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The economic value of the Dutch geo-information sector*

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Abstract

Defining the geo-information sector and estimating its economic value on a national level is difficult and standard methodologies are not available. The aim of this paper is to clearly define the geo-information sector and to measure its economic value in terms of turnover, employment, activities and the market. The results of the survey in the Netherlands estimate the economic value of the Dutch geo-information sector at € 1.4 billion, 0.25% of the national GDP. Furthermore, the results show that the Dutch geo-information sector is a fast developing sector with high potential. The authors conclude that the definition used and the developed survey methodology provides a good basis for measuring the value of the national geo-information sector. They suggest carrying out comparable studies in other countries in order to increase awareness of the geo-information sector as a sector of economic importance and to stimulate further development and innovation.

Keywords: Geo-information, economic value, the Netherlands

1. INTRODUCTION

The geo-information sector is a fast developing, innovative sector with ample opportunities and potential. In 2004, the United States Bureau of Labour put geo-technology alongside nano-technology and bio-technology as likely to be the three most important employment growth sectors in the 21st century (Gewin, 2004). However, the geo-information sector is not clearly defined. A lack of a

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common and internationally recognized vocabulary related to geo-information means that the geo-information sector is defined differently from country to country and also often across organizational levels within a single country (Genovese et al., 2009). The importance and the economic value are difficult to measure in terms of turnover, employment, activities and market.

There is, however, a growing awareness that more attention has to be paid to assess the broader economic and socio-economic impacts of developments in the geo-information sector (Craglia and Nowak, 2006). Studies conducted so far have mainly focused on public investments in Spatial Data Infrastructures (SDIs) and geoportal development. The INSPIRE directive, aimed at establishing an Infrastructure for Spatial Information in Europe (European Commission, 2007), was the subject of an extended impact assessment in 2003-04 to assess its environmental, social, and economic impacts (Craglia, 2003). The investments of INSPIRE were estimated, at € 93 to € 138 million per year for 10 years with the associated benefits potentially running from € 770 to € 1150 million per year (Duformount, 2004). Crompvoets (2006) has analysed the worldwide development and impact of national clearinghouses and estimated that around € 120 million worldwide is spent yearly for clearinghouse management. A study on the socio-economic impacts of the spatial data infrastructure of Catalonia estimated the cost at € 1.5 million over a 5 year period. This latter study indicates that savings could exceed €2.6 million per year and the total investments could be recovered in just over 6 months (Garcia Almirall, et al. 2008).

A few studies have been conducted to estimate the economic value of the (geo-) information market. The Pira study (2000) estimated the economic value of public sector information (PSI) in the European Union. Economic value was defined as the value added by PSI to the economy as a whole and estimated at € 68 billion a year in the European Union in 1999. Within this total, geographical information accounted for € 36 billion (Pira, 2000). An Australian study estimated the aggregated economic impacts on the national economy (ACIL Tasman, 2008). The authors conservatively estimated that industry revenue in 2006-07 could have been of the order of 1.37 billion AUD – 0.15% of the Australian Gross Domestic Product (GDP) - and industry gross value added around 682 million AUD. The economic footprint of the spatial information industry is to be considered larger. The accumulated impacts of these direct impacts are considered to mount to a cumulative gain of between 6.43 billion AUD and 12.57 billion AUD − equivalent to 0.6% and 1.2% of the GDP respectively (ACIL Tasman, 2008). Recently, in the United Kingdom, the current market size and growth potential for geographic information products and services has been assessed in a “supply-side” assessment, not taking into account human resource capital in customer organisations. Based on a survey, the market size in the calendar year of 2007 has been assessed at a total of £ 657 million, with a breakdown between segments as follows: software £152 million, services £223

million, data £254 million, hardware £ 28 million (Coote and Rackham, 2008). The results of those studies are summarized in table 1.

Table 1: Overview of studies estimating the economic value of the geo-information market

Study	Scope	Economic Value	% of GDP
PIRA study (2000)	Value added by geographic PSI to the economy	€ 36 billion	0.40%
ACIL Tasman (2008)	Industry revenue in 2006-07	1.37 billion AUD	0.15%
Coote and Rackham (2008)	"Supply-side" assessment	£ 657 million	0.06 %

The Netherlands is an international player in the geo-information sector, with companies such as TomTom and TeleAtlas, and major engineering consultancies such as Fugro, Arcadis and Grontmij. In the public sector, many institutions are using geo-information and it has become indispensable for solving social issues concerned with public safety, spatial planning, the environment and providing e-services to citizens and companies (VROM, 2008). In a number of scientific publications, the Netherlands is positioned as fifth behind the United States, Great Britain, Canada and China (including Hong Kong) (Veller et al., 2009). Furthermore, € 20 million have been invested in the 'Space for Geo-Information' (RGI) innovation programme aiming at eliminating the fragmentation of knowledge, encouraging innovation, and improving cooperation (Bregt et al., 2008). Looking at those national and international developments the geo-information sector in the Netherlands has been identified as a sector with high potential for government and industry (VROM, 2008). Nevertheless, the Dutch geo-information sector suffers from a lack of visibility and it is not recognized as an economic sector of importance for the national economy. This makes it difficult to raise awareness at political and administrative levels for issues concerning the sector, e.g. education and the labour market, investments in research and innovations, international relationships, data and privacy policies, etc. In order to put geo-information on the agenda, a well defined and clearly recognizable sector supported by solid economic data is essential. However, defining the geo-information sector and estimating its economic value on a national level is difficult and standard methodologies are not available.

This paper presents the methodology for defining the economic value and activities of the national geo-information sector on the basis of a survey. The results of the Dutch survey are presented and further discussed in a wider national and international context.

2. METHOD

To define the economic value and the main activities of the Dutch geo-information sector, three steps were followed: 1) together with the stakeholders, the authors defined the geo-information sector and its main activities; 2) the authors designed and tested a survey to collect economic data and; 3) the authors collected and validated the economic data. Part of this research was to develop a survey and collect data about the private sector. Data about the governmental sector and the research sector were obtained in parallel surveys (Welle Donker, et al., 2008; Vonk, et al., 2008).

2.1. Defining the geo-information sector

In order to measure the economic value of the geo-information sector and to define its main activities, a clear and well supported definition is needed. However, it is difficult to define exactly what the geo-information sector is and which activities are part of it. A geo-information product or service is usually not the end product, but will be applied in other domains where value will be added and it is therefore difficult to identify. In literature, the term geo-information science and related activities has been defined and discussed (Goodchild, 1992; Mark, 2003). The Geographic Information Science and Technology Body of Knowledge (GISTBoK) is a reference document produced by the University Consortium for Geographic Information Science in which an attempt is made to create a comprehensive outline of the concepts and skills unique to the geospatial realm (DiBiase et al., 2006). However, a clear definition of the geo-information sector as economic sector, for use as a basis in a survey, was not available. Therefore, in July 2008, a brainstorm session took place with eight experts from the private and public sector with links to the geo-information sector.

The discussion was chaired by an independent discussion leader with no link to the geo-information sector. The project team carrying out the survey could follow the discussion on a TV and by reading the minutes from the meeting. On the basis of the results of this discussion, the project team formulated the definition which was sent for validation to the participants of the brainstorm session. This provided us with a well supported definition and a first classification in main activities, which was an important input for the survey design.

2.2. Survey design

To measure the economic value of the geo-information private sector, a survey was carried out. The project team developed together with Heliview Research [1], a professional market research company, a questionnaire on the basis of own knowledge and the outcomes of the brainstorm session. The questionnaire was tested several times by the project team, participants in the brainstorm session and additional experts.

The final questionnaire consisted of six parts: 1) introduction questions; 2) activities 3) economic value; 4) market for geo-information products and services; 5) developments; 6) final questions. In the questionnaire the activities have been further split in a selection of specific geo-information products and – services. This selection and categorization has been made on basis of a list used in a German market study (Harzer, 2007). Special attention was given to the business to business market by exploring sectors in which geo-information products and services are currently applied and where future developments can be expected. The indicated options were selected by the project team from the official list from the Netherlands Chamber of Commerce [2]. A translation of the questionnaire used to survey the private geo-information sector is included in the Appendix of this paper.

2.3. Collection and validation of the data

The survey to collect data about the private sector was distributed among 300 Dutch geo-information companies. The target group was defined by the association of the Dutch geo-information industry, Geobusiness Nederland [3]. The 100 members of the association were part of the target group, as did a further 200 companies which were considered as potentially being part of the geo-information sector. The names of the additional 200 companies came from the network of the first 100 members, representing large and small companies. The questionnaire was programmed and distributed via Internet by Heliview Research. All 300 companies received a letter and a phone call to inform and encourage them to participate. The outcomes of all questions were collected in Excel sheets. To validate the outcomes, a session was organized with an expert panel with representatives from the private and public sector. They concluded the outcomes of the survey to be representative.

Data about the governmental sector was obtained from the research project “de efficiënte geo-overheid”. In this project, the number of governmental employees working on geo-information products and services and their main activities were measured and published (Welle Donker, et al., 2008).

Data about the research sector was obtained from the project Nedgeos, “Het Nedgeos survey Nederlands geo-informatie onderzoek”, which explored the

status and potential of geo-information research in the Netherlands (Vonk, et al., 2008). This research was carried out between August and December 2008 among Dutch universities and knowledge centres working on geo-information.

The data about the governmental and research sector has been used to provide an overall picture of the economic value and main activities of the geo-information sector in the Netherlands. To make the studies comparable all studies have used the same definition for a geo-information employee. Furthermore, data from those studies is used to compare activities and developments in the private sector with the governmental and research sector.

3. RESULTS

3.1. Definition

General

The definition used for this study is: the geo-information sector works with location specific (x,y,z) information or services. A geo-information employee is defined as an employee having as a main task (> 50%) working with geo-information products and services.

Within the geo-information sector, four areas of activities are identified.

1. Measuring, collecting and storing of data about geo-objects.

2. Processing, editing, modelling, analyzing and managing that data.

3. Presenting, producing and distributing the data.

4. Advising, educating, researching and communicating about processes and use of geo-information products and services.

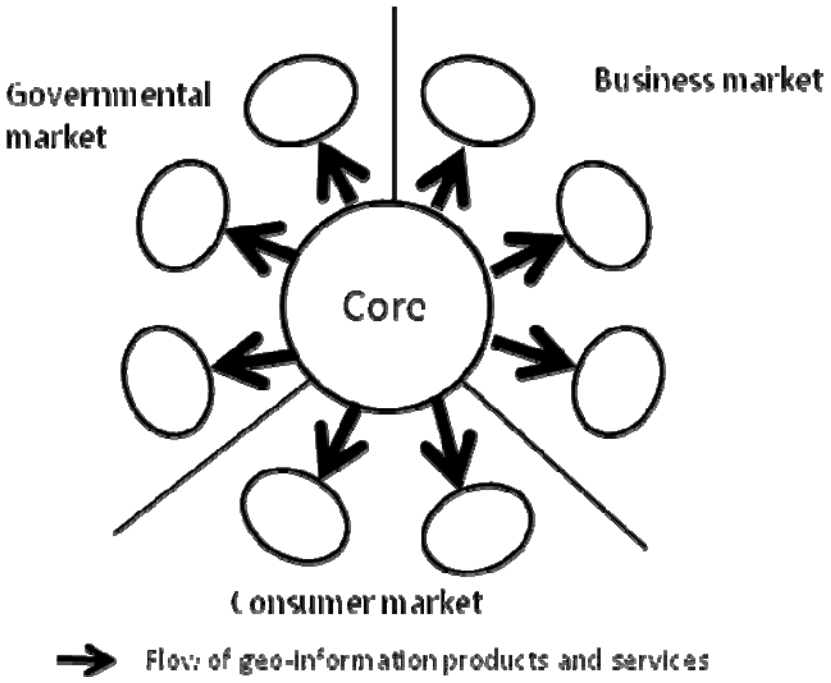
This breakdown within the four areas of activities is commonly used and can also be found in geo-information study- and handbooks (see e.g. Longley et al., 2001 and Heywood et al., 2006).

Three sub sectors have been identified: 1) private sector; 2) governmental sector; 3) research sector. To estimate the economic value of the governmental and research sector, the number of geo-information employees in the different governmental organisations and institutions and their main activities were measured (Welle Donker, et al., 2008; Vonk, et al., 2008). The definition and identified activities used for the governmental and research sector fit the general definition described above.

Private sector

To measure the economic activity of the private sector, the definition of the geo-information sector is further refined. On the one hand, you have the 'core', or primary, economic geo-information sector where the company is a supplier of geo-information products and services and value is added to it. On the other hand, you have the secondary economic activities, otherwise described as 'the market', where existing geo-information products and services are used and applied, but no value is added to the geo-information product and service itself. To estimate the economic value of the geo-information sector, the flow of geo-information products and services from the core activities to the market activities was measured (see figure 1). The market was then further divided into the business, governmental and consumer market.

Figure 1: Economic flow of geo-information products and services from the core of the private geo-information sector to the three market segments.



3.2. Economic value

The total economic value of the Dutch geo-information sector in 2008 was estimated at € 1.4 billion, with almost 15,000 full time employees (FTE) working on geo-information products and services (see table 2). The total size of the GDP of the Netherlands was € 596 billion in 2008 [4], which gives the total geo-information sector a share of 0.23 % in the Dutch economy.

Table 2: Number of geo-information employees and economic value of the geo-information sectors in the Netherlands in 2008

Sector	Geo information employees (FTE)	Economic value (millions of €)
Private	9977	900
Governmental	4650	465
Research	450	45
Total	**149977**	**1400**

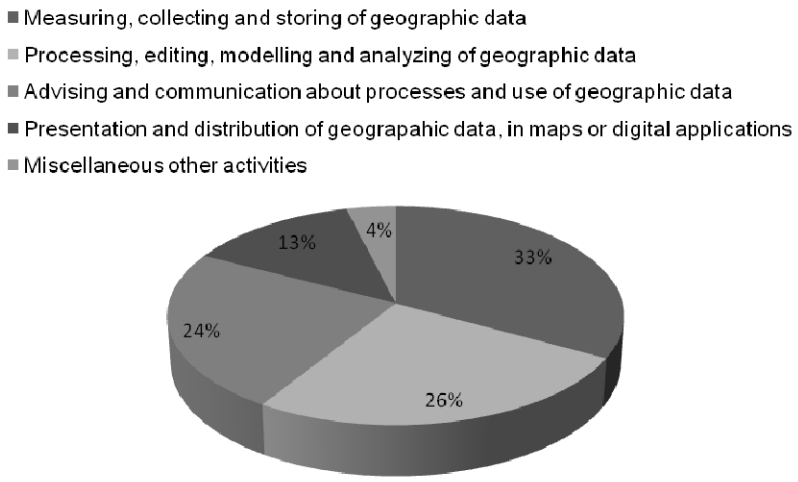
In 2008, the private sector had a turnover of € 900 million from geo-information products and services for which 9977 employees were responsible. Geo-information products and services had a share of 11% in the total turnover of the companies surveyed. On average the companies had 35 geo-information employees, 30 % of the companies had less then 10 geo-information employees. The turnover from geo-information products and services grew 17% in 2008 compared to 2007. De average economic growth in the Netherlands in 2008 was 2% [5]. This data is based on response from over 100 companies – a response rate of 35% - and was considered as representative and reliable by an invited group of experts.

In the governmental sector 4650 FTE were employed working on geo-information products and services and a further 450 FTE at universities and research institutes. Using an average of € 100,000 (including overhead) per FTE, the combined governmental and research sectors come to a total economic value of € 500 million. The cost of € 100,000 per FTE is an average FTE price in the public sector in the Netherlands. The majority of the governmental geo-information employees were working for municipalities (39 %).

3.3. Activities

The private sector turnover of € 900 million worth of geo-information products and services is broken down into the following categories of activities. The most important activity, with a turnover of € 297 million, was measuring, collecting and storing geographic data. These are the more traditional land surveying activities of the sector, using increasingly more digital techniques. Further geographic information system (GIS) related activities such as processing, editing, modelling and analyzing of data account for € 234 million. Consultancy related activities such as advising and communication about processes and use account for € 216 million. This can be seen as relatively new activities, which already have a substantial market share. Finally the presentation and distribution of the data, in maps or digital applications (geo-portals) has a share of € 117 million. Miscellaneous other activities account for the last € 34 million of the total value of about 900 million. Figure 2 gives the break down in percentages.

Figure 2: Turnover of private sector in 2008 broken down by activities (%).



The geo-information products and services offered most by the private sector in 2008 were more 'traditional' geo-activities like cartography, geodata management and GIS analysis, all offered by more than 50 % of the companies. Newer products like web services and more complex data modelling were offered by more than 50 % of the companies to. In the future it will be interesting to see if a shift in activities and products and services over the years can be identified.

The main activity of governmental employees were data collection, data management and data distribution (2679 FTE), followed by systems design (730 FTE), data collection in the field (711 FTE) and management activities (538 FTE).

In the governmental sector it looks as though there is still a strong focus on the data itself, although the results are difficult to compare with the private sector because of the difference in the division of activities.

The main focus of geo-information research was on databases and data modelling, data editing and conversion and analytical methods.

3.4. Private sector market

The private sector market has been broken down into three market segments: 1) business to government; 2) business to business; 3) business to consumer.

Business to government market

The business to government market was the most important market for the private sector, with a share of 54% of the total turnover. Municipalities were the most important customer in the business to government market. In 2008 they bought € 200 million worth of geo-information products and service from the private sector. Ministries (€ 83 million), water boards (€ 68 million), provinces (€ 53), and agencies (€ 53) were other important customers buying geo-information products and services.

Business to business market

The business to business market had an economic value of € 369 million, which is a share of 41%. The most important customers were companies from the building and infrastructure sector, followed by the water and energy sectors, spatial planning and the environmental sector (see table 3). In addition, there were nine other sectors to which geo-information products and services were supplied: 1) public safety, 2) mobility, 3) finance, 4) telecom and IT, 5) agriculture, 6) chemistry 7) trade, 8) culture and tourism, and 9) creative industry. Each of these had a market share of more than 1% in 2008.

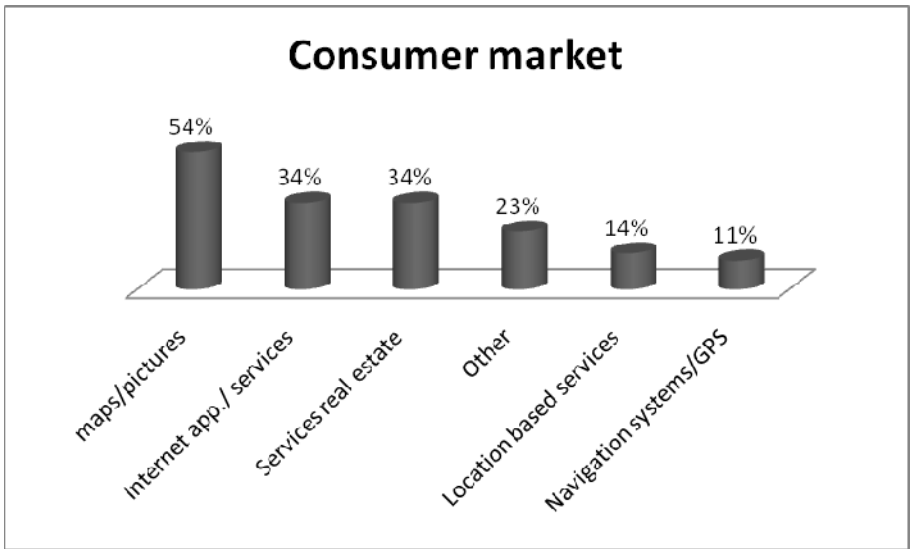
Table 3: Share and turnover of sectors in the business to business market for geo-information products and services.

Sector	Share (%)	Turn-over in millions
Building and infrastructure	31%	€114
Water and energy	14%	€ 52
Spatial planning	12%	€ 44
Environmental	10%	€ 38
Other	33%	€121
Total Business to Business	**100%**	**€ 369**

Business to consumer market

The share of the consumer market was 5 % (€ 16 million). The most important geo-information products and services were classical products like (road) maps and (aerial) pictures. However, internet based products and services and location based services also had an important share (figure 3).

Figure 3: Share and turnover of geo-information products and services business to consumer market.



The total economic value of the consumer market was relatively low and seems to be of minor importance to the companies included in this survey. A reason might be that this survey only focused on the core of geo-information products. In effect, the companies that focus on the consumer market may be not sufficiently represented in the population of the survey.

3.5. Development

In 2008, the companies surveyed spent 21%, (€ 56 million) of their research and development budget on geo-information products and services. Together with the public research sector which is valued at € 45 million, a total of, over € 100 million has been spent on innovations in the geo-information sector.

Table 4 lists the geo-information products and services with the highest growth potential per activity. Products and services related to consultancy and internet based services were indicated by more than 40% of the companies, directly after GIS analysis and terrestrial data collection.

Table 4: Geo-information products with highest growth potential for the private sector (> 40 % response).

Measuring, collecting and storing of data	
Collecting: (terrestrial)	41%
Processing, editing, modelling and analyzing of data	
GIS analysis	51%
Presentation and distribution of the data	
Development of geoservices (internet)	46%
Web services	43%
Advising and communication about processes and use	
Geo-project management	41%
Geo-secondment	43%
Geo-consulting process design	43%

The sector with the highest growth expectations for geo-information products and services was spatial planning (46%). Also building and infrastructure, water and energy, public safety and disaster management were indicated by more the 30% of the companies as sectors with high growth expectations.

The focus of the research sector for the next 5 years is expected to continue being on databases and data modelling, data editing and conversion and analytical methods (table 5). It is expected that promising areas for the next 5 years are going to be geo-computation and organizational aspects of geo-information.

Table 5: Focus of research sector for the next 5 years and most promising research areas.

N=23	Future research (5 years) (Total =100%)	Most Promising
Databases and data modelling	12%	30%
Data processing (conversion, aggregation, transformation, etc)	12%	20%
Analytical methods (geostatistics, data-mining, network analysis, etc)	12%	40%
Geo-computation (simulation modelling, CA/ABM/Neural networks, heuristics, uncertainty, etc)	11%	60%
Cartography en visualisation	11%	10%
Geospatial data (remote sensing and surveying, digitalization, metadata, quality)	10%	15%
GI system design and development	10%	25%
Organisational en institutional aspects (GI community, adoption of standards, management)	8%	40%
Conceptual and philosophic concepts	8%	40%
GI & society (juridical, economic, ethical, governance aspects)	6%	35%

Source: Vonk et al., 2008

Cartography and visualisation was seen as a promising area by only 10 % of respondents, yet it is ranked fourth in future focus. On the other hand organisational and institutional aspects and conceptual and philosophic concepts were seen as relatively very promising, but there is little focus on them in future research. It seems that research priorities will not change very much over the coming years, despite the identification of promising new areas.

4. CONCLUSIONS AND DISCUSSION

The aim of the research was to develop a definition and methodology to carry out a survey to measure the economic value and activities of the national geo-information sector. The results of the survey show that the Dutch geo-information sector is a significant, fast developing sector with high potential. Parallel research in the governmental, research and private sectors made it possible to give a complete picture of the Dutch geo-information sector in 2008. The study contributed to make the geo-information sector better recognizable as sector of importance and raise (political) awareness about problems in e.g. geo-information education, the labour market and data policies. It helped the association of the geo-information private sector (Geobusiness NL) and its members to profile themselves with solid data. Furthermore the definition and the developed survey methodology for the private sector provide a good basis for a yearly market monitor to measure the economic value as well as trends and developments in the Dutch geo-information sector. A more comprehensive view on the private, governmental and research sector can be achieved by a better integration and synchronization of terms, identified activities and timing of the surveys. Therefore in the 2009 study of the Dutch geo-information sector the private and public sector will together carry out one survey to give a complete picture of the Dutch geo-information sector.

Giving the geo-information sector a clear and well supported definition and making it recognizable as an economic sector has been proven challenging. The study used a definition with a limited scope, focused on the core of the geo-information sector working on primary geo-information products and services. However, part of the value is probably added by companies other than the core of 300. Companies working more on the application and use of the products and services, e.g. in real estate property, transport and logistics, banks and IT sector. If a broader scope of the definition of the geo-information sector is used, the economic value can be expected to be greater. An indication for this is the low share of the consumer market, whereas many geo-information products and services are available on the consumer market. However, measuring the value of geo-information products and services outside the core would require a different approach than the survey approach. No umbrella organizations and contacts are known for these diverse activities as they are for the core activities and the geo-information products and services in those secondary sectors were not identifiable as separate entities. An interview approach was considered but this was not feasible within the scope of this research.

In literature different views exists on how to define economic value. Krek (2002) defines economic value as the difference between acting with and without the information. In this approach economic value will be measured by quantifying benefits of using geo-information. Longhorn and Blakemore (2008) define the

economic value as revenues and the number of people employed by the GI sector. The approach which also includes non commercial values, such as improving informed decision-making is defined as socio-economic value (Van Loenen and Zevenbergen, 2009). Our objective was to measure the national economic value and therefore we used an approach of measuring turnover and GI employment to estimate the importance as economic sector.

This study estimated the share of the core geo-information sector in the Dutch economy in 2008 to be 0.23%. Studies in UK and Australian use a different definition and scope and estimate the economic share lower (see also table 1). However, the UK study estimated only the value of the private geographic information products and services, not including the human resource capital in customer organisations, at £ 657 million, 0.06 % of the GDP of the UK in 2007. The Australian study estimated the industry revenue in 2006-07 at 1.37 billion AUD which gives the industry a direct share of 0.15 % of the GDP, but with a much higher economic footprint, of between 0.6% and 1.2% of the GDP. The Pira study assessed the value added by public sector information (PSI) to the economy as a whole of accounted for by the geographical information industries in the EU 15 to be € 36 billion. Assuming the Netherlands has an average share; this would amount to roughly 1.5 billion, higher then the 1.4 billion in 2008 in this study. However, the PIRA study used a broader scope, taking into account the total economic footprint of the value adding industry.

The difference in scope, definitions and used methodologies in different studies make it difficult to compare different countries and to make an aggregation to the European or world level. Definitions are context specific and the scope of the research depends on the aim of the study. Our research provides a good basis for ongoing research on trends and developments regarding the core of the Dutch geo-information sector. Furthermore, it can be used to do comparable studies in other countries or develop a European or even worldwide study, based on a coherent definition and survey methodology. We think the definition, break down in activities and survey questions used, can be transferred to other countries and settings. Depending on the objectives of the survey questions can be removed or added, but the 18 questions form a good basis for measuring the economic value of the geo-information sector. Such studies will improve the visibility of geo-information as an important sector, raise awareness in (the higher) political and administrative circles and encourage further economic development and innovation.

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