealed a number of challenges for the respective organisations, namely:

- the increased complexity of 3D geodata affecting the aspects of know-how, training, production and dissemination

- an increasing demand for up-to-dateness of the geodata with its effects on production and updating capacities, and

- the need to further adapt the licensing and business models of NMCA's in order to get the national data used in VGs and to minimise redundant data acquisition

The survey also identified a number of opportunities for NMCA's. A few examples are:

- the potential to increase the visibility of geospatial data and to reach new markets and customer groups

- the possibility to use virtual globes for new application scenarios, such as geospatial collaboration, or as a basis for the development of INSPIRE and GMES services

Geospatial Base Data (Topic 4) and Imagery Base Data (Orthoimagery) (Topic 4.1)

The questions of Topic 4 should give an indication on the type and source of geodata used in the main two virtual globe technologies, which had been identified in a previous question. These main two technologies were Google Earth and MS Virtual Earth / MS Bing Maps 3D.
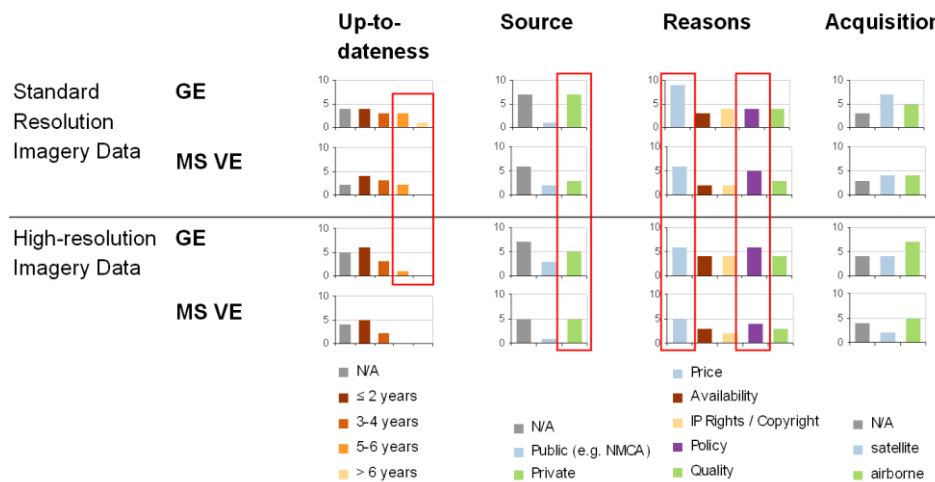
The following evaluation and short discussion focuses on imagery base data (Topic 4.1.) as the most important geospatial data type. The answers revealed that the vast majority of imagery data in virtual globes was acquired by private industry, despite the fact that many NMCA's would have imagery data sets available with similar or better data quality. The main two factors for the predominant use of data from private industry rather than data from NMCA's are pricing and policy, which in many cases prevented NMCA's from providing national imagery data sets to major international corporations.

General Quality Issues (Pos. 6)

With the introduction of virtual globes there had been concerns that the quality of geospatial data might be inferior to that of established products. This question tried to assess, whether the introduction of virtual globes has affected the quality of geospatial data in the past and which effect it might have in the future. While participants were undecided about the short-term effects, they generally agree that virtual globes will have a positive influence on geospatial data quality in the long term.
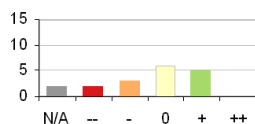
Short-term effects of VGs on quality   **Long-term effects of VGs on quality**
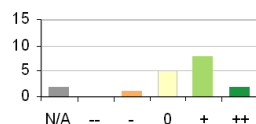
Participants were also asked to report known quality issues with virtual globes. The main issues identified can be assigned to three groups: 1) data currency (most prominent issue), 2) geometric quality (elevation data, orthoimagery, other layers such as building data), and 3) quality of place names (completeness, spelling, multi-lingual support etc.).

Standardisation and Harmonisation (Pos. 7.1)

The answers to the questions concerning the past and future effects of virtual globes on standardisation acknowledge the fact that, for example, Google Earth with its de facto standard KML has considerably influenced geospatial standardisation. The responses also indicate that virtual globes will have an even stronger influence on future standardisation efforts and that standardisation in the domain of virtual globes and 3D geoinformation is very important.
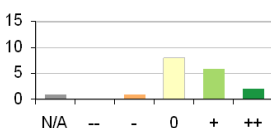
Effects on Standardisation   **Long-term effects on Standardisation**   **Importance of Standardisation**
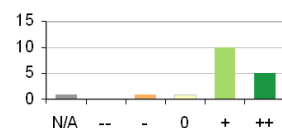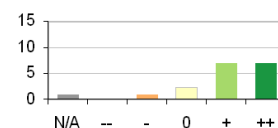
With respect to the possible role of EuroSDR in this standardisation process there are two main lines of argument: 1) that it is questionable that EuroSDR could or should play an active role in the actual standardisation process, and 2) that EuroSDR should focus on standards related activities such as a) capacity building – including training programmes (e-Learning), workshops etc. (like it had done in the case of CityGML) – and b) linking European projects (in terms of technical matters and standards) and in helping a shared and practical view of virtual globes to emerge.

Outlook and Trends (Pos. 8)

The following graphical summary shows how the participants rated the importance of selected (future) developments and issues on the usefulness and long-term success of virtual globes:
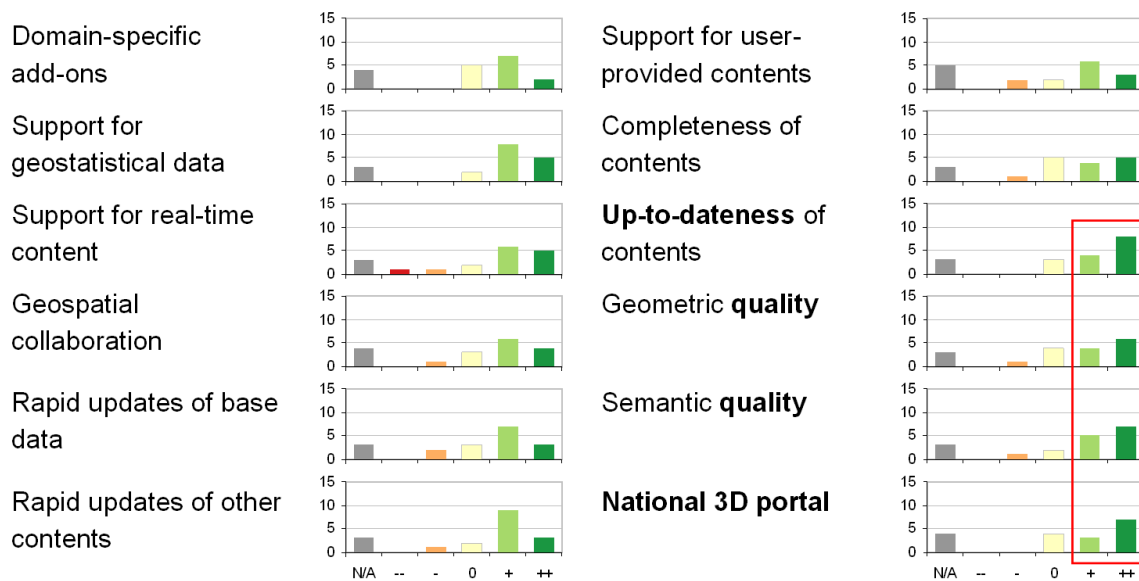
Domain-specific add-ons		Support for user-provided contents	
Support for geostatistical data		Completeness of contents	
Support for real-time content		**Up-to-dateness** of contents	
Geospatial collaboration		Geometric **quality**	
Rapid updates of base data		Semantic **quality**	
Rapid updates of other contents		**National 3D portal**	

Legend: -- very negative   0 neutral / no effect   ++ very positive   N/A not applicable / no answer / don't know

The graphical summary shows that most of the listed aspects were considered important. However 1/3 of the participants or more considered the following issues as *very important* and worth following up:

- *up-to-dateness* of contents – and its improvement

- *geometric quality* of virtual globes and of their contents

- *semantic quality* of geospatial content, and last but not least

- the establishment of *National 3D Geoportals*

II.IV Conclusions of Project Phase I

Project Phase I with the evaluation of the online survey showed that virtual globes are indeed relevant to NMCA's and to many other EuroSDR member organisations. The survey showed that virtual globes create several challenges but also offer a number of opportunities. One of the main goals of Phase I were the identification of important issues which should be followed up in a subsequent project phase.

The selected key issue which had received particular attention in the survey was the establishment of national or international 3D Geoportals with the special consideration of private-public partnerships. Within this context the following topics were to be discussed further:

- Quality / Up-to-dateness

- Reliability / Credibility

- Applications / Application Scenarios

- Geospatial Collaboration based on 3D Geoportals

- Organisational Issues / Operational Issues

- Interoperability

The project team proposed a EuroSDR Workshop on 'National 3D Geoportals – Research Issues, Potential Applications, Quality and Legal Issues' in which these topics were to be addressed and discussed in detail. The workshop was approved by the EuroSDR Steering Committee in their 114th meeting on May 13-15, 2009 in Paris.

III PHASE II: WORKSHOP ON NATIONAL 3D GEOPORTALS AND VIRTUAL GLOBES

III.I Workshop Details

The 1st EuroSDR Workshop on National 3D Geoportals and Virtual Globes was held on the 21st of September 2009 at FHNW University of Applied Sciences Northwestern Switzerland, Muttenz (Switzerland). This workshop, organised by EuroSDR and FHNW, brought together experts and interested members from organisations planning to establish 3D Geoportals, from industry and universities developing and researching today's and tomorrow's Virtual 3D Globe technologies and from existing and potential users of 3D Geoportals.

The event attracted 59 participants from 11 different nations. With 46% of the participants from academia, 28% of the participants from NMCAs and about 26% from industry it was a well distributed group according to the communicated goals. The major goals of the workshop were to:

- assemble experts from throughout Europe to identify and discuss some of the core issues related to Virtual Globes and (future) National 3D Geoportals

- provide for an exchange between experienced users, researchers, developers and other interested parties and

- raise the awareness among scientists for NMCA's demands and requirements with respect to Virtual 3D Globes and National 3D Geoportals

The workshop addressed research issues, applications, quality and legal issues and was organized in two plenary sessions and four break-out sessions (see workshop programme in Table 1 below). The two plenary sessions with invited speakers were focusing on (1) Strategy, Views and Legal Issues and (2) Technology, Standards & Applications. The provided PDFs of the presentations are available on the Workshop website at: http://www.3dgi.ch/eurosdrws/program.php. The four break-out sessions were focusing on Interoperability, Strategies, Architectures, and Applications. All break-out sessions were well attended and a lively atmosphere supported the discussions.

Workshop Programme (21st September 2009)

Workshop Chairs: Stephan Nebiker, FHNW Muttenz & Eberhard Gülch, HFT Stuttgart

09:00	Registration starts	
10:00	**Plenary Session 1 – Strategy, Views and Legal Issues**	
	Streaming in 3D: a French experience	Pascal Pons, IGN France
	Google Earth – Dimensions	Daniela Brica, Senior Associate, Google, Switzerland
	The strategic role of 3D in the Swiss Federal Office of Topography and the '3D Ethics Charter'	Beat Tschanz, swisstopo, Wabern, Switzerland
11:10	Coffee Break	

11:30	**Plenary Session 2 – Technology, Standards and Applications**	
	OSM-3D and the role of standards in 3D geoinformation services	Alexander Zipf, Department of Geography, University of Bonn, Germany
	GRIFIN Technology – A platform for Virtual Globe applications	Lars Bodum, Centre for 3D GeoInformation, Aalborg University, Denmark
	The Geoinformation Loop – Developments and Trends in Virtual 3D Globes	Stephan Nebiker, FHNW, Muttenz
	Geospatial Collaboration with ERDAS TITAN	Michael Lanini & Michael Baumgartner, ERDAS / MFB-GeoConsulting, Messen, Switzerland
12:40	Lunch Break	
13:40	**Break-out Session 1**	Topics based on preferences of participants (poll during online registration)
14:30	Short Break / Change of Sessions	
14:40	**Break-out Session 2**	Topics based on preferences of participants (poll during online registration)
15:30	Coffee Break	
16:00	**Wrap-up, Discussion and Future Steps**	
16:30	Apéritif	

Table 2: Workshop programme of the 1st EuroSDR Workshop on National 3D Geoportals and Virtual Globes

III.II Summary and Outcome of Workshop Break-out Sessions

The presentations of the plenary sessions provided valuable information on diverse aspects of 3D geoinformation technologies and applications in general and on virtual globes in particular. They also helped to establish common ground and to spark ideas for the subsequent break-out sessions. The main discussion topics and the outcome of the four break-out sessions are listed below.

Break-out Session 1.1: Interoperability & Standards for 3D Geoportals

(Chair: Alexander Zipf)

Topics

- Initiatives (OGC, ISO)

- Current / emerging 3D standards (KML, OGC W3DS, 3D-SLD, Collada ...)

- 3D data formats vs. 3D web services

- Shortcomings / future requirements

Summary

- **There is a strong need for common standards.**

- Standards should be kept simple in a first version in order to facilitate their introduction and use.

- The aspect of georeferencing in global and local reference systems is important and should be addressed properly.

- Scene graph has no semantics but can be queried

- Streaming support is a must.

- Security should be addressed in a separate architectural layer independent from geospatial 3D standards.

- Matrix set for tiling 3D data

- Input from national mapping agencies is needed.

- **A Testbed for 3D geo web services should be established!**

Break-out Session 1.2: Strategies, operational and business models for 3D geoportals

(Chair: André Streilein)

Discussion Topics

- Types of 3D platforms (commercial, government operated, open source)

- Public contents in private virtual globe platforms?

- Scenarios (e.g. public private partnerships) for operating national 3D Geoportals

Summary

- Who needs 3D? – It's a trend, nobody can escape.

- We need two different types of city models:
  - one that is graphically appealing / nice to look at (with possibly lower geometric and semantic quality)
  - one with high accuracy (and semantics), for professional users
  - ⇨ how to generate the two different models out of the same 'base' model

- Today: **navigation is the driving force for 3D** ("accuracy doesn't matter"), but future navigation will be dependent on more accurate data (e.g. pedestrian navigation, lane navigation etc.)

- Business models:
  - classical – sell high quality to professional users
  - advertising – e.g. Google
  - governmental – make available for free, pre-financed
  - services – e.g. based on governmental, stable geoportals

Break-out Session 2.1: Technology / Architectures

(Chair: Lars Bodum)

Discussion Topics

- Service-oriented architectures

- 3D streaming architectures
- Collaborative architectures
- Other trends: e.g. temporal and semantics in VGs
- Info Viz in virtual 3D environments

Summary

- Standards just for visualization are not enough
- Who wants 3D? (Perception of data / information)
- What is 'the simple architecture' for 3D solutions?
- API as a key issue / open or not?
- What is the basic 3D geoportal from a national mapping agency?
    - Make data interoperable
    - Reference data
    - Terrain
- Collaboration: Share (geo-)data in real-time via Intra- or Internet
- Future platforms, e.g. augmented reality on mobile units

Break-out Session 2.2: (Potential) Applications

(Chair: Eberhard Gülch)

Discussion Topics

- Existing applications of 3D Geoportals
- New / future applications
- Examples: urban planning, natural risks management, flood prevention and analysis, online Atlases, census / geostatistics

Summary

Examples of existing applications:

- Example application: www.blomurbex.com/3d (login required)
- Major application: Tourism (3D portals)
- 3D models in Google as advertisement
- Professional / governmental use (planning, climate, noise, hydrography, cultural heritage …)
- Disaster management, security, defence (governmental use)
- Gaming industry (e.g. H.A.W.X uses data from TeleAtlas)
- Simulators, air traffic control

New / Future Applications:

- **Navigation: 3D will become standard.**

- Virtual shopping

- (3D) location based services with mobile devices. Still very expensive (device and data transfer). Devices still too slow. Map content often not good enough.

- There is a need for 3D for smart objects ➔ Internet of things.

- 3D is not the solution for all applications but it is essential for some.

- 3D cadastres

- What we now do in 2D will be done in 3D in the future. Not really new applications but evolution from 2D to 3D. The modern map will be in three Dimensions (many humans cannot read 2D maps).

IV   OVERALL CONCLUSIONS AND OUTLOOK

The main goals of the EuroSDR project on Virtual Globes were a) to collect facts and opinions on the subject of virtual globes and b) to assemble experts and users to discuss important issues, to identify future trends and developments which should be jointly addressed by research, industry and NMCA's.

The comprehensive online survey with the participation of 21 organisations from 11 European countries is probably the first and so far best grounded study on virtual globes and their effects on NMCA's and members of the geospatial industry. The main findings of the survey can be summarised as follows:

- Virtual globes have had a generally positive impact on NMCA's – from an economical and political perspective and also with respect to the corporate image.

- Virtual globes also have a positive impact on GI industry in the respective geographical areas and have led to numerous changes in business strategies.

- Participants of the survey also report that the emergence of virtual globes has a positive effect on education in GI technology and on number of students.

- While NMCA's see few threats by virtual globes, they identified several challenges for their own organisations, namely: training and know-how in 3D geoinformation, increasing demands on data and production (update rates, capacities, quality), and further adaptation of licensing and business models of NMCAs.

- Virtual globe technologies are believed to offer numerous opportunities, e.g. for reaching new markets and customer groups and for raising the awareness for new geospatial applications requiring high quality geospatial base data.

- The participants of the survey identified the establishment of (National) 3D Geoportals, geospatial collaboration, rapid updating and further improvement of geometric and semantic quality of geospatial contents as important future trends.

The first EuroSDR workshop on National 3D Geoportals and Virtual Globes provided an excellent platform to discuss the current state-of-the-art and state-of-technology, to identify existing and emerging requirements and to point out further action in terms of research, development and standardisation. The main findings and recommendations of the workshop were:

- A strong demand for further standardisation in the domain of 3D geoinformation, covering the aspects of data modelling and exchange, 3D scene portrayal, 3D content access and delivery etc.

- It was recognised that *3D geo web services* will play a particularly important role in facilitating the exploitation of 3D geodata by a broad range of users and applications.

Proposed Future Activities

Based on the workshop outcome, the project team proposed the following future activities in the domain of 3D Geoportals and 3D Web Services to be supported by EuroSDR:

- Definition and establishment of an international testbed for 3D web services and 3D geodata standards based on the latest OGC specifications and recommendations (e.g. Web 3D Service, Web Perspective Service and 3D SLD) and with the active participation of several NMCAs.
- Dissemination and discussion of the '3D Charter' (http://www.3dok.org/en) setting out ethical standards for the use of 3D geodata and 3D representations. Active promotion of the '3D Charter' among the EuroSDR members in case of a general agreement with its core values and intentions.

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APPENDICES

A1   Online questionnaire of phase I as PDF copy

A2   Call for participation in the online questionnaire of phase I

A3   Publication of a project summary in the GIM International Magazine (Nebiker S., Bleisch S. & Gülch E., 2010: Virtual Globes. GIM International, Volume 24, Number 7, July 2010.)