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**Fach Geoinformatik**

**Electronic Marketplaces for Geographic Information**

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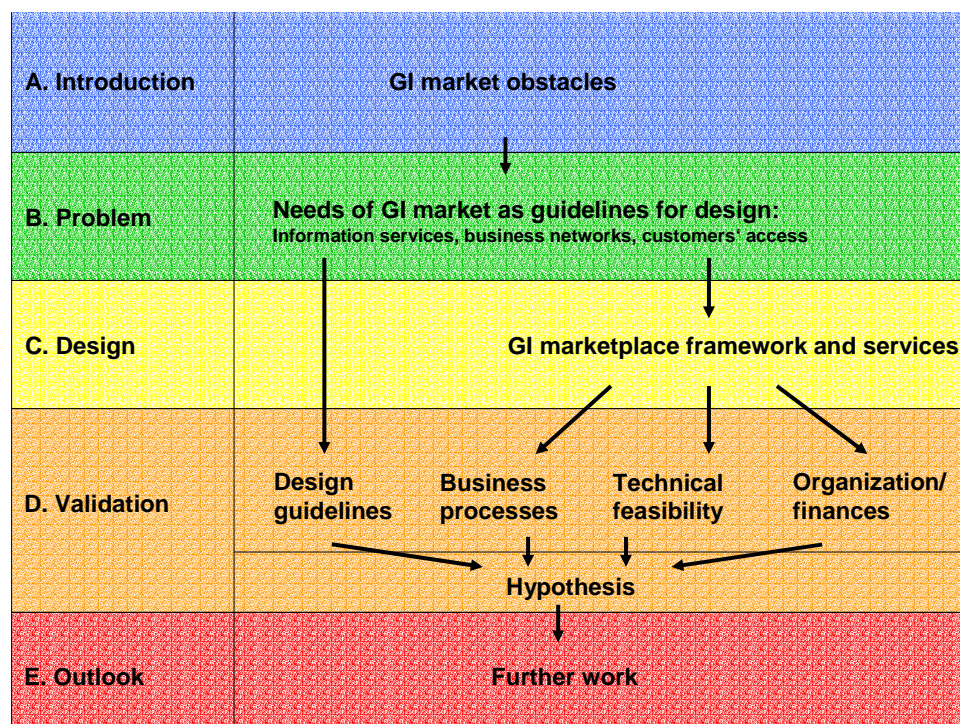
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## SUMMARY

The market for geographic information (GI) lags behind its expected growth, for example in Germany (Fornefeld, Oefinger and Rausch 2003). Still GI products, business models, and business processes are not capable to exploit the GI market's potential. The author suggests electronic marketplaces for geographic information as tools for improved market coordination and cooperation of business partners.

The following figure depicts the five parts of the thesis and its logical flow, which will be described in the subsequent paragraphs:



**Fig. 1: Thesis logic**

Based on the thesis' motivation of unexploited GI market potential, **part A** (equivalent to chapter 1) describes the major obstacles in the current GI market: Provision of inappropriate GI products, monolithic business models, and impeded customers' access to GI products and providers.

Based on the current obstacles, **part B** (equivalent to chapter 2) identifies three major needs of the GI market: providing aggregated information services, GI providers cooperating in business networks, and improved access of potential customers to the GI market. The concepts and the added value of information markets, electronic markets, and existing electronic marketplaces in markets in general reveal their potential of addressing these needs.

**Part C** targets the design of GI marketplaces. An analysis of a broad range of existing spatial and non-spatial marketplaces yields the design of the institutional and organizational framework of GI

marketplaces (chapter 3). The specific needs of the GI market are not unique in the economy, but we can observe an *extended relevance* of specific characteristics to be considered in the GI marketplace design. Metaphorical design transfers the services of a weekend food market to the target system GI marketplaces (chapter 4). The result is a set of mandatory and optional services a GI marketplace provides to its users.

After developing framework and services of GI marketplaces, **part D** (equivalent to chapters 5 - 10) validates these concepts within the branch of potential and potent customers of GI: The financial services industry.

Chapters 5 and 6 validate the design guidelines for GI marketplace framework and services identified in part B. The typical GI product required by financial service providers is a complex information service, composed of various technological, human, organizational, and institutional GI services (chapter 5). A test of existing GI Internet platforms shows the current discrepancy between supply and demand (chapter 6). The potential customer does not get sufficient information about price, benefit, or even existence of the required GI product.

Chapters 7 - 9 validate the concrete GI marketplace design of part C on three levels:

- GI marketplaces can perform appropriate mixed-mode business processes, integrating collaboration-oriented as well as transaction-oriented processes (chapter 7).
- On the implementation level, a key requirement is to integrate technological and human GI services by a semantically enabling description language. Chapter 8 validates that according to its concepts OWL-S (formerly DAML-S) is capable of describing human-technical service chaining.
- Chapter 9 provides a feasible business plan for the realization of a vertical GI marketplace for the financial services industry.

Chapter 10 discusses the achieved results: GI marketplaces can improve GI economy, can be executed in terms of business processes, can be implemented by existing technologies, and can be financed by public funding and public-private partnership.

**Part E** (equivalent to chapter 11) outlines future work within an implementation project and accompanying research.

## **PART A: INTRODUCTION**

Part A is equivalent to chapter 1 “Introduction”.

# 1. INTRODUCTION

This research on electronic marketplaces for geographic information (GI) suggests a generic, innovative approach to exploit the technological innovation of interoperable technical GI services in economically successful business processes.

The thesis suggests an extended cooperation of providers through business networks. It suggests information services as usable GI products, adding human, technical, organizational, and institutional services to the raw products geographic data and software. The thesis introduces GI marketplaces as tools for the GI market's cooperation and coordination. The ultimate goal is to support the sale of component-based GI products in the economy.

This chapter starts with the motivation for this thesis (section 1.1). Section 1.2 describes obstacles observed in the current GI market. This leads to the research questions and the overall hypothesis (section 1.3). Research approach and results are then presented in section 1.4. Section 1.5 defines the scope of the thesis and the targeted audience. Then, section 1.6 provides an overview of the structure of the thesis. Section 1.7 lists the author's publications in the context of GI marketplaces, which form the basis of this thesis.

## 1.1. MOTIVATION

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The motivation for this thesis is to improve the business value of geographic information. Given the central role of space in political and economic decisions, geographic information should have a high market potential. Geographic information is used in many different application fields, e.g., navigation, logistics, marketing, regional and ecological planning (Keenan 2004). However, market growth does not seem to achieve its potential (CommonGIS 1999), (Nebert 2000). A recent market study estimates that the GI market potential in Germany is about €8 billion; however, currently €1.2 billion are exploited (Fornfeld, Oefinger and Rausch 2003). Frank (Frank 1999) estimates that GI could improve efficiency of economy by 15 %. Thus, the improvement of GI business value is required from two perspectives: GI industry is willing to improve its business, and companies from the economy are willing to use GI as a valuable resource.

## 1.2. OBSTACLES IN THE CURRENT GI MARKET

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We observe three major obstacles in the current GI market:

- a. Products often do not match customers' needs.
- b. Monolithic business models impede the efficient provision of products.
- c. Potential customers have no appropriate access to GI products.

### **Ad a.) Products often do not match customers' needs:**

For too long, geographic data and GIS were considered as usable products per se. However, they do not fulfill the user requirements, because for the most part they are not ready-to-use. This problem became apparent observing many GI projects of our institute and its partners, companies and authorities: The implementation of a GI solution usually required a GI project, where most of

the costs resulted from working hours of the personnel. Their human services consisted for example in GI consulting and integration of geographic data and GI software into a non-GI system. Available products of the GI market were not ready-to-use. Most GI products in the market are made up of several intermediate products. In a case study of a typical business client requesting a typical GI product, more than 90 % of the costs went into human services (Brox and Kuhn 2004).

**Ad b.) Monolithic business models impede the efficient provision of products:**

The technological step forward in GI is interoperability. The Open Geospatial Consortium promotes the combination of technical GI services versus the model of monolithic GIS. Innovative and interoperable components have been developed, e.g., in the BRIDGE-IT project ([www.bridge-it.info](http://www.bridge-it.info)).

Technological evolution forces economical evolution as well; interoperability has to be transferred from technology to business. Most of the GI market's business models are still monolithic. There are many examples of companies that cover all tasks of a geospatial value chain: data production, data adjustment, software production, adjustment of applications to users' needs, system integration, user consultation, and user training (Brox and Kuhn 2004).

Monolithic business models affect impediments for the GI market. Many GI products consist of various intermediate products. Typically, a company has a core competence in provision of one or some intermediate products. But a single company mostly is not able to cover all intermediate products needed for the provision of the required end product, such as different as GI consulting, software development, and training. Consequently, the end product delivered by one company will lack quality and/or will have too a high price. In addition, potential customers will not be able to compare different providers by quality and price. A customer is dependent on monopolistic providers in an in-transparent market.

Providing complex GI products requires a networked cooperation of the entire geospatial value chains of producers, service providers, integrators, service enablers, and end-users (Niedzwiadek 1999). This requires new forms of business models, tools for its establishment, and cooperation of business partners within the value chains.

**Ad c.) Potential customers have no appropriate access to GI products:**

On the one hand, various potential applications of GI affect a high market potential. On the other hand, this leads to an almost unlimited number of profiles of potential GI products and providers. Consequently, geographic information is a heterogeneous, fragmented market (Brox, Kuhn, Janowicz et al. 2004).

Typically, potential customers have little knowledge about the GI products they need. In this case, a potential customer has two options:

- Rely on and engage a general contractor, or
- Use existing resources for information.

Both options impede the GI market. A general contractor might suggest non-optimal GI products due to a lack of knowledge about all aspects of a complex GI product. Or he might be contracted to specific software vendors and data providers affecting the usage of a less appropriate software or data. Lack of competition might lead to high prices. Most existing Internet resources do not offer

information for non-GI-specialists – often not even for GI-specialists – in order to get a sufficient overview of GI products and prices (see also chapter 6).

### 1.3. RESEARCH QUESTIONS AND HYPOTHESIS

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In all economic sectors we observe the transition to e-commerce and e-business. Electronic marketplaces initiate transactions between buyers and sellers and offer mechanisms for transactions via the marketplace (Spiller and Wichmann 2000). In the “marketplace hype” around the year 2000, transaction-oriented marketplaces were supposed to be *the* success factor of an improving economy (Spiller and Wichmann 2000). But they did not fulfill the high expectations, and many marketplaces failed (e.g., (Day, Fein and Ruppertsberger 2003), (Ranganathan 2003)). However, “electronic marketplaces flourish in several industries and the use of - specialized forms of – electronic marketplaces [...] has gained momentum” (Gogolin and Klein 2004). Klein and Gogolin (Klein and Gogolin 2002) and Gogolin (Gogolin 2003) suggested collaboration-oriented marketplaces as potentially successful models for a new generation of electronic marketplaces.

The success and failure of electronic marketplaces in the economy evoke the question whether GI marketplaces are capable of addressing the obstacles in the GI market discussed above. This leads to the first research question addressed by this thesis:

#### *1. Are electronic marketplaces tools for improving the turnover of the GI market?*

Today’s GI market targets e-business, but until recently just a small percentage of the annual turnover has been transacted via the Internet (Fornefeld and Oefinger 2001). We can assume that the GI market has specific challenges and chances. For example, trading a book in an electronic marketplace is comparably simple, because the product is ready-to-use. Geographic information on the other hand usually is not ready-to-use: it requires the integration of several technical and human services. Consequently, we can assume that success factors of electronic marketplaces in general cannot be transferred to the GI market one to one. Therefore, the second goal of the thesis is to clarify the research question:

#### *2. What is an appropriate design of electronic marketplaces targeting the GI branch?*

Assuming that GI marketplaces have the potential to improve GI business and there is a GI-market-specific design for electronic marketplaces, the feasibility of a GI marketplace implementation still has to be validated. Therefore, the thesis addresses the third research question:

#### *3. Can a GI marketplace be implemented?*

Implementation has to consider different aspects:

- Easy-to-handle and low-cost business processes accepted by the users
- Technical feasibility of implementation
- A convincing business model including financial feasibility.

The third research question is too broad for scientific work. Many aspects, e.g., different target branches, various countries, legal aspects, and a bundle of appropriate GI marketplace services, are too complex to be managed in a single project. Therefore, the hypothesis of this thesis narrows the focus of the third research question:

1. The hypothesis focuses on the German financial services industry for several reasons: First, the author is familiar with the requirements and impediments of this branch due to projects and personal contacts with decision makers in banks and insurance companies. Second, financial service providers are valuable potential clients of the GI market in terms of financial resources and their need for geographic information (Fornfeld and Oefinger 2001). In addition, financial service providers can be considered as typical business clients, allowing a generalization of the results.
2. The hypothesis focuses on the first step of business transactions: information retrieval. Tests of existing Internet-based GI platforms show that the initiation of business transactions is interrupted (Brox and Kuhn 2004). Therefore, a solution is urgently needed.
3. The hypothesis focuses on a complex GI product. It consists of several intermediate products, namely human and technical GI services. This type of product is typically what business clients (companies, authorities) need (Brox and Kuhn 2004), so we can generalize the results.

Thus, we derive from the third research question the following overall hypothesis:

*Electronic marketplaces for geographic information give decision-makers from the German financial services industry faster and cheaper access to complex GI products than current Internet-based and other business models.*

#### 1.4. RESEARCH APPROACH AND RESULTS

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This section describes the methodological approaches used to address the research questions of detailed problem description, GI marketplace design, and validation of concepts. In addition, it describes the results of each step.

Ad 1.) *Research question: Are electronic marketplaces tools for improving the turnover of the GI market?*

The first research question targets a detailed problem description. The overall method of this part is to analyze existing information in literature and the Internet. The thesis analyzes current obstacles in the GI market, and suggests solutions for the GI market:

- The GI market mostly offers geographic data. Obviously, this product supply is not successful in the market. Therefore, several types of GI products potential customers request are analyzed. The GI products demanded are more complex than data and software. Human, organizational, and institutional services have to be added. The final result of this step is a model describing the product called “information service”.
- The modification of current business models is necessary in order to provide information services. Companies that perform the business processes of entire geospatial value chains represent an outdated business model. Such a business model is inefficient, not transparent to potential customers, and is not competitive in the market. Based on the need for information services, the thesis develops a new business model that provides the required GI products more efficiently. In the economy, the products are produced by value chains of several providers, each ad-hoc contributing with his key competences and key products.

The final result of this step is a description of business networks as appropriate business models for the GI market.

- New ways of accessing the GI market are needed for information services and business networks. The thesis analyzes the access potential customers currently have to GI products, i.e., Internet-based solutions, and then identifies the obstacles in obtaining GI products. The trend to e-business is on the right track, but the processes for accessing GI products have to be improved. The final results of this step are recommendations for an improved Internet-based access to GI products.

Based on the three major challenges to the GI market, the thesis analyzes whether electronic marketplaces meet these challenges. First, an overview of current trends in electronic markets and electronic marketplace models is provided. Then, the capabilities of electronic markets and marketplaces are identified and matched with their ability to address the above described challenges in the GI market. A detailed analysis of the needs of the GI market forms a guideline for the following design of GI marketplaces.

Finally, previous work and research on the GI marketplace topic are analyzed. Based on the observation that little research has been done in this field, and the models of information services and business networks have not been sufficiently targeted before, the final result of this step is the validation of the evidence of the research approach.

*Ad 2.) Research question: What is an appropriate design of electronic marketplaces targeting the GI branch?*

Based on the concept of the general design guidelines, the thesis then targets the design itself (part C). The first step is to define exactly what a GI marketplace is. Further research addresses the institutional and organizational framework of GI marketplaces, and the services GI marketplaces provide. The overall approach is to transfer successful mechanisms of the economy to GI marketplaces.

A detailed analysis of existing spatial and non-spatial marketplaces shows a broad range of business solutions. The GI market has specific requirements that are different from other market segments in the economy. Therefore, existing spatial and non-spatial marketplaces are then compared. The author takes into consideration their organizational frameworks and the services they offer, and the above described three major needs of the GI market are then matched with existing business solutions.

The final result is an institutional and organizational framework for GI marketplaces, which addresses these needs and identifies the types products traded, the type of marketplace appropriate for the GI market, the GI marketplace players, horizontal and vertical orientation, and guidelines and standards for achieving an open market.

The next step is the definition of services GI marketplaces have to provide. For the transfer of successful mechanisms from economy to the GI market, the thesis chooses the method of metaphorical design. Metaphorical design helps to understand complex problems by transferring mechanisms of a well-known system to the new system under construction (Madson 1994). The weekend market in Münster, Germany, is used as the well-known system. The analysis identifies roles of the weekend market's players and processes that are apparently successful – the weekend



market has existed for a couple of centuries. Then, the services of the weekend market are transferred to GI marketplaces. This yields an unsorted and preliminary list of services that *could* be used for a GI marketplace design.

In order to be as complete as possible, the achieved results are compared with the categories of general marketplaces services of Bakos (Bakos 1998), and the broad range of services that the analysis of existing spatial and non-spatial marketplaces provide. The preliminary list of services is matched with the three major needs of the GI market identified before in order to achieve a list of mandatory and optional GI marketplace services.

The final results are i. the design of an organizational framework of GI marketplaces and ii. the design of categorized services to be provided by GI marketplaces.

*Ad 3.) Hypothesis: Electronic marketplaces for geographic information give decision-makers from the German financial services industry faster and cheaper access to complex GI products than current Internet-based and other business models.*

So far, the thesis yields two basis concepts: Design guidelines addressing the three major needs of the GI market, and the design itself identifying framework and services of GI marketplaces. The validation (part D) addresses both concepts. The overall methodological approach is to focus on the German financial services industry.

The validation procedure consists of several intermediate steps:

Validation of design guidelines addressing the key needs of the GI market (compare part B):

- Personal interviews identify the types of GI products required by the financial services industry. An Internet search evaluates existing GI products that are successfully offered to this branch. The final result is a validation of the financial service providers' need for information services and business networks.
- A typical information service is defined. Based on the GI solution required by the bank, intermediate GI products composing the required end product are identified. Then, three existing Internet-based GI platforms in Germany are tested for the fulfillment of this demand; test persons try to get information about price and potential benefit of the targeted product. The final result is a validation of the need for improved access to the GI market for potential customers.

Validation of the GI marketplace design (compare part C):

- Based on the GI marketplace design and the validation of the GI market's needs, a new business process model performed by the GI marketplace is developed. We observed that the first step of business transactions, information retrieval, is blocked; therefore, the focus is on this step. The thesis develops a business process model that i. includes technical as well as human GI services, ii. integrates various players of the geospatial value chains, and iii. provides information to the customer about the required product, i.e., price. The methodological approach draws analogies from a well-known, well-defined, and obviously successful business process model: public procurement. A public call for tenders of a public authority for building a new school house divides the end product "school" into intermediate products, e.g., roof construction and landscaping, establishes ad-hoc business

networks that provide these products, and provides easy access for the public authority to the specific products and providers. The final result is a validation that the business process model mediated by the GI marketplace supports overcoming the above identified obstacles in the GI market.

- The next step is to investigate the technical feasibility of a GI marketplace implementation. General business process languages are available. The challenge is to describe technical and human services for Internet-based transactions. Technical-human service chaining affects the demand for a semantic enabling web description. The most promising candidate is OWL-S (Janowicz and Riedemann 2003), (Brox and Janowicz 2004). Therefore, the parameters are identified, for which a semantic enabling web description language has to describe within the scenario. Then, the concepts of OWL-S (service profile, service model, service grounding) are investigated to see whether they are capable of doing so. The final result is a validation of OWL-S fulfilling the requirements of a semantic enabling web description for human-technical service chaining.
- The following step targets the organizational and financial feasibility of a GI marketplace implementation according to the GI marketplace design described in chapters 3 and 4 (part C). A process model of creating a new company in the economy uses McKinsey guidelines (Heucher, Ilar, Kubr et al. 1999) for creating a business plan. This business plan analyzes the business ideas, services offered, entrepreneurs, marketing, intra-organization, realization plan, budget, and risk analysis. The final result is a validation of organizational feasibility, also weighing the financial risks versus the potential benefits of a GI marketplace implementation.

After validating single aspects of the GI marketplace concepts, the next step is to validate the overall achievements. Validation includes two issues: methodological approach and results.

First, the thesis validates the methodological approach of the validation concept considering three criteria: Is the methodological approach appropriate to achieve general, complete, and significant results?

Then, the discussion validates the three aspects of the hypothesis: information services, business networks, and access to the GI market. Final result is the validation of the hypothesis.

## **1.5. SCOPE OF THE THESIS AND INTENDED AUDIENCE**

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The thesis points out the need for GI marketplaces and describes key issues and offered services of successful electronic marketplaces for geographic information on a conceptual level.

It provides

- New approaches for the marketing of GI by the concepts of information services, business networks, and improved Internet access to the GI market
- A validated organizational framework of GI marketplaces
- Validated services GI marketplaces need to provide
- Validation of technical and organizational feasibility of GI marketplace implementation

- Evidence for the hypothesis.

The thesis does not

- Prove the hypothesis (a proof would be i. an evaluation of the economic success of the case study ii. an evaluation of the economic success of several GI marketplaces.)
- Provide detailed technical specification or architecture
- Implement the organizational framework and services
- Focus on low-level user requirements, e.g., design of a user interface
- Focus on data integration
- Focus on general e-business aspects, e.g., security mechanisms.

The intended audience consists of

- Public organizations who are willing to support the GI market by establishing a GI marketplace, i.e., Spatial Data Infrastructure initiatives
- Companies and organizations of the GI market as potential providers and users of a GI marketplace
- Companies and organizations as users of geographically related products
- Researchers in interdisciplinary projects of geographic information science and economy.

This thesis deals with an urgent topic of the GI market, which is not sufficiently covered by previous research: Making GI economically successful. The GI marketplace models of this thesis are ready to be directly implemented by companies and organizations of the GI market.

## 1.6. STRUCTURE OF THE THESIS

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This document consists of five overall parts:

- A. Introduction
- B. Detailed problem statement
- C. Design of GI marketplaces
- D. Validation of concepts
- E. Outlook.

**A. Introduction** Chapter 1 introduces electronic marketplaces for geographic information. It provides the motivation, identifies the key obstacles in the current GI market, and formulates the research approach and expected results.

### **B. Detailed problem statement**

Chapter 2 points out major challenges to the GI market: overcoming the mismatch of available and demanded products, monolithic business models, and limited access of potential customers to GI products. GI marketplaces address these challenges, and therefore are capable of improving

business in the GI market. Then, the research approach is evidenced. This chapter concludes with a discussion of achieved results of part B.

### **C. Design of GI marketplaces**

The thesis' approach is to transfer existing concepts to GI marketplaces. The principle design guideline is to address the above identified needs of the GI market. Chapter 3 analyzes and compares existing spatial and non-spatial marketplaces against the background of the key challenges to the GI market identified in the previous part. As a result, the thesis describes the design of the institutional and organizational framework of GI marketplaces.

Chapter 4 transfers the services of the Münster weekend market to GI marketplaces by metaphorical design. These findings lead to categories of GI marketplace services, and to a detailed list of mandatory and optional GI marketplace services. This chapter concludes with a discussion the results achieved in part C.

### **D. Validation of concepts**

The German financial services industry and a scenario of a bank requiring a typical GI product serve as a setting for validating the feasibility of GI marketplace concepts.

Chapter 5 evaluates the demand of decision-makers from the financial services industry for GI products and providers. Chapter 6 tests how this demand is fulfilled by current Internet solutions. Chapter 7 validates the business processes of a GI marketplace; the exemplary business process model of an online call for tenders addresses the first step of a business transaction: information retrieval. Chapter 8 validates the technical feasibility of the business process implementation of the semantic enabling web description language OWL- S. Chapter 9 describes a feasible business plan for the implementation of a GI marketplace for the financial services industry.

Chapter 10 discusses the results achieved in part D and the overall methodological approach, and validates the hypothesis of the thesis.

### **E. Outlook**

Chapter 11 provides an outlook to future work on realization of a GI marketplace and accompanying research.

Finally, chapter 12 lists the references.

The following table provides an overview of the thesis:

Tab. 1: Thesis overview

Part/chapter	Methods	Results
<b>A. Introduction</b>		
Chapter 1	-	Theoretical foundation of the thesis
<b>B. Problem statement</b>		
Chapter 2	Literature and Internet search	<ul style="list-style-type: none"> <li>Evidence of needs for information services, business networks, and improved access to the GI market (= guidelines for further design)</li> <li>Evidence of GI marketplaces' capability to address these needs</li> <li>Evidence of research approach</li> </ul>
<b>C. Design of GI marketplaces</b>		
Chapters 3-4	<ul style="list-style-type: none"> <li>Analysis of existing spatial/ non-spatial marketplaces</li> <li>Metaphorical design</li> </ul>	<ul style="list-style-type: none"> <li>Organizational framework of GI marketplaces</li> <li>Categories of GI marketplace services</li> <li>Mandatory and optional services</li> </ul>
<b>D. Validation of concepts</b>	(Overall method: Scenario of a bank that requires a specific GI product)	(Overall result: Validated design of a vertical GI marketplace for financial service providers)
Chapter 5	<ul style="list-style-type: none"> <li>Analysis of existing GI products for financial service providers by interviews and Internet search</li> </ul>	<ul style="list-style-type: none"> <li>Validation of need for information services and business networks</li> </ul>
Chapter 6	<ul style="list-style-type: none"> <li>Analysis of intermediate products of a complex GI end product in a specific scenario</li> <li>Test of three Internet-based GI platforms</li> </ul>	<ul style="list-style-type: none"> <li>Profile of a typical GI product consisting of many intermediate products (human and technical services)</li> <li>Mismatch of product supply and demand</li> <li>Interruption of first business transaction step: information retrieval</li> <li>Validation of need for improved customer access to the GI market</li> </ul>
Chapter 7	<ul style="list-style-type: none"> <li>Design of new business processes derived from public procurement</li> </ul>	<ul style="list-style-type: none"> <li>Business process model with an online public call for tenders</li> <li>Validation of business processes</li> </ul>
Chapter 8	<ul style="list-style-type: none"> <li>Validation of implementing human-technical service chaining by analysis of OWL-S concepts</li> </ul>	<ul style="list-style-type: none"> <li>Business process language available</li> <li>Need for appropriate semantic enabling description language fulfilled by OWL-S</li> <li>Validation of technical feasibility</li> </ul>
Chapter 9	<ul style="list-style-type: none"> <li>Implementation of business process model by a business plan for a GI marketplace realization</li> </ul>	<ul style="list-style-type: none"> <li>Business plan</li> <li>Validation of organizational and financial feasibility</li> </ul>
Chapter 10	<ul style="list-style-type: none"> <li>Analysis of methodological approach and hypothesis aspects</li> </ul>	<ul style="list-style-type: none"> <li>Validation of methodological approach</li> <li>Validation of hypothesis</li> </ul>
<b>E. Outlook</b>		
Chapter 11	<ul style="list-style-type: none"> <li>Identification of open issues</li> </ul>	<ul style="list-style-type: none"> <li>Concepts for future work</li> </ul>
<b>Bibliography</b>	-	Bibliography

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## **PART B: DETAILED PROBLEM STATEMENT**

Part B is equivalent to chapter 2 “The Need of the GI Market for Electronic Marketplaces”.



## **2. THE NEED OF THE GI MARKET FOR ELECTRONIC MARKETPLACES**

Geographic information is ubiquitous, applied in many specific domains for many different purposes. Compared to non-spatial markets, there are many data formats, product types, software systems, providers, and users with extremely different requirements (Abel 1997). Consequently, the GI market has specific obstacles, as well as specific solutions.

The first step is to identify the specific needs of the GI market, because electronic marketplaces should be designed to meet the needs of the parties using the marketplace (Choudhury, Hartzel and Konsynski 1998). Section 2.1 shows the need for information services versus the current supply of geographic data offered. Providing information services affects the need for new business models instead of traditional, monolithic business models (section 2.2). A third need of the GI market is improving access of potential customers to GI providers and products (section 2.3). Then, section 2.4 evaluates the potential of GI marketplaces to support overcoming the identified obstacles of the GI market. Section 2.5 presents the relevance of the chosen research approach. Section 2.6 summarizes and discusses the results of part B “Detailed Problem Statement”.

### **2.1. THE NEED FOR INFORMATION SERVICES AS APPROPRIATE GI PRODUCTS**

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Geographic information is a potentially valuable resource for the economy, but too often it cannot be used in business and decision processes. Geographic data sets have been considered a solution for providing successful products for too long. Selling raw data assumes that the user has the expertise to use the data. This is often not the case and the producer is forced to find new ways to enter the market. A typical example is retailers using geographic information for marketing activities. The solution the GI market could provide was: Buy a GIS. But GIS were too complex to handle, and they could not be integrated into enterprise resource planning systems (ERP) and workflows of GI business users (Sliwinski 2001). The challenge is to provide a product that is ready-to-use (Brox and Kuhn 1999; Brox and Kuhn 2001).

Beckwith (Beckwith 2000), a marketing expert and internationally acclaimed business speaker, points out the difference of product and service. His example is a concert of Laura Nyro. He visited the concert, and the product – the songs – was perfect. But he was very disappointed and will never visit a Laura Nyro concert again. What had happened? Laura Nyro had entered the stage, sat down on a chair, sang for ninety minutes, and – nothing else. No move, no contact with the audience, no good vibrations at all. Not only has the quality of the product mattered. Everything else – presentation, stage show, and human contact - mattered. The “more” is the difference between product and service.

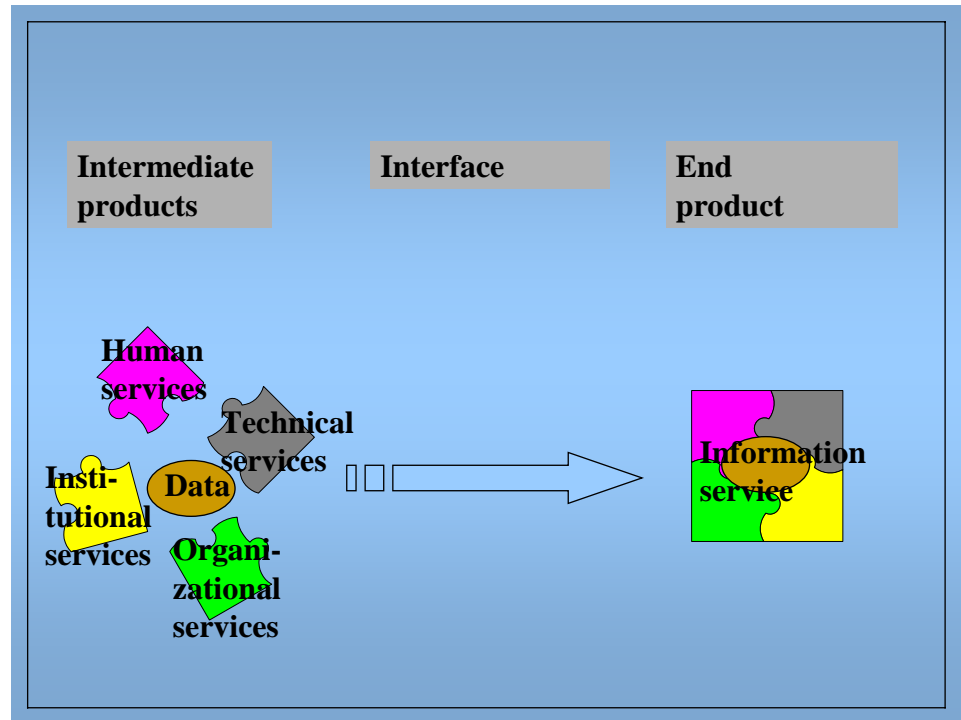
The situation within the GI market looks similar. For a while the “perfect product geographic base data” was considered to be the breakthrough in the use of geographic information. The next approach was to add services to data – in a technical sense. The idea is to add functionalities, e.g., data selection or payment via Internet, to data sets. This is considered to be the “perfect product”, product in the sense of Beckwith. Generating products from components, with data and technical services as building blocks, is a big improvement. But there are five reasons it is not sufficient:

- The products cannot be “perfect”, because the state-of-the-art is not that far advanced. Interoperability of data and technical services is rarely available yet, architectures for a service-oriented distributed computing environment still have to be improved, and semantic problems have to be solved.
- Users of geographic information need a wide range of products. All necessary building blocks for generating all products needed cannot be in stock. Data and technical services will often need adaptation to the users’ needs; new building blocks will even have to be created.
- Human knowledge and human work have to be added, e.g., a consultant advises an insurance company, which data sets support their marketing decisions, or an integrator adapts a geo-software application to the business system.
- Organizational services have to be added, e.g., providing information. How can a potential user buy a geographically related product if he does not know where and how? Or can he buy GI, if he does not even know that he needs GI?
- Institutional services have to be added, e.g., standardization. Data and services cannot be interoperable without them. The GI market needs institutional means for coordination.

“Increased selling effectiveness comes from being able to design appropriate products to address the needs of individual consumers (Bakos 1998)”. The future market for geographic information is not a market of data but a market of *information services* (Brox and Krek 2002; Brox and Kuhn 2002). Geographic data are the raw material of the market, equivalent to Beckwith’s term “product”. The improvement of adding technical services leads to *information*. Sometimes, this information is exactly what the user needs. Very often the information does not answer the users’ questions, it is the wrong information, or it is not delivered in an appropriate way. Organizational and institutional services have to be added in order to create an information service. Our definition of information service is equivalent to Beckwith’s term “service”. An information service answers users’ specific questions. It is tailored to specific users’ needs. According to the definition within the report, an information service is generated by

- Applying *technical* services
- *Human* services
- *Organizational* services
- And *institutional* services
- To *data* sets.

The following figure illustrates the required aggregation of information services.



**Fig. 2: Applying services to data**

In simple cases, applying only technical services to data sets can generate an information service. This is possible, if *all* services needed are automated and implemented in (technical) service chains. But most of the required end products are information services that involve human, organizational, and institutional services.

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## 2.2. THE NEED FOR BUSINESS NETWORKS AS NEW BUSINESS MODELS

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In the past, the technical innovation was to add technical, interoperable services to the raw material of geographic data sets. Due to the standardization efforts of International Organization for Standardization (ISO) and Open Geospatial Consortium (OGC) we have made the step from monolithic systems to component based systems and interoperable services. Today's challenge is to use the technical innovation within economically successful business processes.

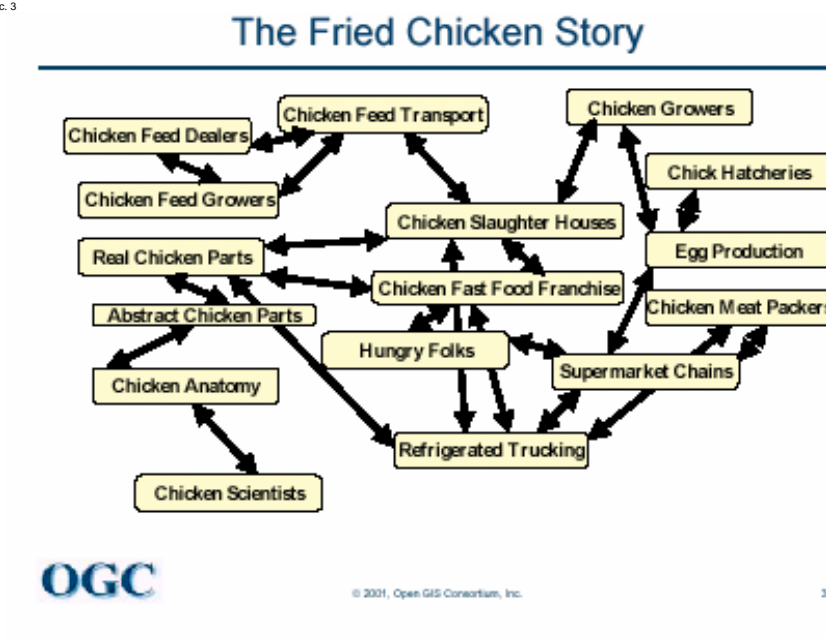
Despite the technical innovation, most business models of the GI market are still monolithic. There are many examples for companies that cover all tasks of a geospatial value chain. For example, the Swiss GI company Endoxon AG produces data, adjusts data, produces software, adjusts applications to users' needs, integrates systems, consults users, and trains users (Widmann 2001). A lesson we learnt from the technical aspects of monolithic systems is: these systems can do a lot, but very often they do not provide exactly what the user needs.

In many economic sectors we have observed that big companies split up into smaller companies (or at least into autonomous departments) with their specific core competences and core businesses. The generation of products shifted from the traditional philosophy "One product equals one company" to a combination and integration of processes required for generating a product, and several small business units that are particularly capable of executing each process. The trend for

the 21<sup>st</sup> century is towards decentralized systems with very small networked companies. Companies in the value chains of a specific economic sector cooperate in ad hoc projects in order to generate the desired product (Malone and Laubacher 1999). The providers are cooperating and competing at the same time (“coopetition”). The goal is to achieve a higher profit due to the market improvement, although each provider’s market share is reduced (König and Weitzel 2003). An example is Broadway in New York. Although there is lots of competition, it attracts many more visitors per theatre than a single theatre could, and qualified actors, musicians, writers, etc. are more readily available.

Open Geospatial Consortium and ETeMII (Gisform 2002) illustrate a “toy example of a real marketplace, which exhibits a high degree of interoperability, from which we may draw analogies: The market which links hungry consumers to a chicken distribution site (otherwise known as a fried chicken restaurant) is at least as complex as this diagram. This market example is interoperable in that we might “unplug” a transport company and substitute it (rather quickly) with another offering better or cheaper service, without disrupting the flow (service chain) from suppliers to consumers. The same would be true for a chicken feed supplier or for the company which produces paper boxes in which the chicken is delivered. So what does this have to do with the GI market? Accepted rules (standards) among the various actors involved are essentially the glue, which holds the chicken market, and many other mature markets, together. Do these rules exist within the (European) GI market? It is safe to assume that the answer is no, or at least that sufficient maturity does not yet exist. When the rules of collaboration among GI actors become clear, then an interoperable marketplace will emerge.”

© 2001, Open GIS Consortium, Inc. 3



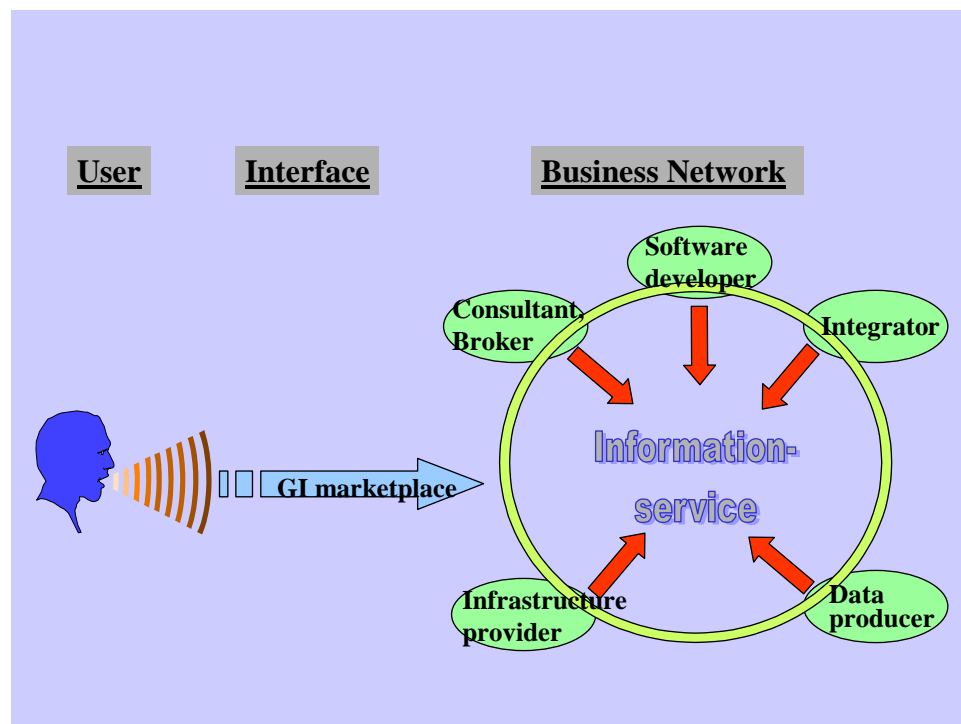
**Fig. 3: The Fried Chicken Story (by OGC, 2001)**

The future generation of information services requires a networked cooperation of the entire geospatial value chains of producers, service providers, integrators, service enablers, and end-users (Niedzwiadek 1999). In addition, e-commerce und e-business is emerging onto the GI market. This

requires new forms of business models called *business networks* (Brox and Kuhn 1999). The term “business networks” takes up the terms “business networking” and “process networks” of Benz et al. (Benz, Fleisch, Gruenauer et al. 1999).

The future generation of products will be process-oriented (Malone and Laubacher 1999). This requires a business “on the fly” of several companies, where the integration of business processes of different companies can be realized in an automated way (Otto and Waesch 2003). Value chains companies of a specific economic sector are found together in ad hoc projects in order to generate the desired product. A simple example is building a house. Nobody would think that the architect is building the roof or doing the garden. In contrary, the house construction consists of many processes, in Germany well defined by such standards as ISO 9000. The end product “house” is generated by a business network of many companies, e.g., architects, bricklayers, electricians, banks, gardeners, etc.

As the example of Endoxon AG (see above) shows, in the GI market monolithic business models are still wide-spread. The challenge is to introduce new, process-oriented business models to the GI market as well. Specialized providers of the entire geospatial value chain will have to co-operate in business networks in order to generate the required geographic information services.



**Fig. 4: Business networks**

In contrast to the current monopolistic business model, marketplaces go along with cooperation and competition. By opening the market to a competitive business model, users profit by an enhanced transparency of the market, which affects lower prices and higher quality of offered products. On the other hand, providers profit as well. By cooperation in business networks, the critical mass of providers (data producers, software developers, integrator, consultants, brokers, infrastructure providers) can be achieved in order to establish a profitable market.

### **2.3. THE NEED FOR IMPROVED CUSTOMERS' ACCESS TO GI PRODUCTS, PROVIDERS, AND PRODUCT INFORMATION**

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A key obstacle in the GI market is the lack of access to the market. Fornefeld and Oefinger (Fornefeld and Oefinger 2001) identify four success factors of the sale of data: quick access, clear source, clear price, and up-to-date data. The author strongly supports this argumentation; however, the access facilitation has to be extended by the above described access to information services and business networks.

Many projects and contacts to companies and authorities showed that potential GI customers have little knowledge about geographic information. They are not usually able to define their requirements, e.g., if a geographic data set is suitable to fulfill the customer's task. Therefore, the GI market should assure an even better access to products, product information, and providers than for goods that are less complex and at least somewhat familiar the potential clients, e.g., cars, books, and gardening services. The opposite is true; from the point of view of a potential GI customer, there is a low transparency in products and prices (Brox, Kuhn, Janowicz et al. 2004).

This leads to monopolistic business models (Gogolin, Brox and Klein 2005). For example, the Swiss GI company Endoxon AG made an agreement with Credit Suisse about an overall GI consulting (Widmann 2001). Although this agreement was not exclusive, the bank customer mostly will rely on a single provider. This business model might lead to a lack of quality and a high price for the required GI product:

- Providing a complex GI product requires expertise in several fields of geographic information. The provider might have a high quality standard in producing and adapting data, but little know-how in integrating GI software with the customer's business software, e.g., SAP. This leads to a loss of quality in the end product.
- A provider might have a special interest or exclusive contracts for selling a specific vendor's software or data. This might lead to the offer of software X, although software Y would have a better quality according to the customer's requirements and/or a higher price.
- A monopolistic business model lacks competition. Exclusive providers might charge high prices, which cannot be controlled by the customers. Providers might even develop GI products that already exist on the GI market.

The current trend to GI Internet platforms has not yet improved this situation significantly. A test of three existing GI Internet platforms in Germany showed that mostly data was offered (Brox and Kuhn 2004). First, this selection did not match the need of complex GI product including human services. Second, not even the data offered was presented in a way that potential customers could judge the usability of this product for their purposes. The final result was that a customer could not decide about buying the required GI product, because she/he did not receive sufficient information about price and potential benefit (see chapter 6).

## **2.4. THE POTENTIAL OF ELECTRONIC GI MARKETPLACES**

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From the economic perspective, the three major needs of the GI market can be attributed to the following challenges:

1. Improve product potentials
2. Improve value chain structures
3. Increase weakly articulated demand by increasing transparency in a fragmented market

Ad 1.) The current offer of GI products mostly consists of geographic data, which are not usable to most of the potential customers, and usable information services, which often are provided by complex GI consultancy projects (see chapter 5). Typically, these GI projects are costly, pricing is in-transparent, and quality is varying. The technical evolution from complex GI systems to distributed GI services offers the opportunity to improve the product potentials by bundling intermediate GI products of various providers, and product differentiation.

Ad 2.) The current business structure can be considered as monopolistic and oligopolistic, and “monolithic”. The situation in North-Rhine Westphalia provides a good example: The establishment of the SDI initiative CeGi ([www.cegi.de](http://www.cegi.de)) was driven by the North-Rhine Westphalian mapping authority. The monopolistic data provider is also a major stakeholder of the “firm CeGi”. Further stakeholders are less than twenty leading companies in North-Rhine Westphalia, selected by the mapping authority. The GI market has to overcome the concentration on governmental mapping agencies and few big players. It will be crucial to open business opportunities for new firms and innovative products (Fornfeld, Oefinger and Rausch 2003). In addition, the challenge is to replace “monolithic” GI providers covering the whole value chain by “real” value chains in terms of business networks (see section 2.2).

Ad 3.) Although the GI market potential is estimated highly, the demand is weakly expressed (Fornfeld, Oefinger and Rausch 2003). GI is ubiquitous and can be applied on a great range of applications. On the one hand side, this can be considered as a chance. On the other hand, the GI market faces a high fragmentation. Fragmentation is one of the reasons for lacking market transparency. A potential GI customer needs to invest much time into searching for GI products, providers, and prices; in addition, the search results are not appropriate (see chapter 6). A challenge is to reduce transaction costs and to enhance efficiency of information retrieval.

The following sub-sections analyze if electronic GI marketplace have the potential to address these challenges. Sub-section 2.4.1 describes the trends in information markets, electronic markets, and electronic marketplaces in markets in general. Based on these trends, sub-section 2.4.2 analyzes the shift from transaction-oriented marketplaces to collaboration-oriented marketplace models. Then, sub-section 2.4.3 analyzes if the potential of information markets, electronic markets, and electronic marketplaces address the economical challenges of the GI market.

#### **2.4.1. Information markets, electronic markets, and electronic marketplaces in markets in general**

The upcoming of electronic markets started to change organizational and business structures in markets in general (Malone, Yates and Benjamin 1987). In this context, one of the key words is information. The author considers the “information market” of Kuhlen (Kuhlen 1995) as a meta-model of electronic markets. The information market is a value-adding market of intermediaries. “Added value not grows out of itself” but depends on “informational work” that relies on already existing objects (Kuhlen 1995).

According to Kuhlen (Kuhlen 1995), “electronic markets for business communication” are instances of information markets. They are “supposed to target physical goods, but factually they are run via information and communication processes. Ways of communication and types of information are not an end in itself, but promote the exchange of the targeted products. But more and more, the exchange of information objects becomes the target in a way that information goods become consumables”.

In literature, the terms “electronic market” and “electronic marketplaces” often are not differentiated. The author considers “electronic market” a conceptual model for describing market mechanisms. The term “electronic marketplace” will be used for physical institutions acting in the market. But what is the role of electronic marketplaces in markets in general?

According to Bakos (Bakos 1991), electronic marketplaces can be considered intermediaries between buyers and sellers in a vertical market; typically they reduce the “search costs buyers must pay to obtain information about the prices and product offerings available in the market”. But it was also considered a risk that efficient, direct interaction between buyers and sellers might eliminate the role of intermediaries (Choudhury, Hartzel and Konsynski 1998).

In commodity markets, products are “essentially identical across all sellers”; “buyers will typically choose the seller with the lowest total costs (Bakos 1991). Thus, the “role of an electronic marketplace is to provide information about the existence and the price of the seller (Bakos 1997)”. Commodity markets are driven by price competition (Brox and Krek 2002).

However, the GI market rarely bases only on price competition. We can observe price competition in some segments of geomarketing data on the US and Canadian market; however, the GI market mostly refers to non-price competition in differentiated markets (Brox and Krek 2002). Differentiation is achieved “when a firm provides something unique that is valuable to buyers beyond simply offering a low price (Porter 1985)”. “Differentiated markets involve a variety of product offerings and consequently the search problem becomes more complex; buyers need to consider both the price of a particular seller and the characteristics of the corresponding product offering (Bakos 1991)”. Thus, electronic marketplaces may “generate substantial allocational efficiencies by enabling customers to locate suppliers that better match their needs (Bakos 1991)”.

Applied on the GI market, there will be two types of search costs: Obtaining price information as well as obtaining information about other product characteristics. It can be argued that “it will become easy to match directly buyers and sellers, and as a result, the role of intermediaries may be reduced or even eliminated leading to “disintermediation” (Bakos 1998)”. This claim would



contradict the establishment of electronic GI marketplaces. However, this is a subject of verification:

- Does the reduction of search costs lead to a disintermediation?
- Are there other roles for intermediaries?

In the aircraft part industry, the answer to the first question is two-folded. Choudhury et al. (Choudhury, Hartzel and Konsynski 1998) investigated these issues in a case study. Choudhury et al. identify two market functions in the context of search costs: *identification* of potential trading partners and products, and comparing prices across sellers (*selection*). In the aircraft part industry, Choudhury et al. rather see few opportunities for intermediaries in the identification stage, but rather in the selection stage. The key concern is the value added by the intermediaries. Potentials of adding value are different in different markets. This is particularly true for the GI market: Having a high market variability in product availability and prices, an electronic market is “particularly useful for locating sellers the offer a specific product (identification) and/or for comparing prices across sellers (selection) (Choudhury, Hartzel and Konsynski 1998)”. An additional characteristic of the GI market is that most GI products are not ready-to-use. GI services, e.g., data integration, are not on stock, but have to be provided ad-hoc according the specific customer’s requirements. Currently, it is almost impossible for potential GI customers to get appropriate information about products and providers, prices and other product characteristics (see chapter 6). Therefore, GI marketplaces can provide added value in both the identification stage and the selection stage. As a result it can be assumed that in the GI market the reduction of search costs does not necessarily lead to disintermediation. In contrary, intermediation leads to a reduction of search costs.

The second question addressed further roles of intermediaries. In the aircraft parts industry, intermediaries can create added value by supporting executing the transactions, e.g., negotiation. This is in line with Bakos, who predicts the “growth of new types of electronic intermediaries. These intermediaries will perform functions that include matching buyers and sellers, providing product information to buyers and marketing information to sellers, aggregating information goods, integrating the components of consumer processes, managing physical deliveries and payments, providing trust relationships and ensuring the integrity of the markets (Bakos 1998)”.

Although the dynamics of market restructuring might lead to disintermediation in some cases, Klein and Teubner (Klein and Teubner 2000) predict new roles of intermediaries in re-intermediation and cyberintermediation (*intermediation* in *cyberspace*). In the reintermediation scenario, “traditional intermediaries will be forced to differentiate themselves”, and in the cybermediation scenario “wholly new markets for intermediaries will be created” (Giaglis, Klein and O’Keefe 2002).

In the GI market, the author assumes new options for intermediation as well. These will be analysed in sub-section 2.4.3.2 and further detailed in the GI marketplace design in part C. But even more important than finding new business opportunities for intermediaries is another point of view: An intermediation of GI marketplace targets the improvement of the entire GI market.

### 2.4.2. Trends in electronic marketplace models

In the late 1990s, electronic marketplaces emerged with the focus on reduction of transaction costs (Spiller and Wichmann 2000). Coase (Coase 1937) first introduced the concept of transaction costs. It contradicted the Neoclassic Economics, which assumed an “ideal market”, where processes and mechanisms for the coordination of demand and supply were assumed to be cost-neutral (Schwickert 1998). The New Institutional Economics maintains a point of view closer to reality, assuming the market is a structure of institutions and transactions within and between these institutions; transactions were not considered to be cost-neutral any more (Schwickert 1998). Estimates attribute 50-60 % of the national income of modern economies to transaction costs (Richter and Furubotn 1996); Wallis and North (Wallis and North 1986) measured a value of 45 % for the US market.

In all economic sectors the transition to e-commerce and e-business is *the* success factor. Underestimating the Internet causes hardships for companies. For example, SAP stocks declined from more than 600 Euros in 1998 to 265 Euros in 1999 because of the company’s Internet strategy. After investing hundreds of millions German Marks into new concepts, e.g., the new marketplace platform mySAP.com, SAP shares recovered with a price of €740 in March 2000 (Kerbusk 2000).

Electronic marketplaces emerged, and in the “marketplace hype” around the year 2000 experts expected B2B marketplaces to be successful and promising in businesses worldwide. A ten-fold increase by 2002 leading to 600-800 electronic marketplaces in Germany, with an expected volume of up to US\$ 15 billion were estimated (Berlecon\_Research 2000). But many marketplaces failed in practice and did not fulfill the high expectations (e.g. Wise and Morrison 2000; Day, Fein and Ruppertsberger 2003; Ranganathan 2003). However, many B2B marketplaces are still successful. For example, the Volkswagen Group (Volkswagen 2001) claimed that 500.000 transactions took place in 2001, and that they are already processing almost the entire procurement with a total volume of €50 billion via marketplace. It comes down to a matter of perspectives: The glass is half full or half empty. In the context of the decrease of the New Economy, 45 % of the B2B marketplaces failed in 2002. Obviously, the other 55 % survived (Sleeper 2003).

The failure of some marketplaces provides opportunities of new roles of intermediaries (Giaglis, Klein and O’Keefe 2002). A significant shift of concepts goes hand in hand with the new economic perspective. Williamson (Williamson 1991) describes a transaction as the occurrence when a good or a service is transferred across a technologically separable interface. We can differentiate the following transaction phases:

- Pre-sale (acquisition, information gathering, marketing, negotiation)
- Sale (contracting, fulfillment)
- After-sale (customer relationship management).

Electronic marketplaces aim to improve business processes. However, there are two aspects to improvement: *quantity* and *quality*.

Transaction-oriented marketplaces primarily focus on *quantity* in terms of time and price. A simple example is that sending a product offer by email is cheaper and quicker than by traditional mailing.

Through the facilitation of transactions by e-Procurement and the optimization of logistic workflows, the process durations can be reduced, e.g., within the marketplace of the Volkswagen Group by 95 % (Volkswagen 2001). Of course, the increased efficiency affects a decrease of prices.

However, *quality* is another aspect to look at. Marketplaces enable providers to offer their products in a better way, e.g., by enhanced usability of a catalogue. Clients have better access to the market, e.g., by retrieval of needed information about product quality and potential benefit, and the possibility to compare products of various providers. Providers cooperate in a distributed business environment in order to aggregate required end product. In order to address these needs, marketplaces include collaboration services.

After the “marketplace hype”, we can observe a shift from exaggerated to realistic expectations concerning market share, and from pure transaction-oriented marketplaces to collaboration platforms (Gogolin 2003), (Klein and Gogolin 2002). Collaboration-oriented marketplaces extend the service portfolio by coordination and integration of inter-organizational processes by “additional service offerings with interaction or collaboration services such as planning capabilities, product life cycle management, capabilities for collaboration around new product design or supply chain support (Gurbaxani and Whang 1991), (Schlüchter 2001), (El Sawy 2003)”(Gogolin and Klein 2004).

The following table provides an overview of transaction- and collaboration-oriented features:

**Tab. 2: Transaction-oriented vs. collaboration-oriented electronic marketplaces (Gogolin and Klein 2004)**

	Electronic marketplace	
	Transaction-oriented	Collaboration-oriented
Platform characteristics	Transaction services, negotiated pricing (catalogues, auctions, exchanges, bidding), spot trading	Collaboration services, planning support (VMI, CPFR) and product life cycle management (coordination and integration of inter-organizational processes and transactions)
Market orientation	Horizontal, vertical	Mainly vertical
Service portfolio	Lean service portfolio, focus on efficient price formation/price discovery and settlement	Broad service portfolio (ranging from data format conversion to virtual project management)
Business functions	Purchasing, procurement, distribution	Not determined, but often supply chain focus
Number of participants	High (necessary for critical mass and market liquidity)	Low – Medium
Membership stability	Dynamic, high fluctuation	Stable
Open for new entrants	Open	Closed (network-specific)

Participant relationship	Arm-length/transactional relationship (“market”)	Co-operative/relational relationship (“network”)
Success factors	Simple access, low entry barriers, back-end integration facilities depending on transaction frequency	Expectation management, asset specificity, lock-in/dependency, trust/commitment among participants

The new trend is a mixed-mode model combining transaction-oriented and collaboration-oriented features (Raisinghani and Hannebeck 2002). Mixed-mode marketplaces have already emerged, e.g., SupplyOn, a marketplace in the automotive industry; this marketplace “provides tools and services for process integration and automation (e.g., a Web-EDI interface, Vendor Managed Inventory, etc.) as well as transaction-oriented features like business directories, product catalogues, support for quotation processes, auctions, etc.” (Gogolin and Klein 2004).

#### **2.4.3. Addressing the GI market’s challenges**

Today’s GI market targets e-commerce and e-business, but just a small percentage of the annual turnover is transacted via the Internet (Fornfeld and Oefinger 2001). Within the new Internet-based businesses, new tools for cooperation emerged, e.g., marketplaces, sell-side solutions, and portals, e.g., InGeoForum (InGeoForum 2000), Geodata Infrastructure North-Rhine-Westphalia (Brox, Kuhn and Bishr 2000), geocommunity (geocommunity 2001), OGETA (OGETA 1999), and [www.GeoMarktplatz.de](http://www.GeoMarktplatz.de) ([www.GeoMarktplatz.de](http://www.GeoMarktplatz.de) 2001). Yet, there are relatively few, and some of them are in a rather conceptual stage. A break-through toward usable and accepted geographically referenced products is still far away.

Currently, the GI market’s approaches in e-commerce and e-business focus on search, order, deliver, and pay geographic data sets via the Internet. It is better to think of them as Internet platforms than as electronic marketplaces. On the demand side, electronic marketplaces are especially promising in fragmented markets with many actors and low transparency (Spiller and Wichmann 2000). This is particularly true for the GI market, because geographic information is relevant and applied by many communities of interests (Abel 1997).

In markets in general, solutions for business-to-business (B2B) electronic marketplaces are more advanced than within the GI market. The failure of many marketplaces in the past years seems to contradict the introduction of electronic marketplaces in the GI market. However, the opposite is the case. Most of the marketplaces in the “marketplace hype” were auctions and bursaries, which are transaction-oriented. A typical (and successful) example of a C2C marketplace is ebay. The products have an almost unlimited variety, from washing machines, books, clothes, watches to stamp collections and motorcycles, but they have one thing in common: Products are ready-to-use. In contrast, geographic data sets often are not products that could be readily accepted by the users, because they are

- Held in formats requiring specialized software
- Too complex to be easily browsed or combined with other information

- Marketed through pricing schemes that reflect production costs rather than value (Krek and Frank 2000).

Can the transfer of electronic marketplace concepts to the GI market improve this situation? The following sub-sections address this question on the three levels of information markets, electronic markets, and electronic marketplaces: Sub-section 2.4.3.1 analyzes if the above identified economic challenges to improve product potentials, to improve value chain structures, and to increase weakly articulated demand by increasing transparency in a fragmented market, will be addressed by the potential added values of information markets according to the added value system of Kuhlen (Kuhlen 1995). Sub-section 2.4.3.2 analyzes of the potential effects of intermediation in an electronic GI market. Then, sub-section 2.4.3.3 analyzes, if electronic GI marketplaces can address the needs of the GI market identified in sections 2.1 - 2.3.

#### **2.4.3.1. Value added by information markets**

Kuhlen (Kuhlen 1995) provides a system of added values in information markets. The following paragraphs will analyze if the potential added value can be applied on an electronic GI market and address the challenges identified above: Improve product potentials, improve value chain structures, and increase weakly articulated demand by increasing transparency of a fragmented market:

The system of Kuhlen (Kuhlen 1995) consists of three added value types:

1. The *product-related informational added values* directly address the need for improving the GI market's product potential. Obviously, electronic markets can provide more information compared to non-electronic markets, e.g., by information that a GI product exists (comparative added value). Even more important is the potential improvement of single components of an electronic product, a service, or an end product, e.g., by adding the possibility of a metadata search on a data collection (inherent added value). The agglomeration of previously separated products, e.g., data provision and data integration, is a key impediment of the GI market (agglomerative added value). The combination of different types of services and products directly addresses the need for information services vs. the provision of geographic data sets (integrative added value).
2. The *organization-related informational added values* address the need of improving value chain structures. The introduction of information and communication systems facilitates the cooperation of GI providers in business networks (organizational added value). On a institutional level, information and communication systems enable a pool of GI providers, from which ad-hoc business networks are established (strategical added value). The establishment of GI business networks facilitates the options for innovative product development and more efficient re-organization of business processes (innovative added value). From the macro-economic perspective, informational work can improve the entire GI market by exploiting its potential (macro-economic added value).
3. The *effect-related individual information added values* cannot directly be matched to the GI market challenge of increasing a weakly articulated demand by increasing transparency of a fragmented market. The increase of demand is on the level of companies. However, it can be argued, that lacking access to the GI market is also a question of individual staff

members, e.g., a bank manager, who is evaluating GI products for bank purposes. By information and communication technologies working processes can be managed quicker, easier, and cheaper, e.g., by using online catalogues of potential data sets (added values increasing efficiency). And working processes can affect better results, e.g., by additional information if a specific data set is appropriate for the bank manager's purposes (added values increasing effectiveness). Usable information and communication systems increase the individual well-being and acceptance, yielding an improved willingness of accessing the GI market via electronic media (esthetical, emotional, and comfort-related added value). In addition, information and communication systems allow different types of information retrieval and information provision, e.g., a GI provider provides his or her product information in the "language" of bank managers (added value by flexibility).

The comparison the added values of electronic markets with the economical challenges of the GI market yield a high matching quota on the product, organization, and individual level, the latter in terms of individual companies. The expected added values of electronic markets directly address the economic challenges of the GI market identified above.

#### **2.4.3.2. Potential effects of intermediation in an electronic GI market**

Giaglis et al. (Giaglis, Klein and O'Keefe 2002) predicted new roles of intermediaries in electronic marketplaces. Based on market functions of Bakos (Bakos 1998), Giaglis et al. analyzed the potential added value of intermediation in traditional market functions, claiming that electronic markets essentially perform the same functions with an increased efficiency and reduced transaction costs. They concluded likely effects of electronic markets on intermediation.

This sub-section uses a similar approach for analyzing the potential added value, and the effects of intermediation in an electronic GI market, basing on the following market functions:

**Tab. 3: Functions of a market (Bakos 1998), (Giaglis, Klein and O'Keefe 2002)**

<b>Primary market functions</b>	<b>Subfunctions</b>
Matching buyers and sellers	<ul style="list-style-type: none"><li>• Determination of product offerings</li><li>• Searching</li><li>• Price discovery</li></ul>
Facilitation of transactions	<ul style="list-style-type: none"><li>• Logistics</li><li>• Settlement</li><li>• Trust</li></ul>
Institutional infrastructure	<ul style="list-style-type: none"><li>• Legal</li><li>• Regulatory</li></ul>

Based on these market functions, the author analyses the potential added value and likely effects of an electronic GI market, taking into account the results of Giaglis et al. (Giaglis, Klein and O'Keefe 2002):

### **Matching buyers and sellers – Determination of product offerings**

In the highly fragmented GI market with a wide range of potential GI applications and usages, GI providers are little aware of the demand for appropriate GI products. The mostly offered geographic data sets do not fulfill the demand. An electronic GI market can create value by a more specifically articulated demand of buyers, enabling sellers to improve the design of product offerings. This directly addresses the above identified economic challenge of improving GI products. A second aspect is the current monolithic value chain structure. Determination of product offerings is not only needed by single companies, but also for establishing business networks, where each company contributes its specific intermediate GI product or service. In an electronic GI market, intermediation can add value by determination of product offering on the individual level of single GI providers, and on the meta-level of business networks, thus addressing the above identified economic challenge of improving value chain structures.

Giaglis et al. claim that a personalization of products and services will lead to disintermediation by direct marketing strategies (Giaglis, Klein and O'Keefe 2002). The author assumes that this can be the case as well for a small part of the GI market, especially in data provision. However, most of the GI products are not ready-to-use; many of them have to be designed on-the-fly according to specific user requirements. In the GI market it is not very likely that sellers can achieve an “a priori” design of product offerings. Therefore, a central role of electronic GI markets is in intermediation of customized GI products.

In the GI market, aggregation and disaggregation of products are two sides of the same coin. Currently, we can observe an aggregation of products, but in terms of monolithic value chains offering a huge range of products from data production to training of employees on a new system. Aggregation is crucial, because – as described in section 2.1 – the GI market is a market of information services. But on a meta-level, the GI market needs disaggregation in terms of unbundling products amongst different roles in the geospatial value chains. Again, the GI market is not in line with the results of Giaglis et al., who assume a cybermediation on product bundling and disintermediation in disaggregation of product components. Due to the challenge of restructuring value chains, in the electronic GI market there is a potential for cybermediation in both.

In the current GI market, the demand for GI products is weakly expressed. Many potential customers do not even know of the potential benefit of GI products. Intermediation by vertical GI marketplaces, for example for the financial services industry, can aggregate the demand. This has two aspects: In line with the results of Giaglis et al., “pooling” of buyers will reduce prices (Giaglis, Klein and O'Keefe 2002). A second aspect is creating awareness for the potential benefits of GI products, thus increasing the number of GI customers. Currently, complex information services mostly are provided by costly projects. Demand aggregation in terms of increasing the number of potential customers and bundling them in vertical marketplaces can be considered a future role of intermediation by GI marketplaces.

### **Matching buyers and sellers – Searching**

Being a highly differentiated market, in the current GI market search costs for appropriate providers and products are high, not to say a potential customer is not able to find the required information at all (see chapter 6). One of the reasons is again, that GI products mostly are not on

stock, but have to be provided ad-hoc according to customers' requirements. From the perspective of sellers, the high variability of GI products makes it difficult to search for potential customers. GI marketplaces have a high potential to add value by improving search in an in-transparent and fragmented market.

Intermediation of GI marketplaces can significantly improve this situation: Providing a single entry point for potential customers eases the search for products and providers. From the sellers' perspective, a single entry point facilitates the search for potential customers.

#### **Matching buyers and sellers – Price discovery**

As will be shown in chapter 6, potential customers of GI market hardly find information about the quality of a demanded GI product. Comparing prices of different providers is unlikely to be managed. In addition, prices for complex information services are too high, mostly provided by costly GI projects performed by monolithic GI providers. Therefore, the potential value added by GI marketplaces is two-folded. First, electronic GI markets can enable price discovery. Second, electronic GI markets can improve pricing schemes.

Intermediation by GI marketplaces firstly can provide mechanisms for price discovery. This enables potential customers to compare costs with the expected benefit of a GI product. But even more important and extending the price discovery function in markets in general, the potential role of GI marketplaces can be a tool for coordinating the entire GI market. The GI market is weakly developed, because pricing mostly does not reflect the expected value of GI products for customers (Krek and Frank 2000). Therefore, intermediation of GI marketplaces can yield the establishment of value-related pricing schemes in the GI market, supported by improvements of product design and restructured value chains.

#### **Facilitation of transactions – Logistics and settlement**

In electronic markets in general, logistics involve warehousing and distribution for products, or licensing, booking and subscriptions for services; potential added value of intermediation can be achieved by economies of scale and scope for logistical operations. In addition, intermediaries facilitate, monitor, and guarantee the settlement transactions (Giaglis, Klein and O'Keefe 2002).

Again, the GI market is not in line with these results due to specific GI market characteristics. Electronically supported intermediation might happen in a small part of the GI market: data provision. Data are on the stock, and in some cases they will be ready-to-use. In this case, a GI marketplace might add value by logistics operations and settlement.

But due to the complexity of most appropriate GI products, it will not be the case for a bigger part of the GI market. A complex information service cannot be distributed and settled via an electronic marketplace, e.g., monitoring the fulfillment of data integration will remain handicraft. Therefore, it can be argued that GI marketplaces can provide added value by intermediation on logistics and settlement of "simple" GI products as data sets. But GI marketplaces will not affect the need for traditional intermediation, e.g., by GI consultants. In contrary, GI marketplaces have the role of supporting the establishment of traditional intermediaries as important roles in geospatial value chains.

In this context the future role of GI marketplaces will depend on two issues:



- Technical improvements in providing automated GI services: The current GI market has started to provide data sets in an automated way. Data sets, or even data set objects and single GI functionalities can be ordered and paid via the Internet. Technical improvements could provide additional options for electronically supported logistics and settlement. For example, a search for *appropriate* geographic information by semantic matching of user requests and product offerings could extend the opportunities for electronically supported intermediation.
- Business model of a GI marketplace: As argued above, traditional intermediaries will not be replaced by electronically supported intermediation of GI marketplaces. To the author it remains an open question if GI marketplaces should jump into the role of traditional intermediaries. On the one hand side, this business opportunity could provide financial benefit to the GI marketplace organization, and controlling of transactions could create trust by GI customers. On the other hand, a GI marketplace would compete with providers of the GI market, thus creating the opposite of trust among the GI providers using the GI marketplace. An approach for bridging these options might be the provision of a regulatory framework (see below), thus controlling business interactions on a meta-level.

#### **Facilitation of transactions - Trust**

Creating trust adds value by guaranteeing to “sellers and buyers the non-opportunistic behavior of other market participants (Giaglis, Klein and O’Keefe 2002)”. In the GI market, creating trust is crucial on two levels:

- GI marketplaces have the potential to unite several business partners of geospatial value chains in business networks. Thus, elsewhere competing companies have to cooperate.
- GI buyers mostly have little knowledge about required GI products and providers. This increases the need for reliable business partners.

In both cases, GI marketplaces have the potential to create trust. A GI marketplace bundles the business partners in a single entry point. Being a neutral third-party, a GI marketplace can control interactions on a meta-level: Marketplace participants, especially sellers, can be selected on the basis of a positive-catalogue of criteria, e.g., ISO 9000 certification. Business partners getting known for malpractices can be excluded. The author assumes that creating trust is mostly depending on creating an appropriate institutional infrastructure.

#### **Institutional infrastructure – Legal and regulatory**

Intermediation can add value by providing “the legal basis for market operation” and providing “mechanisms for the enforcement of legal, ethical, and behavioral rules in markets” (Giaglis, Klein and O’Keefe 2002). In the GI market, legal issues will mostly be settled by existing laws, for example on the European level by the Directive 2001/29/EC of the European Parliament and of the Council of 22 May 2001 on the harmonisation of certain aspects of copyright and related rights in the information society, *OJ L 167*, 22 June 2001, 10, and Directive 2002/58/EC of the European Parliament and of the Council of 12 July 2002 concerning the processing of personal data and the protection of privacy in the electronic communications sector, *OJ L 201*, 31 July 2002, 37. However, there might be value added by political lobbying. In Germany, there is an ongoing

discussion about pricing schemes of tax-funded authoritative geographic data sets. Already ongoing lobbying might result some improvements.

A key issue of GI marketplaces is to provide a regulatory framework for interactions of market participants. As described before, most of complex GI products are performed by individual GI projects. Often, matching buyers and sellers base on personal contacts; each interaction is settled by individual contracts. This yields a high grade of in-transparency and uncertainty about appropriate rules for interactions of business partners. A great variety of possible types of GI products and providers increases this effect. Intermediation of a GI marketplace can provide a standardized and improved regulatory framework, thus enabling more transparent, reliable, more efficient, and smooth interactions between business partners.

The major potential of electronic GI marketplaces lies in restructuring the GI market. As described above, GI marketplaces have a clear focus on matching buyers and sellers. In the GI market, intermediation of matching buyers and sellers extends the potential of improving business processes and finding new roles for intermediaries: GI marketplaces have the potential of establishing new structures in the GI market by improving GI products and value chain structures, and to increase weakly articulated demand by increasing transparency in a fragmented market. Therefore, a regulatory framework for interactions is even more important and has more potential impact on the GI market than on other markets.

#### **2.4.3.3. Potential of mixed-mode electronic marketplaces**

As shown above, purely transaction-oriented marketplace models of the past are not appropriate for the GI market anyway. To the contrary, the GI market actually requires the integration of collaboration-oriented features and can profit by the new approaches in the economy. In the following, we show the potential of mixed-mode marketplaces in addressing the three major needs in the GI market.

##### **1. Providing information services**

There are many GI intermediate products, and their market is fragmented and complex. Although the majority of marketplaces provide goods as books, food, and furniture, services are offered and traded as well, e.g., training, financial services, and knowledge. The marketplaces' capability to aggregate intermediate products to a composed end product is even more important for the GI market than offering a wide range of products (Bakos 1998).

For example, Alta Energy ([www.altra.com](http://www.altra.com)) combines the raw products oil, gas, and power with logistics services for delivery to the customer. Cosinex ([www.cosinex.com](http://www.cosinex.com)) mediates the execution of complex public orders by online invitations to tender, and manages this process according to the public procurement law. GULP ([www.gulp.de](http://www.gulp.de)) is an Internet portal mediating the provision of complete IT projects.

The GI market requires similar offers. GI marketplaces are capable to extend the current provision of data sets by mediating a provision of information services. In analogy to the examples above, GI marketplaces can offer

- Raw products, e.g., data sets

- Human services, e.g., data integration and consulting, or even the provision of a complete GI project
- Organizational services, e.g., a procedure for ordering, pricing, and delivery
- Institutional services, e.g., provision of standards for business processes and products.

Therefore, electronic marketplaces are capable to support overcoming the first identified obstacle in the GI market by mediating the provision of information services.

## **2. Establishment of business networks**

Offering information services is not sufficient. GI marketplaces also have to connect the providers of the geospatial value chains, who are offering them.

In market in general, “collaborative arrangements have developed from monolithic, tightly-coupled supply chains to dynamic, highly integrated value-added networks” (Otto and Waesch 2003). Traditional value chains are changing to new value networks with electronic marketplaces in the center (Baldi and Borgmann 2001b). The trends and solutions in the economy target fulfillment services (Spiller and Wichmann 2000) and collaboration-oriented services (Gogolin and Klein 2004). Therefore, new concepts of non-spatial marketplaces coincide and address the need in the GI market for cooperation of many providers in business networks.

Existing non-spatial marketplaces prove their capability to integrate distributed business partners to business networks, e.g., the Volkswagen Group ([www.vwgroupsupply.com](http://www.vwgroupsupply.com)) in its B2B supplier platform.

In the GI market, business networks still have to be established. Marketplaces have the capability to do so. First, GI marketplaces gather different providers on a single platform. Second, collaboration-oriented services mediate the process of an ad-hoc establishment of business networks.

A good example is public procurement via the Cosinex marketplace ([www.cosinex.com](http://www.cosinex.com)). It mediates a clearly defined process for the provision of a product, e.g., a new primary school. In analogy to Cosinex, a GI marketplace can

- Identify potential providers, who are capable to provide the needed intermediate products, e.g., data sets, data integration, and consulting
- Inform providers about the customer’s request
- Evaluate the providers’ offers according to quality and price
- Contract a business network of providers with best offers, e.g., data provider X, data integrator Y, and GI consultant Z, who commonly provide the required information service.

Consequently, electronic marketplaces are capable to support overcoming the second identified obstacle in the GI market by mediating the communication and cooperation of business networks.

## **3. Customers’ access to product information, products, and providers**

Currently, potential customers of geographic information have no appropriate access to the GI market. Many customers still rely on personal contacts to single companies. Emerging Internet solutions lack sufficient product information and product variety (see section 2.3).

From the providers' perspective, one of the key arguments for competing in a GI marketplace is achieving a critical mass. The same argument from the customers' perspective is a single access point to the GI market. Marketplaces integrate many different products and providers in one hand. The GI market access mediation by a GI marketplace evokes the following advantages:

1. The potential customer has access to a great variety of products and providers.
2. A single access point significantly reduces transaction costs for information retrieval.
3. Cooperation of many providers in a single marketplace reduces costs to a single provider for presenting product and provider information. Consequently, there are more financial resources to present this information in an appropriate and user-friendly way.
4. Competition among providers leads to a higher market transparency, which results in reduced prices and/or higher quality of offered products.
5. The organization running a GI marketplace is able to set up quality standards and perform some control of products and providers. This addresses one of the key success factors of each business: the trust of the potential customer.

Existing non-spatial marketplaces prove their capability to address these requirements. Well-known examples are B2C and C2C marketplaces such as ebay ([www.ebay.de](http://www.ebay.de)) and Amazon ([www.amazon.com](http://www.amazon.com)). B2B marketplaces such as mySAP.com ([www.mysap.com](http://www.mysap.com)) provide many tools for facilitating the access of potential customers: partner index, request for offers, auctions, collaboration services, electronic tendering and reverse auctions, additional services (personalization of UI, language support, branch news, interaction of participants).

Therefore, electronic marketplaces are capable to support overcoming the third identified obstacle in the GI market by mediating the access to a critical mass of products and providers, and assuring sufficient information for deciding whether or not to buy a product. Customers are able to find the required product in a way that results in an increased demand for products.

## 2.5. RELEVANCE OF THE RESEARCH APPROACH

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The thesis approach starts with the observation that the GI market is lagging behind its expected market growth. The GI market needs information services instead of raw geographic data. The author suggests transferring concepts from markets in general to the GI market: business networks, and GI marketplaces as tools for their cooperation and coordination.

The evidence for the relevance of the research approach rests on three arguments:

1. Relevance of the problem
  2. Lack of previous work
  3. Potential of the marketplace idea to solve the problems.
1. *Relevance of the problem:* The relevance of the overall problem that GI is not sold according to its potential, is generally accepted. An analysis of publications support the relevance of this problem, e.g., (Fornefeld and Oefinger 2001), (Frank 1999). In order to make business out of

geographic information, the GI market needs to face its challenges: e-business, process-oriented business models, services, and the GI market's specific requirements.

2. *Lack of previous work:* Previous work has been done in the context of Geospatial Infrastructures, e.g., in Australia, Germany, Netherlands, Portugal, United Kingdom, USA ((ANZLIC 1999), (InGeoForum 2004) (CeGi 2004), (RAVI 1999), (CNIG 2000), (OXERA 1999), (NGDF 1999). Within these infrastructures platforms for information and also sale of geographic information were created. However, some of them are still in a conceptual phase, others did not make a breakthrough. Improvements are due, for example, in the role of coordinating the GI market, and to ease the access of potential users by branch specific marketplaces.

Recent publications improved the idea of marketplaces. The original idea of marketplaces is a mere shop, buying data via Internet. Further research added the idea of services, e.g., (Gaede 1997), (Gabriel and Wagner 2001).

The improvement of our research approach is the shift from ready-made products, mostly data, to building blocks for generating products: intermediate products and services. But not all needed building blocks are ready-made and on stock. The users' requirements of geographically related products are extremely varied; the building blocks have to be adapted, or even created. This requires ad-hoc processes for generating information services and an extended need for cooperation of geospatial value chains.

Other publications focus on specific business aspects, e.g., pricing of geographic information (Krek and Frank 2000). This research is very valuable, but – by definition - does not cover the general problem of not using the potential of GI.

OCG is a protagonist for the realization of services on a technical level. Although the business aspects of a distributed, service-based environment, e.g., the cooperation of geospatial value chains are recognized (Niedzwiadek 1999), solutions are necessary. Other publications focus on the technical and architectural aspects of distributed, service-based environments, e.g., (Abel 1997), (Senkler and Remke 2001). The technical approaches do not neglect, but underestimate the business point of view "Design a business plan first, and then look for technical realizations".

Based on the analysis of previous work, the following GI marketplace ideas of this thesis are improvements of previous work or mainly new:

- Marketplaces for geographic information integrate the ideas of e-business, process-oriented business networks, services, and the specific requirements of the GI market on a conceptual and organizational level in a single model for GI marketplaces.
- GI marketplaces are tools for coordination, communication, and cooperation within the GI market. They can be considered as a middleware in an organizational meaning, to some extent in a technical meaning as well.

- Improvements start with organizational and business concepts; technical solutions are developed for realizing them - not the other way around: “We know intelligent technical solutions; afterwards we will find a market for it”.
  - GI marketplaces integrate automatically generated products and services with additional services. We call the integration of data and technical, human, organizational, and institutional services information service.
  - The building blocks for generating geographically related products (intermediate products and services) are not all ready-made and in stock. They have to be adjusted or even created in ad-hoc business processes.
  - GI marketplaces shift the idea of interoperability from technical to business processes.
  - The future GI market is process-oriented. This requires business networks, where providers, producers, integrators, and consultants with specific core competences cooperate in order to generate the information service tailored to the users’ needs.
  - Branch-specific vertical marketplaces provide access to geographically related products and its’ providers for specific branches.
3. *Potential of the marketplace idea to address these problems:* Sections 2.1 - 2.3 identified three key obstacles in the current GI market. Section 2.4 has evidenced that the GI marketplace model has the potential of solving the addressed obstacles in the GI market.

## 2.6. SUMMARY AND DISCUSSION OF RESULTS OF PART B

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Part B addressed the first research question of this thesis: *Are electronic marketplaces tools for improving the turnover of the GI market?*

The methodological approach addressing this research question included three major steps:

- Identification of current GI market obstacles
- Evaluation of the potential of existing electronic market and marketplace solutions to address these obstacles
- Evaluation of the relevance of the research approach.

The first identified obstacle in the GI market is providing geographic data sets. This observation and its impediment was evidenced by literature search (e.g., (Frank 1999), (Krek 2003)) and a preliminary evaluation of existing GI marketplaces. Experiences from many ongoing GI projects, observed or joined by the author, provided further evidence for the fact that data alone are not accepted products in the market.

In the economy, the proliferation of aggregated products is obvious, e.g., building a house or constructing a car. A general and increasing trend is the process-oriented proliferation of aggregated products (Malone and Laubacher 1999). Further research of the author evidenced the need for information services, e.g., by calculating the costs shares of a typical GI product less than 10 % for data and more than 90% for additional human services (Brox and Kuhn 2004).

A consequence of the proliferation of aggregated information services is the cooperation of several providers for their composition. The disadvantages of monolithic business models were discussed and evidenced the need for new business models. In the economy, inter-organizational relationships and cooperation create value (Barringer and Harrison 2000). The cooperation of business partners in networks is obvious even in every day life, e.g., chicken growers, chicken feed dealers, chicken slaughterhouses, chicken fast food franchise and many others cooperate to serve chicken (see Fig. 3: The Fried Chicken Story (by OGC, 2001)). The need for enhanced business cooperation on the GI market was evidenced by literature search, e.g., (Gisform 2002), and research by the author in the context of the conception of a business model of a North-Rhine-Westphalian geospatial infrastructure business model (Brox, Kuhn and Bishr 2000), (Brox and Kuhn 2002).

Literature search of trends and solutions in markets in general, and an analysis of their potential for improving the GI market was performed on three levels:

- Information markets
- Electronic markets
- Electronic marketplaces.

Using the system of Kuhlen (Kuhlen 1995) of potential values added by information markets yielded a matching quota with addressing the economic challenges of the GI market. The *product-related informational added values* directly address the need for improving the GI market's product potential. The *organization-related informational added values* address the need of improving value chain structures. The *effect-related individual information added values* can be matched to the GI market challenge of increasing a weakly articulated demand by increasing transparency of a fragmented market. To the author the most interesting aspect is the potential for organization-related informational added values. On the meta-level of information markets, Kuhlen sees a potential for organizational, strategical, innovative, and macro-economic added value. This coincidence with the author's point of view that GI marketplace are not only capable to shift existing business to the "electronic age", but also to restructure the entire GI market. Also Bakos claims that market processes "create economic value for buyers, sellers, market intermediaries, and for society at large (Bakos 1998)".

The potential of restructuring the GI market was also observed on the level of electronic markets. Based on the market functions of Bakos (Bakos 1998), the author used a similar approach as Giaglis et al. (Giaglis, Klein and O'Keefe 2002) for analyzing the potential added value, and the effects of intermediation in an electronic GI market. The outcome was that the potential added value of intermediation in an electronic GI market and consequently the role of GI marketplaces in

- Matching buyers and sellers is high,
- Facilitation of transactions in terms of logistics and settlement is rather low or addressing traditional intermediation,
- Facilitation of transactions in terms of creating trust, and in providing an institutional infrastructure, is high.

Again, we could observe the potentially added value of GI marketplaces not only in transferring traditional intermediation to electronic intermediation. Electronic GI markets also have the

potential to address the economic challenges for the GI market to improve GI products and value chain structures, and to increase transparency in a fragmented market. Therefore, GI marketplaces have the capability to be a coordination tool on the macro-economic level.

The general trend from transaction-oriented marketplace models towards collaboration services coincides with and addresses the needs of the GI market. The evaluation of marketplace models (Gogolin, Brox and Klein 2005) and the evaluation of existing spatial and non-spatial marketplaces (see also section 3.1) proved the existence of mechanisms addressing the identified obstacles in the GI market and their potential to support overcoming them.

Overcoming the current obstacles means improving the GI market. Therefore, the answer to the research question is yes: Electronic marketplaces are capable of improving the turnover of the GI market.

The evaluation of the relevance of the research approach implies the relevance of the problem. It is common sense in the GI community that GI lags behind its potential. This common sense is supported by market studies, e.g., (Fornefeld, Oefinger and Rausch 2003) and other literature, e.g., (Frank 1999).

There is a lot of published research on electronic marketplaces in markets in general, but very few authors combine the topics of GI market and electronic marketplaces. Apart from a few limited approaches, e.g., (Gaede 1997), (Gaede 1998), (Gabriel and Wagner 2001), no detailed and comprehensive research on this topic is known to the author.

Therefore, the research fulfils the three criteria for its relevance: Relevance of the problem, lack of previous work, and the above discussed potential of the marketplace idea to solve address these problems.



## **PART C: DESIGN OF GI MARKETPLACES**

Addressing the identified needs of the GI market forms the principle guidelines for the design of GI marketplaces. Based on the achieved results, part C addresses the following questions:

- What is an appropriate organizational and institutional framework for GI Marketplaces (chapter 3)?
- What are services to be provided by a GI Marketplace (chapter 4)?

### 3. INSTITUTIONAL AND ORGANIZATIONAL FRAMEWORK FOR GI MARKETPLACES

Over the last few years the Internet has achieved a critical mass that makes an external co-ordination of activities in distributed environments much more efficient than a centralized co-ordination (Merz 1999). This lead to Internet-based solutions for distributed e-business. In the economy, solutions for e-business are more advanced than within the GI market. This chapter transfers existing marketplace concepts to GI marketplaces.

The approach used is to analyze and compare existing non-spatial and spatial marketplaces and discuss them keeping in mind the key needs of the GI market identified in the previous chapter. From these findings, the design of the institutional and organizational framework of GI marketplaces is derived. The non-spatial marketplace selection targets an overview of different types of marketplaces. Due to few existing spatial marketplaces, the selection also provides Internet platforms similar to marketplaces or even in a conceptual phase. The analysis is supported by literature and Internet search evaluating existing marketplaces.

Section 3.1 provides an overview of selected spatial and non-spatial Internet-based platforms. The derived key findings define the institutional and organizational framework of GI marketplaces:

- Type of products traded (section 3.2)
- Type of GI marketplaces (section 3.3)
- Players of GI marketplaces (section 3.4)
- Horizontal and vertical GI marketplaces (section 3.5)
- Open market and standards (section 3.6).

#### 3.1. SPATIAL AND NON-SPATIAL INTERNET PLATFORMS

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The following Internet-based solutions form the basis of this approach:

**Tab. 4: Evaluated marketplaces, portals, and sell-side solutions**

Marketplace	Link	Characteristics
<i>Non-spatial</i>		
Altra Energy, US	<a href="http://www.altra.com">http://www.altra.com</a>	Energy marketing and trading, operates Altrade marketplace, bursary to trade gas, oil, and power, services include deal capture, monitoring, physical scheduling, and reconciliation of completed transactions, more than 7.000 users worldwide (not accessible in Dec 2004)
Amazon, UK, Germany	<a href="http://www.amazon.com">http://www.amazon.com</a>	B2C marketplace, leading Internet platform for books, DVD, etc., C2C services (used books)
Atradapro.de, Germany	<a href="http://www.atradapro.de">http://www.atradapro.de</a>	Trading services, e.g., in consulting, IT, marketing and advertisement, real-estate management, logistics; ~ 150.000 entries
BizWiz, US	<a href="http://clickit.com">http://clickit.com</a>	Horizontal B2B marketplace targeting a

Marketplace	Link	Characteristics
		very broad range of branches and business (e.g., finance industry, purchasing, manufacturing, human resources, legal issues, office supplies, travel, real estate), 300.000 companies in 186 industries worldwide
Chemplorer, Germany	<a href="http://www.cc-chemplorer.com/ccp/controller.do">http://www.cc-chemplorer.com/ccp/controller.do</a>	Chemical industry, e-procurement of goods and services (MRO, maintenance, repair and operations), transactions between enterprises and suppliers, ~ 15.000 transactions per week, SAP-certified
Cosinex, Germany	<a href="http://www.cosinex.com">http://www.cosinex.com</a>	E-Procurement according to public procurement law for public authorities, online public invitations to tender and its processing management, aggregated products, content management, processing workflows, contracting, reverse auctions, matching of enterprises and suppliers, consulting
eBay, Germany	<a href="http://www.ebay.de/">http://www.ebay.de/</a>	C2C and B2C auctions
Gem <sup>TM</sup> (the Government Electronic Market), Australia	<a href="http://www.gem.wa.gov.au/Gem">http://www.gem.wa.gov.au/Gem</a>	E-procurement tool of Western Australian government, services: purchasing of low-value goods, tendering for high-value goods and services (bulletin board), and contract management tool
GULP, Germany	<a href="http://www.gulp.de/">http://www.gulp.de/</a>	Portal for IT projects, mediates personnel and service providers, more than 17.000 equivalent to 70% of freelancing IT professionals are integrated
Intoko, Germany	<a href="http://www.intoko.de/">http://www.intoko.de/</a>	C2C marketplace, adverts for all types of products, auctions or fixed prices
mySAP.com, SAP Service Marketplace, Germany	<a href="https://websmp104.sap-ag.de/~SAPIDP/002006825000000234912001E">https://websmp104.sap-ag.de/~SAPIDP/002006825000000234912001E</a>	Provider of marketplace solutions as well as running a marketplace itself, very broad service portfolio: partner index, request for offers, auctions, collaboration services, electronic tendering and reverse auctions, additional services (personalization of UI, language support, branch news, interaction of participants), partnerships e.g., with Andersen Consulting, Hewlett-Packard, IBM, KPMG, Sun Microsystems
SupplyOn, Germany	<a href="http://www.supplyon.de/gen_roo_t_de.html">http://www.supplyon.de/gen_roo_t_de.html</a>	Provider of marketplace solutions for the automotive industry, transactions between enterprises and suppliers, service portfolio supports working processes by consulting, supply chain management, collaborative engineering, and quality management
Volkswagen, Germany	<a href="http://www.vwgroupsupply.com/en/">http://www.vwgroupsupply.com/en/</a>	Suppliers of Volkswagen Group, VW manages nearly all procurement volume of more than € 50 billion via the B2B supplier platform, transaction and collaboration services, more than 550.000 transactions per year, partner of SupplyOn

Marketplace	Link	Characteristics
ZDI Industrieverbund, Germany	<a href="http://www.zdi.de/">http://www.zdi.de/</a>	70 SMEs of food industry, e-procurement of raw products, annual turnover 6.5 Bio. €
(see also market study “B2B marketplaces in Germany”)		(Spiller and Wichmann 2000)
<b>Spatial</b>		
CeGi GEOcatalog, Germany	<a href="http://www.geocatalog.de">http://www.geocatalog.de</a>	Portal to geodata , e.g., orthophotos, geoservices, e.g., web-mapping, geo-resources, OGC- and ISO-conformant metadata, run by SDI initiative CeGi
Geography Network, US	<a href="http://www.geographynetwork.com/">http://www.geographynetwork.com/</a>	Portal to worldwide geographic data and maps as well as to web services and applications, ESRI-based
GEODIS, Germany	<a href="http://www.lv-bw.de">http://www.lv-bw.de</a>	Sell-side solution of Surveying Authority (Baden-Württemberg), sale of geographic data and maps, based on Intergraph technology
Geoware, Germany	<a href="http://www.geomarktplatz.de/">http://www.geomarktplatz.de/</a>	Marketplace for geographic data and GI services, not accessible in Dec 2004
Gisbizz, Germany	<a href="http://www.gisbizz.de/">http://www.gisbizz.de/</a>	Portal for geographic data, fields of navigation, geomarketing, and real-estate, supported by ESRI partners
Inframation, Germany	<a href="http://www.geoport.de">http://www.geoport.de</a>	Portal focusing on real estate appraisal, supported by geographic information, search results online and by call-center (pre-defined products)
InGeoIC, Germany	<a href="http://www.ingeoic.de/">http://www.ingeoic.de/</a>	Portal for geographic data and GI providers, initiated by SDI initiative InGeoForum, OGC- and ISO-conformant metadata,
OGETA, US	<a href="http://www.ogeta.us">http://www.ogeta.us</a>	SDI initiative for the Greater Atlanta Metropolitan area, targets the access to geographic data by data repository, rather conceptual stage
On-geo, Germany	<a href="http://www.on-geo.de/">http://www.on-geo.de/</a>	Vertical platform for the real-estate branch, apart from geodata, specific data and services for site analysis for real estate appraisal
RAVI, Netherlands	<a href="http://www.euronet.nl/users/ravi/folbpfen.html">http://www.euronet.nl/users/ravi/folbpfen.html</a>	Run by council of governmental and public bodies (independent and neutral status), business platform for real estate and geographical information, services target lobbying for GI, discussion and information, knowledge-transfer, networking
Terramapsrerver, Germany	<a href="http://www.terramapsrerver.de/">http://www.terramapsrerver.de/</a>	Trading orthophotos, 3D geographic data, maps, geomarketing data, navigation data, viewing and delivery services
see also: Geospatial Data Infrastructure North-Rhine-Westphalia, Germany	<a href="http://gdi-nrw.uni-muenster.de/gdi-referenzmodell.html">http://gdi-nrw.uni-muenster.de/gdi-referenzmodell.html</a>	Concepts for a GI marketplace in North Rhine Westphalia, (Kuhn, Basedow, Brox et al. 2000), (Brox, Bishr, Senkler et al. 2002)

One of the success factors is the content of a marketplace (Arndt 2002). The non-spatial marketplaces have two main strategies to match the content with the user requirements: product diversity or high business value.

Ebay, Intoko, and BizWiz provide a broad range of products, assuming that everybody will find something. Also branch-specific marketplaces, e.g., Amazon and Atradapro deal with a broad offer of products within the branch. Altra Energy and Chemplorer trade valuable goods in prosperous branches. Some marketplaces combine both strategies, e.g., Volkswagen executes more than 550.000 transactions per year with a turnover of almost €50 billion.

A second success factor is achieving a critical mass (Arndt 2002). Providing required contents (see above) is the basis for this. But there is an additional strategy of non-spatial marketplaces: creating dependencies. The “soft version” is to achieve a leading market position, e.g., ebay, Amazon, and GULP, which integrates approximately 70% German IT freelancers. The “hard version” can be observed in the automotive industry. Volkswagen, SAP, and Gem use their positions for pushing their suppliers into their own marketplace. This strategy also works with SMEs: ZDI is a group of 70 SMEs in the food industry, commonly achieving a market volume of €6.5 billion per year, which is in the range of one of the branch leaders Nestlé (Sperling 2003).

A further observation, which the author assumes is a third success factor, is a trend of non-spatial marketplaces supporting their users. Most of us know ebay and its easy-to-handle searching, offering, and buying functions. For business customers, support also means saving money. Marketplaces try to integrate their functionalities into the business workflows of their customers, e.g., Altra Energy, Cosinex, Gem, SAP, and Volkswagen offer support tools for content management, tendering, supply chain management, collaborative services, process management, contract management, and additional services.

It is difficult to judge existing spatial marketplaces according to their success, because they will not provide numbers of transactions, participants, and turnover as the non-spatial marketplaces do. But just a small percentage of the GI market turnover is currently transacted via the Internet (Fornefeld and Oefinger 2001).

The spatial marketplaces are less advanced, starting with the observation that most of them are not marketplaces but portals (e.g., InGeoIC, CeGi, Ravi, and Gisbizz) or sell-side solutions (terramapserver). There are few services for supporting the access and transaction of potential users (see section 2.3).

However, new strategies are emerging. For example, on-geo, Inframation, and Gisbizz are focusing on specific branches (financial service providers, geomarketing, and real estate). In addition, on-geo offers ready-to-use search results of real estate objects, which according to the definition in this thesis can be considered as information services.

The following sections analyze the characteristics of the marketplaces according to their capability to address the key obstacles in the current GI market. In addition, these marketplaces are evaluated taking into consideration our experience with the user and business requirements within the Data Infrastructure North-Rhine-Westphalia (GDI)” (Kuhn, Basedow, Brox et al. 2000), (Brox, Bishr, Senkler et al. 2002).

### **3.2. TYPE OF TRADED PRODUCTS**

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Non-spatial marketplaces often sell products that are ready-to-use, e.g., Amazon sells books. Geographic information is different from products like books. Geographic information, to be successful in the market, has to be offered as information services consisting of data and services (see section 2.1). Usually such information services are not in stock but have to be generated on demand by human, technical, organizational, and institutional services of various players in the GI market.

Non-spatial marketplaces show the capability of trading services, e.g., Atradapro, Gem, and SAP, or even IT projects, e.g. GULP. Most similar to the aggregation of intermediate products to information services is the public invitation to tender by Cosinex: intermediate products and services from different suppliers are aggregated to a common end product.

On-geo addresses this requirement of aggregated products by specializing in real estate objects. Although this approach might be successful in the market, it is too specific to link the financial service providing industry to the GI market. However, a key design feature of GI marketplaces is the capability to trade information services.

### **3.3. TYPE OF GI MARKETPLACES**

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The term marketplace is used in different ways; some Internet sites call themselves marketplaces, although they should be considered portals or sell-side solutions instead. This thesis uses the terminology of (Spiller and Wichmann 2000):

- In contrast to sell-side solutions, a marketplace includes many, also competing providers.
- In contrast to extranets of big companies (buy-side solutions), a marketplace includes many potential customers.
- In contrast to portals, a marketplace offers Internet-based transactions between users and providers.
- In contrast to C2C (consumer-to-consumer) marketplaces, e.g., eBay, B2B (business-to-business) marketplaces focus on the interaction of business entrepreneurs. In this context, we consider governmental organizations as business entrepreneurs, because they provide key products in the GI market.

The analysis of potential GI market customers proved for the necessity of addressing business customers, e.g., banks and insurance companies, public authorities, energy providers, and traffic/telecommunication industry. Consumers are not a promising target group for the GI market (Fornfeld and Oefinger 2001). Consequently, GI marketplaces have to be B2B marketplaces instead of B2C or C2C.

The focus of non-spatial marketplaces is shifting from mostly sell-side solutions and buy-side solutions of single companies to the selling and buying of goods via B2B marketplaces (Berlecon\_Research 2000). Boosting the GI market requires the cooperation of business networks (see section 2.2). Consequently, the GI market requires the marketplace model with an n:n relationship of various providers.

As described above, existing non-spatial marketplaces trade products that are ready-to-use. Consequently, many non-spatial marketplaces provide the following transaction mechanisms (Spiller and Wichmann 2000):

- Catalogue-based services
- Auctions
- Black boards
- Bursaries.

Due to the need for need for an ad-hoc integration of several intermediate products to information services, these types of marketplaces are not appropriate for the GI market. The B2B marketplaces of the GI market require collaboration-oriented concepts in order to meet the need for information services (see sub-section 2.4.2), because the aggregation of information services essentially needs the collaboration of several business partners.

Summarized, there are four design features for the GI marketplace type:

- Marketplace instead of sell-side solution, extranet, and portal
- B2B instead of B2C or C2C
- Mixed-mode model of transaction- and collaboration-orientation instead of pure transaction-orientation
- N:n-relationship of many GI providers and many business customers.

### **3.4. PLAYERS OF GI MARKETPLACES**

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This section describes players in the sense of organizations establishing and running GI marketplaces as well as in the sense of marketplace users.

#### **3.4.1. Entrepreneurs of GI Marketplaces**

Looking at the non-spatial marketplaces, there are two types of entrepreneurs: Marketplaces like Volkswagen, Gem, and SAP act as a single company with specific interests. Other marketplaces, e.g., Chemplorer, and GULP act as a group of companies and represent the interests of the market segment. Existing spatial marketplaces focus, with few exceptions on the second type of entrepreneurs. For example, in Germany InGeoIC and GEOcatalog are run by Spatial Data Infrastructure (SDI) initiatives (InGeoForum and CeGi).

The “GSDI Cookbook” defines an “SDI as more than a single data set or database”; “an SDI facilitates the conveyance of virtually unlimited packages of geographic information” (Nebert 2000). Apart from rather technical issues, e.g., metadata access and software applications, conveyance require an organizational framework for improving GI business. From an economic and social point of view, Nation and regional SDIs (NSDIs) have a key role to play in realizing vertical electronic GI marketplaces, supporting the needs of potent sectors, and providing simple interfaces to interconnect such marketplaces across national as well as regional borders.

One mission of SDIs is to improve the GI market. This mission represents a substantial, long-term research challenge addressing key societal and economic needs (Sen, Brox and Kuhn 2004):

- Addressing some of the biggest problems in society, such as communicable diseases, malnutrition, water supply, climate change, and migration, requires geospatial information integrated across scales as well as disciplinary, cultural, and technological differences.
- Geographic information is a potentially valuable resource for economy. From the SDIs point of view, two sides of the same coin are crucial: SDIs are often driven by governmental surveying agencies. Their core interest is to market and sell their core products: data. In order to achieve this goal, SDIs have to create a market for data.

SDIs typically have the capability to achieve a critical mass of GI providers and customers. A second characteristic of SDIs is that they are non-profit organizations. The author considers the non-profit business model to be a “must”: First, the GI market needs an input of resources in order to get started rather than being profitable for a marketplace entrepreneur (see chapter 9). Second, a non-profit organization affects trust towards the potential users of the GI marketplace.

A comparison between the German SDIs of InGeoForum and CeGi shows the difference. InGeoForum is an independent organization, while CeGi is driven by the North-Rhine-Westphalian Surveying Authority as a key stake-holder; CeGi is owned by a consortium of companies. This might cause a significant problem: A consortium of some GI companies does not represent the interests of the entire GI market. Therefore, it might lead to a lack of trust, a reduced willingness for participation in a common marketplace, and it might not achieve the critical mass for improving the entire GI market. Therefore, the institutional framework of InGeoForum can be considered the more promising concept for a GI marketplace entrepreneur: The GI marketplace is an independent, neutral organization, which is open to cooperation of various players and competitors of the GI market.

In principle, companies could also run a GI marketplace. If a data provider strictly adheres to its role, the GI marketplace can be the independent, neutral and non-profit oriented – apart from the entrepreneur’s own role as a data provider. Subsequent roles of the geospatial value chains, e.g., data integrators, software developers, and GI consultants, would not compete with the entrepreneur of the GI marketplace. The financial benefit of a data provider investing in a non-profit GI marketplace is the return of investments by increasing the GI market volume, and thus increasing the use and sale of geographic data. In the starting phase of the North-Rhine-Westphalian SDI initiative GDI the North-Rhine-Westphalian Surveying Authority chose this path, although left it again with the establishment of CeGi.

### **3.4.2. Users of GI Marketplaces**

The essence of B2B marketplaces – spatial or non-spatial – is the cooperation of business entrepreneurs. The following players will use GI marketplaces:

- Sellers of GI products, business and government
- Buyers of GI products
  - Buyers of intermediate products for further refining and finishing within the geospatial value chains, business and government



- Buyers of end products (end users), business and government (e.g. insurance companies, banks, telecommunication).

The consumers, e.g., people using a car navigation system, are targeted indirectly by enabling the geospatial value chains to serve them. For specific reasons, e.g., marketing initiatives, it might be useful to add services directly targeted to consumers. For this, the author describes additional services of a GI marketplace (see section 4.4).

### **3.5. HORIZONTAL AND VERTICAL MARKETPLACES**

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Two types of B2B marketplaces can be differentiated (Spiller and Wichmann 2000):

- Horizontal marketplaces target the requirements of several sectors. They are completeness-oriented.
- Vertical marketplaces target the requirements of a specific sector. They are community-oriented and are based on a deep knowledge of the specific sector.

Markets in general provide a wide range of horizontal marketplaces (Atradapro, BizWiz, ebay, Intoko) as well as vertical marketplaces, which are branch-specific (Chemplorer, Altra Energy, Cosinex, GULP, ZDI) or even company-specific (Volkswagen, Gem, SAP).

We can observe both approaches in the GI market:

- Few marketplaces focus on several branches (Gisbizz, terramapserver) or a single branch (on-geo). Our experience with project partners, e.g., insurance companies or planning agencies, continues to show that geographic information is often needed but cannot be used. Business partners such as insurance companies, banks, telecommunication companies, or public utility organizations are not experts in geographic information. Therefore, a holistic-oriented horizontal marketplace will not match the requirements of the non-GI-business partners. They require vertical marketplaces for geographic information, where their language is spoken and where insight knowledge and sector-specific solutions will be provided.
- Currently, most of the existing spatial marketplaces are horizontal: CeGi GEOcatalog, Geography Network, GEODIS, Geoware, InGeoIC, OGETA, and RAVI. They reflect the idea that potentially most branches of markets in general could use geographic information as a valuable resource, and the need of a framework that connects all players of the fragmented market. These initiatives are essential for the cooperation of base product providers, which cover the general requirements of a wider market, e.g., geographic base data, essential software tools for selection or presentation of geographic data, or metadata server.

Fornfeld and Oefinger (Fornfeld and Oefinger 2001) support the vertical marketplace model by identifying specific target groups for boosting the GI market. On the other hand, (Fornfeld and Oefinger 2001) name a great number of specific branches, which hardly can be served by a specific vertical marketplace each because of a lack of critical mass. In the author's opinion, it is necessary to focus on branches with a large demand for and use of geographic information, especially as a short-term strategy. Nevertheless, the author suggests covering the horizontal demand as well. A promising model might be the one of Gisbizz and terramapserver, addressing several specific branches.

### **3.6. OPEN MARKET AND STANDARDS**

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The GI market is a young and growing market. A key success factor for the GI market will be achieving a critical mass. Consequently, GI marketplaces have to be open for new providers and new products. Within the GI market connected value chains for the generation of information services are missing, more so than in private industry. It will be crucial to integrate a critical mass of providers within the marketplaces for geographic information. Therefore, the impediments for new providers entering the GI market and participating with the marketplaces have to be kept as low as possible (Merz 1999), furthermore, the integration of new providers and new products has to be actively facilitated.

An open market corresponds with the need for standards, e.g., technical agreements, and rules, e.g., legal regulations about offering products within marketplaces. Standards constitute networks of users form the framework for their business processes (König and Weitzel 2003). Technical standards, e.g., OGC and ISO, are crucial for the GI market. However, standards might have some undesirable effects: They improve the efficiency of inter-organizational solutions, but decrease the flexibility (Voigtmann and Zeller 2003).

On the business level, the Cosinex marketplace is an advanced example for business process standards, which even implements public procurement law for public authorities. Too few standards and rules will not allow for a successful cooperation of providers and providers or providers and customers. Too high a degree of standards and rules will increase the costs and the organizational efforts for the business within a GI marketplace and could prevent the integration of new, innovative companies and products (Merz 1999). The challenge is to keep the balance between

- Providing mechanisms and standards in order to stimulate the market
- Avoiding over-regulation, stimulating the self-organization of the individual players, and keeping the infrastructure of co-ordination open to new products and providers (Merz 1999).

## 4. SERVICES PROVIDED BY GI MARKETPLACES

The definition of a marketplace is given by the services it offers (Brox and Kuhn 2001). Again the method is to transfer existing concepts to GI marketplaces. In this case, the thesis uses the method of metaphorical design, which is described in section 4.1. Successful mechanisms of the Münster weekend market are transferred to the design of GI marketplace services (section 4.2). From this list of services, categories of GI marketplace services are derived (section 4.3), followed by a detailed list of mandatory and optional GI marketplace services (section 4.4). This provides the basis for the (re)-design of a specific marketplace for geographic information, which addresses the validation process. This chapter closes with a summary and discussion of results of part C “Design of GI marketplaces” (section 4.5).

### 4.1. THE IDEA OF METAPHORICAL DESIGNS

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Metaphorical design is a method to transfer mechanisms of a source system into the context of a similar working target system. In linguistics, a metaphor can be defined as a concept from one linguistic category (the source) used about a phenomenon normally referred to by concepts from a different linguistic category (the target) (Madson 1994).

Moreover, metaphors are not only rhetorical flourish, but partially structure our everyday concepts (Lakoff and Johnson 1980). The following example “gives an idea what it could mean for a concept to be metaphorical and for such a concept to structure an everyday activity” (p. 4): It starts with the concept “love” and the conceptual metaphor “love is war” (p. 49).

#### “LOVE IS WAR

He is known for his many rapid *conquests*. She *fought for* him, but his mistress *won out*. He *fled from* her *advances*. She *pursued* him *relentlessly*. He is slowly *gaining ground* with her. He *won* her hand in marriage. He *overpowered* her. She is *besieged* by suitors. He has to *fend them off*. He *enlisted the aid* of her friends. He *made an ally* of her mother. Theirs is a *misalliance* if I’ve ever seen one.”

Lakoff and Johnson (Lakoff and Johnson 1980) argue that human thought processes are largely metaphorical.

Copying from nature (bionics) led to a new design of the wing tips of the Airbus A 320. Engineers used the red kite (*Milvus milvus*) as a model. Even nature itself uses this strategy, e.g., the tested arrangement of fins is transferred from the “system fish” to the “system mammals”: dolphins adapt this form following the function of swimming.

Metaphorical design has been established for the development of user interfaces. Metaphors of well-known user conceptions are transferred to a computer system (Carroll, Mack and Kellogg 1988). A popular example is the desktop metaphor of Microsoft, which creates a more usable design of Office products.

A GI marketplace is a new and complex concept. Therefore, the author chose the method of metaphorical design as a method of thinking and a method to enhance completeness of conceptual

design. The weekend market in Münster, Germany, is an appropriate model - weekend markets have been functioning for centuries. And they are well known to everybody.

The goal is to derive categories of services that GI marketplaces need to provide as well as the detailed services. There is no expectation of transferring all items of the Münster weekend marketplace to GI marketplaces. To the contrary, the mismatches can be the most valuable results.

#### **4.2. TRANSFER FROM A WEEKEND MARKETPLACE TO GI MARKETPLACES**

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The following table evaluates the actors, and actions and interactions on the Münster weekend market, and transfers the metaphorical concept to GI marketplaces:

**Tab. 5: Actors, their actions and interactions on Münster weekend market and GI marketplaces**

<b>Actions/interactions on Münster weekend market</b>	<b>Actions/interactions on GI marketplaces</b>
<b>Organizer: City of Münster</b>	<b>Infrastructure provider</b>
Concept and creation	Business plan and realization
Selection of providers	Selection of providers
Organization of place	Providing technical infrastructure
Providing an attractive place (central, beautiful surrounding)	Providing an attractive user interface
Standards for offered products	Definition of standards for offered products
Quality standards	Definition of quality standards
Marketplace rules	Definition of marketplace rules, business model
Division of marketplace into segments, e.g., cheese row, meat row, bread row, vegetable row, etc.; provides a quick overview of providers	Providing horizontal and vertical marketplaces; Information about branches and providers
Marketplace controlling	Marketplace controlling
Marketing	Marketing
Providing information for providers and clients	Providing information for providers and users
Creation of synergy effects, e.g., the weekend market on Saturdays in combination with flea market, extended opening hours of shops, and city festivals attract more clients than the respective single events	Creation of a critical mass by making a competent business network accessible to GI users
<b>Farmer</b>	<b>Data producer</b>
Production of vegetables, meat, fruits, etc.	Data production

<b>Actions/interactions on Münster weekend market</b>	<b>Actions/interactions on GI marketplaces</b>
Sale of products	Sale of products
Presentation of products in an appealing manner, market booster	Providing an easy access to products, and marketing
Payment of marketplace fees	Payment of marketplace fees, business model
Comparison and adjustment of products and prices, market observation	Comparison and adjustment of products and prices, market observation
Communication with other providers, e.g., information exchange about products, clients' behavior, and business opportunities	Communication with other providers, e.g., information exchange about products, clients' behavior, and business opportunities by yellow pages, information site, discussion forum
Communication with clients	Communication with business users
Promotion of additional products	Promotions of additional products (cross selling)
<b>Dealer (e.g., for tropical fruits and vegetables)</b>	<b>Broker</b>
Finding and buying cheap goods	Finding, possibly buying data, software, and services
Offer and sale of goods	Offer and sale of goods
Addressing foreigners by providing their respective hometown foodstuffs	Provision of services for international users, e.g., English sites
Market boosting, market barker	Marketing
Payment of marketplace fees	Payment of marketplace fees, business model
Comparison and adjustment of products and prices, market observation	Comparison and adjustment of products and prices, market observation
Communication with other providers, e.g., information exchange about products, clients' behavior, and business opportunities	Communication with other providers, e.g., information exchange about products, clients' behavior, and business opportunities by yellow pages, information site, discussion forum
Communication with clients	Communication with business users, e.g., discussion forum
Promotion of additional products	Promotions of additional products (cross selling)
<b>Snack bar owner on the weekend market</b>	<b>Integrator</b>
Buying vegetables, bread, meat, etc., at the market	Buying raw materials (data, software, services) from the GI marketplace
Feedback on price and quality of farmers' and	Feedback on price and quality of data producers'

<b>Actions/interactions on Münster weekend market</b>	<b>Actions/interactions on GI marketplaces</b>
dealers' products	and brokers' products/services
Offer and sale of meals including services like serving the meal, and cleaning dishes	Offer and sale of data, software, and additional services
Market boosting, market barker	Marketing
Payment of marketplace fees	Payment of marketplace fees, business model
Comparison and adjustment of prices, market observation	Comparison and adjustment of prices, market observation
Communication with other providers, e.g., information exchange about products, clients' behavior, and business opportunities	Communication with other providers, e.g., information exchange about products, clients' behavior, and business opportunities
Communication with clients	Communication with business users
Promotion of additional products	Promotions of additional products (cross selling)
<b>Tool provider (e.g., farming and retailing tools)</b>	<b>Software provider</b>
Production of tools	Software development
Offer and sale of tools	Offer and sale of software
Market boosting, market barker	Marketing
Payment of marketplace fees	Payment of marketplace fees, business model
Comparison and adjustment of products and prices, market observation	Comparison and adjustment of products and prices, market observation
Communication with other providers, e.g., information exchange about products, clients' behavior, and business opportunities	Communication with other providers, e.g., information exchange about products, clients' behavior, and business opportunities
Communication with clients	Communication with business users
Promotion of additional products	Promotions of additional products (cross selling)
<b>Aunt Martha</b>	<b>Customer (end-user)</b>
Search of products, information about products, comparison of prices and quality	Search of products, information about products, providing metadata
Ordering, buying, and paying products	Ordering, buying, and paying GI products
Negotiating prices	Price negotiation
Feedback on products to providers	Feedback on products to providers, need for customer relationship management

<b>Actions/interactions on Münster weekend market</b>	<b>Actions/interactions on GI marketplaces</b>
Feedback on products to Aunt Agatha	Personal contact amongst users, e.g., by discussion forum
Meeting Aunt Agatha and chatting about job opportunities for her son, cheap flights to Gran Canaria, and the weather	Communication with other end-users, request for additional services, e.g., job bursary, training opportunities, branch news, “amusement”
Getting cooking recipes from the farmer	Request for product information and/or hotline, possibly consultants are needed
Enjoying the music player at the market entrance	Providing additional services, e.g., cultural information, weather reports, traveling information, school holidays calendar
Receiving the newest program of the Wolfgang-Borchert-Theatre	Providing additional services, e.g., cultural information, weather reports, traveling information, school holidays calendar
<b>Restaurant owner</b>	<b>Business user</b>
Search of products, information about products, comparison of prices and quality	Search of products, information about products, providing metadata
Ordering, buying, and paying vegetables, bread, meat, etc., for his kitchen	Ordering, buying, and paying GI products
Negotiating prices	Price negotiation
Feedback on products to providers	Feedback on products for providers, need for customer relationship management
Feedback on products to other restaurant owners	Personal contact amongst users, e.g., by discussion forum
Meeting other restaurant owner and chatting about job opportunities for his son, cheap flights to Gran Canaria, and the weather	Communication with other business users, request for additional services, e.g., job bursary, training opportunities, or “amusement”
Getting cooking recipes from the farmer	Request for product information and/or hotline, possibly consultants are needed

The Münster weekend market is a useful metaphor for the design of GI marketplaces. Many actors’ roles and interactions can be transferred.

The most obvious (or at least loudly) role on the weekend market has the market barker (in German “Marktschreier”). Market barkers provide services at the weekend market that are lacking in the GI market, e.g.,

- Create awareness

- Speak the language of the targeted audience
- Create personal bindings between buyer and seller
- Create a traditional, well-known, and therefore comfortable buying atmosphere for the client
- Mediate sale of products the client was not even thinking of before
- Inform about the offered product
- Negotiate prices
- Create trust and credibility
- Facilitate cheap and quick transactions.

Still today the role of the market barker at the weekend market is considered so important, that e.g., in Münster, there are market barker contests. The following figures illustrate the market barker contest 2004 by two participating market stalls:



**Fig. 5: Market barker contest, photo a, Münster, February 2004**



**Fig. 6: Market barker contest, photo b, Münster, February 2004**

The method of metaphorical design provides a large amount of matches for transferring mechanisms of the Münster weekend market to GI marketplaces. Yet, we observe significant mismatches between Münster weekend market and the needs of GI marketplaces.

First, the products are different. At the Münster weekend market products are mostly ready-to-use. Most of the products currently offered in the GI market are not. The raw material of the GI market is geographic data. But these products are not successful in the market; services have to be added (see section 2.1). Therefore, some mechanisms of electronic marketplaces cannot be transferred to GI marketplaces: More than 60 % of B2B-marketplaces outside the GI field offer black boards and some kinds of exchange transactions, 41 % offer auctions, and 31 % catalogues (Spiller and Wichmann 2000). Because of need of the GI market for composed information services, such



models alone will not satisfy the needs of the GI. The GI market needs an enhanced service chaining in B2B marketplaces in comparison to the Münster weekend market.

The Münster weekend market example of a snack bar owner on the weekend market, who buys vegetables, bread, and meat at the weekend market, is not typical. Based on the different product offers, the players of the Münster weekend market are different to GI marketplaces. GI consultants and integrators are poorly matched in this comparison to the Münster weekend market.

The Münster weekend market mainly targets end-users; it can be considered mainly as a B2C marketplace. Business users, e.g., restaurant owner, are not the focus of the weekend market. Although business users are not typical, they are addressed; B2B marketplace-mechanisms can be observed and analogies can be concluded. In order to avoid neglecting B2B aspects due to the different focus of the Münster weekend market, the findings of the metaphorical design will be matched with the marketplace categories of Bakos (Bakos 1998) in the following section.

### 4.3. CATEGORIES OF SERVICES

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The transfer from Münster weekend market to GI marketplaces by metaphorical design resulted in an unsorted list of services. The next step is to group the services into categories and to check that it is complete. Therefore, the findings will be compared with the general categories of marketplace services by Bakos (Bakos 1998) “Matching buyers and sellers”, “Facilitation of transactions”, “Institutional infrastructure”, and their sub-categories, which are adapted to the needs of the GI market.

- One of the key success factors of the Münster weekend market is *matching buyers and sellers*. Direct personal contact facilitates determining product offerings, search, and price discovery. Matching buyers and sellers can be directly transferred to the design of GI marketplaces. Specific services provide valuable hints; e.g., the stalls of groups of providers are set up in rows: cheese row, meat row, and bread row. This observation supports the design of vertical marketplaces, or the grouping of providers in the user interface of a horizontal GI marketplace. The focus of this category is on information and addresses one of the key obstacles in the current GI market: too little access to products and providers.
- Although not the focus of the Münster weekend market, interaction and cooperation between marketplace providers can be observed, e.g., the snack-bar provider can buy raw products at the meat and the bread stall. A particular requirement of the GI market is to *support cooperation within the geospatial value chains*. For this, a GI marketplace should provide mechanisms and services for the connection various providers to geospatial value chains and their cooperation.
- The Münster marketplace is a consumer-oriented model for *facilitation of transactions*. The consumers have access to a broad range of products, are able to compare quality and prices easily, and are able to buy directly the required product. Also electronic marketplaces offer, in addition to the services of shop solutions or portals, the facilitation of transactions. A GI marketplace facilitates B2B transactions between buyers and sellers of geographically referenced products. B2C transactions might be included for special reasons, e.g., marketing initiatives (see section 4.4).

- The market barker is the most noticed *marketing* strategy of the Münster weekend market. Marketing within a GI marketplace covers two aspects. First, a GI marketplace provides services for the marketing of the products offered by the companies and organizations. Second, it is crucial to initiate marketing initiatives for the GI market and the GI marketplace. This includes an extended awareness of customers to the potential use of geographic information and an extended cooperation of business partners within the GI marketplaces.
- Rules, standards, and infrastructure determine the Münster weekend market. There are laws controlling the quality of food, and tax and financial laws for the providers. There are predetermined business hours, and controlling takes place directly at the market by the City of Münster authorities. The infrastructure not only consists of the site itself, but also on parking lots for the providers, and an organization of stalls into rows. The GI market consists of a great variety of players, is fragmented, and lacks standards and tools for cooperation. To improve the use of geographic information, the cooperation of business networks, and transparency of the market, GI marketplaces need to *provide an institutional, organizational, and technical infrastructure*.
- A contribution to attracting visitors to the Münster weekend market is the atmosphere, e.g., musicians, to meet and chat with some friends, and to get the latest theatre program. Also in GI marketplaces, the *provision of additional services* extends the provision and transaction of goods by customer relationship management. For example, GI marketplaces require multi-lingual services. The significance of international cooperation increases; the bigger non-geospatial marketplaces in Germany employ 25 % of its personnel abroad, smaller marketplaces employ at least some staff in a foreign country (Spiller and Wichmann 2000).

Conforming to the needs of the GI market, the general trend and solutions of non-GI marketplaces extend marketplace services to fulfillment services, logistic services, Enterprise Resource Planning (ERP) Systems – CRM (Customer Relationship Management), collaboration services, consulting, content, newsletter, marketing, public relations, and addressing international clients (Spiller and Wichmann 2000). The following section will describe in detail the transfer of the Münster weekend market services to GI marketplace.

#### 4.4. SERVICES OF GI MARKETPLACES

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This section sorts the results from the metaphorical design in section 4.2 into the six service categories defined in section 4.3. In addition, their relevance for GI marketplaces is weighed by their capacity to address the key challenges of the current GI market – providing information services, cooperation of business networks, and access of potential customers to the GI market:

- m = mandatory (service has to be provided)
- o = optional (service could be provided).

The classification into mandatory and optional is a preliminary judgment by the author, which might change during the realization of a specific GI marketplace.

**Tab. 6: Services of marketplaces for geographic information**

Services	Relevance
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<b><i>Matching buyers and sellers</i></b>	
1. Create and maintain catalogue of products offered (services and information services)	m
2. Provide query mechanism for products (search and discovery) 2.1. (Meta-)metadata of data, services, and information services 2.2. Facilitate price determination 2.3. Information about reference projects.	m
3. Publish requests for information services on a Bulletin Board	o
4. Visualize geographic data	o
5. Publish providers' profiles and advertisements	m
6. Establish and maintain news group/discussion forum	o
7. Provide call center/hot line and consulting	m
8. Group product and provider information in order to facilitate information retrieval	m
<b><i>Support of cooperation within the geospatial value chains</i></b>	
9. Inform about technical and organizational services of companies within the GI marketplace	m
10. Provide mechanisms and tools for partner search 10.1. Yellow pages 10.2. Notification service for companies about requests for complex information services which need the cooperation of several business partners	m
11. Provide mechanisms and tools for the cooperation among providers, e.g., by coordination and support of forming business networks	m
12. Provide mechanisms and tools for the pricing of complex information services	m
<b><i>Facilitation of transactions</i></b>	
13. Provide a usable, user-friendly navigation and support	m
14. Facilitate one step business transactions between any users of the GI marketplace	m
15. Enable access to and retrieval of products (information services, technical processing services, human services (organizational, consulting)) by the marketplace user interface 15.1. Ordering 15.2. Dissemination 15.3. Payment 15.4. Authentication and security services (not excluding direct communication with providers)	m
16. Support integration of geographic information in user systems with technical tools, consulting, or mediation of services	m
17. Supervision and control of projects	o
<b><i>Marketing</i></b>	
18. Attract traditional and new users of geographic information by information about its opportunities and chances, e.g., by providing free geographic information for customers	m
19. Attract traditional and new providers, i.e., SME's, as components of the marketplace, e.g., by providing information (helpdesk) for potential participants of the marketplace	m
20. Lobbying in politics and economics	o
21. Initiate monitoring and trend scouting within the GI market, initiate studies and pilot projects	o
22. Inform about sector news, trends, projects, scientific research	m
23. Offer various Internet services, e.g., 23.1. Provide tools for customer relationship management 23.2. Career service/recruiting of employees 23.3. Office information	o

23.4. Traveling 23.5. Events 23.6. Entertainment	
<b><i>Provision of an institutional, organizational, and technical infrastructure</i></b>	
24. Provide a business plan for realization	m
25. Initiate and stir consensus processes about standards and specifications	m
26. Define, maintain, and inform about standards and specifications for information services 26.1. Metadata 26.2. Products offered (data sets, technical, human, organizational, institutional services, information services) 26.3. Legal aspects (access rights, copyright, usage, contracts between business partners) 26.4. Security 26.5. Workflows and processes within the marketplace 26.6. Execute quality control of offered products, e.g., certification, and publish this information	m
27. Define standards for providers and select and control providers according to these standards	m
28. Provide a technical infrastructure with generally accepted standards	m
<b><i>Provision of additional services</i></b>	
29. Provide multilingual services	o
30. Initiate and maintain international cooperation	o
31. Provide education and training	o
32. Provide additional information, e.g., job bursary, branch news, cultural information, “amusement”	o
33. Provide tool for customer-customer communication, e.g., discussion forum, chat room	o

Tab. 6 provides a list of services any GI marketplaces *might* provide. The list is meant as a tool to help decide which services have to be included in the conception of a specific GI marketplace realization. In the design of a specific marketplace these services have to be checked for relevance, detailed, and additional services for the specific needs of the targeted users have to be added.

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#### 4.5. SUMMARY AND DISCUSSION OF RESULTS OF PART C

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Part C addressed the second research question of this thesis: *What is an appropriate design of electronic marketplaces targeting the GI branch?*

Addressing the major challenges of the GI market identified principle guidelines for the marketplace design (chapter 3). The institutional and organizational framework of GI marketplaces was designed by analyzing existing spatial and non-spatial marketplaces. GI marketplaces have to

- Trade a great variety of technical and human services as well as geographic data.
- Act as B2B marketplaces in a mixed-mode model of transaction- and collaboration-orientation, mediating the cooperation of a great variety of providers and the ad-hoc establishment of business networks.

- Address the appropriate access of a great variety of potential customers to the GI market by running a GI marketplace mostly by Spatial Data Infrastructure initiatives as neutral, independent, and non-profit organizations.
- Provide horizontal as well as vertical offers.
- Set up standards and rules for participation without over-regulation.

This approach turned out to be a valuable and appropriate methodology, which even shifted the original thinking of the author:

- Markets in general turned out to be much more advanced in e-business than formerly believed. Existing non-spatial marketplaces address and resolve a large amount of GI market business requirements.
- This led to a shift of the author's original assumption that the GI market has several unique requirements. The identified approaches and solutions in non-spatial marketplace lead to the conclusion that GI marketplaces are not unique, but "only" have an extended relevance of and need for specific characteristics: trading a variety of product types, mediating the cooperation of a variety of providers in business networks, and addressing the appropriate access of a variety of potential customers.

The detailed analysis of different non-spatial marketplaces with the background of the design principles in chapter 3, and especially the general market trends analysis in section 2.4 provided a deep insight into existing marketplace approaches and solutions. Therefore, this approach was appropriate for achieving a framework design for GI marketplaces that is as complete as possible.

The new trends of e-business and marketplaces for networked cooperation (Otto and Waesch 2003), process-oriented aggregation of products (Malone and Laubacher 1999), fulfillment services (Spiller and Wichmann 2000), and collaboration-oriented business models (Gogolin, Brox and Klein 2005), coincidence with the specific needs of the GI market. Consequently, current non-spatial marketplaces offer approaches and solutions, which directly address these needs. Therefore, the proposed institutional and organizational framework of GI marketplaces can be considered appropriate in addressing and overcoming the key obstacles in the GI market.

The services of GI marketplaces were designed by metaphorical design. This method proved to be a valuable tool for the author because the well-known source system helped creating and achieving the most complete design of GI marketplace services. Transferring the identified GI marketplace services to the categories of Bakos (Bakos 1998) for general marketplaces yielded six categories of GI marketplace services:

- Matching buyers and sellers
- Support of cooperation within the geospatial value chains
- Facilitation of transactions
- Marketing
- Providing an institutional, organizational, and technical infrastructure

- Providing additional services.

Some of the most interesting results were mismatches between GI marketplaces and the Münster weekend market as well as the service categories of Bakos (Bakos 1998): The Münster weekend market does not focus on services for networked cooperation of providers, and Bakos (Bakos 1998) neglects them completely. However, the identification of needs of the GI market (see chapter 2) clearly evidenced the relevance of services that support the aggregation of information services, the cooperation of business networks, and an improved customer access to the market. This demonstrates that the traditional market structures of a weekend market have to be extended. Furthermore, within the Digital Economy, business models shift rapidly: Since 1998, the transaction-oriented business model of Bakos has been joined by collaboration-orientation. As argued in chapter 3, existing non-spatial marketplaces already address these challenges.

Therefore, it can be considered that the design yields not only the generally common services of electronic marketplaces, but specifically takes into account and addresses the specific characteristics of the GI market.

Consequently, the GI marketplace design, both, of framework and services, can be considered “appropriate”, because it directly addresses the key obstacles in the current GI market identified in part B “Detailed Problem Statement”. A comparison of other researchers’ specific results is not possible, because detailed research on the combined topic of geographic information and marketplaces is not known.

## **PART D: VALIDATION OF CONCEPTS**

The following part D validates the GI marketplace concepts achieved so far:

- The design guideline for a GI marketplace design, which addresses the three key needs of the GI market identified in part B.
- The design of GI marketplaces itself in terms of an institutional and organizational framework of GI marketplaces and the services they need to provide (part C).

The overall methodological approach to the validation concept is to focus on a specific vertical GI marketplace for financial service providers. Part D uses a scenario of a typical business customer and a typical required product of the GI market: A bank requires a GI-supported system for the in-house evaluation of the localities of its branches.

Two steps address the validation of the design guidelines:

- Chapter 5 aims to validate the demand of financial service providers for information services and business networks using an insurance company's personal interviews and the analysis of typical GI products required by a bank.
- Chapter 6 aims to validate the demand of financial service providers for an improved access to the GI market by testing existing GI marketplaces.

The following chapters target the validation of the design of GI marketplaces:

- Chapter 7 aims to validate that a GI marketplace can be implemented in terms of appropriate business processes. This chapter will draw analogies from public procurement and derive a business process model for a vertical GI marketplace for financial service providers.
- Chapter 8 aims to validate that the business process model can be implemented technically. This chapter will verify the need for a semantic-enabled service chaining of human and technical GI services, and analyze the capabilities of OWL-S to enable service chaining.
- Chapter 9 aims to validate that GI marketplaces can be implemented on an organizational level. This chapter provides a business plan for realizing a vertical GI marketplace for financial service providers and analyzes the financial feasibility.

Finally, chapter 10 discusses the thesis results by analyzing the methodological approach, and validates the thesis' hypothesis.

## **5. DEMAND OF FINANCIAL SERVICE PROVIDERS FOR GI PRODUCTS AND APPROPRIATE GI PROVIDERS**

The preceding chapters identified impediments of the GI market, discussed the need for GI marketplaces, and developed general concepts of the organizational framework of marketplaces and services they have to provide. The following sections focus on the branch of financial service providers (banks and insurance companies). This branch is a valuable potential customer for the GI market: Financial service providers need geographic information, and they have the financial resources to pay for it (Fornfeld and Oefinger 2001).

This chapter investigates the demand of financial service providers for GI products and providers. Section 5.1 describes a case study evaluating the specific demand of an insurance company in Münster, Germany. Case study 2 evaluates existing GI products for banks provided by a Swiss GI company (section 5.2).

Major results of this chapter are published in Brox and Kuhn (2004): Demand of Financial Service Providers for GI Products and Electronic Marketplaces. GSDI-7, February 2-6, 2004, Bangalore, India, [www.gsdi7.org.in](http://www.gsdi7.org.in).

### **5.1. CASE STUDY 1: INSURANCE COMPANY**

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This case study focuses on a big German insurance company's demands for GI products. Our approach was to conduct personal interviews in order to evaluate the demand for GI products:

1. Two ifgi staff members interviewed the vice-director of a consulting and software development company for insurance companies. This company has insight into the insurance company as well into other insurance companies in Germany and Switzerland. The interview was not structured. The goal was to define demands of insurance companies for GI products. The interview minutes were checked and commented on by the vice-director. The result was a list of GI products usable for insurance companies.
2. The insurance company was investigated within a high-level students' course in cooperation between ifgi and Department of Information Systems, University of Münster. Ten students had investigated the insurance company's profile, products, clients, workflows, and existing use of geographic information. In a structured interview (two hours, ten students with supervisors, six employees of the insurance company) the students provided suggestions for GI application in the insurance company's business. The usefulness of these suggestions was then discussed. Then, the students asked the employees, which additional GI products will be used by the insurance company. The interview minutes were checked and commented on by the marketing chief officer. The result was a list of GI products usable for the insurance company (Ahmann, Becker, Bonder et al. 2002).

The first result was a general observation: GI could be usable for insurance companies, but they use it rarely. A typical statement was: "We tried to find out if we could use a geographic data set. But we gave up, because we had no idea if the data set is usable for our purposes, matches our quality



requirements, or how it could be integrated into our data and software system.” There was a lack of information about the access to GI products and how insurance companies could produce added value.

The following GI products/GI applications were demanded within the insurance company case study:

1. Consultant and software developer for insurance companies:

- The company requested a *geographical user interface* on top of its own software. The target was to fulfill a concrete request of an insurance company. The insurance company wanted to realize a regional map for entering the internal data warehouse.
- The success of insurance companies depends on space. An insured risk represents the relation of an insured object with its distribution of risks in space. Consequently, an insurance company needs a *tool for risk predictions* of potential clients, e.g., for floods and storms.
- Insurance companies need a better evaluation of its branch offices. A *tool for spatial analysis of distribution of branch offices*, distribution of potential clients, and trading areas as well as the spatial analysis of existing internal clients’ data would support this evaluation.
- Acquisition of clients and marketing initiatives require a detailed knowledge of targeted customers and areas. A *geo-marketing tool* would optimize these actions. E.g., an advertisement campaign would be much more cost effective, if leaflets are distributed in streets or quarters with young people of high income instead of those of low income.

2. Insurance company (Ahmann, Becker, Bonder et al. 2002)

- *Optimizing trading areas*: The business success of insurance companies often depends on the spatial distribution of their branch offices. Tools for spatial analysis can optimize the trading areas of branch offices and its distribution, e.g., by comparing and evaluating information about competitors, buying power, age pattern, and distribution structures of the branch offices’ trading areas.
- *Micro-marketing*: Micro-marketing groups potential clients into homogeneous segments. In these segments, clients’ requests as well as their measure of quality can be identified. Thus, the cross-selling potential can be exploited. Losses due to non-selective advertising can be minimized. The insurance demanded a geo-marketing tool for their marketing department.
- *Location based services*: Claims and loss processing can be supported by location based services. For example, a broken-down car can be located by mobile phone or GPS. Thus, police and towers can be sent directly to the customer. Side services, e.g., information about closest hotels, garages, or doctors, can be added.
- *Route planning for clients and employees*: Route planning for clients, i.e., how to get to the insurance company or its dependencies, has become a wide spread means of customer relationship management. In addition, this service would help the field-staff visiting their clients. An integration of public and private transport is targeted.

- *Fare rates for car insurances:* Besides current criteria for offering discounts, e.g., discount for garage owners, and fee scales based on geographical and individual criteria, would help to make them more transparent and fairer. Indicators such as weather effects, time of day of usage, and location of usage should be integrated into the fee scale.
- *Control of accumulation of risks:* Insurance companies need to have an exact knowledge about the worst-case of their insured risks. Otherwise an insured risk would ruin the company. Geographic analysis of historic damage events or simulations of future damage events, e.g., floods, provide a more precise calculation. Based on this, reinsurances and tariffs could be calculated more precisely.

The following key findings can be derived from the case study:

- The case study proved the demand for GI products. The limitation of the evaluation was the focus on the demand, independent of the costs. Consequently, not all demanded GI products can be realized on a cost-neutral basis. However, most of the GI products already have been realized in similar contexts. Two conclusions can be drawn: a. the demand is economically justified, because other companies already have paid for a similar product. b. even if needed GI products do exist, the insurance did not buy them.
- The insurance company was vaguely aware of the potential benefit of using GI products. If there was awareness, the first step of a transaction was already interrupted: The insurance company did not get sufficient information in order to decide whether or not to buy a GI product. For example, the insurance company wanted to buy a geographic data set, but it could not get information about quality and usability in their business environment.
- There was little demand for raw products (geographic data, software). The focus was on establishing more or less complex GI solutions adapted to the company's workflows. The demanded GI products were complex information services, which add human, organizational, institutional, and technical services to data and software.

## 5.2. CASE STUDY 2: BANK

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This case study uses a different approach. We evaluate existing GI products for banks. The idea is that the need for these products is shown best by its realization, because banks were willing to pay for it. Endoxon AG is a Swiss GI company with a broad spectrum of GI products: data, data adoption, software, software adoption, GI consulting, integration, and training. A key client is Credit Suisse, a leading bank in Switzerland. The partnership of Suisse Credit and Endoxon AG is based on a master agreement, which figures Endoxon AG as a non-exclusive geo-competence center for the bank's GI projects (Widmann 2001). The master agreement covers questions of data delivery, information and functionalities, technical requirements, licenses, development, and implementation.

We evaluate the online descriptions of reference projects ([www.endoxon.com](http://www.endoxon.com), July 10, 2003). Additional information came from a presentation of S. Widmann, Endoxon AG, at the InGeoIC

conference “Use of geographic data for the branch of commerce, banks, and insurance companies”, 2001 (Widmann 2001). Endoxon AG has offered and delivered the following products to banks:

1. The real estate platform of Credit Suisse Bank (<https://entry.credit-suisse.ch/csfs/p/rb/de/hypo/index.jsp>) is a tool for locating the right property in the right place. Various views of the surrounding area together with important utilities and services enable the potential client to assess suitability.
2. The service portal of New Aargauer Bank (<http://www.nabhome.ch>) enables users to make informed decisions when searching for property in the canton of Aargau.
3. The branch locator of Credit Suisse ([www.creditsuisse.ch](http://www.creditsuisse.ch)) visualizes Swiss branch offices of Credit Suisse Group through photos and city maps.
4. The GIS tool for real estate analyses for Credit Suisse Research & Consulting provides macro- and micro scoring, risk classification, and automatic reporting. It contains typical tools of Geomarketing, e.g., analysis of service infrastructure (schools, shops, public transport), and demographic trend analysis ([http://www.endoxon.com/en/kno/kno\\_mar.asp](http://www.endoxon.com/en/kno/kno_mar.asp)).

The case study implies the following key findings:

The master agreement with Suisse Credit shows the business realization of one of the core theses of the author: Banks need GI solutions instead of data or software. They need additional GI services such as GI consulting in order to gain access to the GI market and to pay for its products. The products provided by Endoxon AG support this idea. The delivered products are not data or software. They are systems in terms of business solutions. They integrate many GI products into an information service, which is ready-to-use for the bank and provides services to their clients.

## **6. ACCESS OF FINANCIAL SERVICE PROVIDERS TO GI PRODUCTS AND PROVIDERS**

Section 2.3 identified the need for an improved access to the GI market for potential customers. This chapter tests how existing GI Internet solutions fulfill this demand for financial service providers.

The starting point is to develop a scenario, where a user who requires a typical information service from the GI market (section 6.1). Within the scenario the author identifies tasks, which have to be added to the raw material of geographic data sets in order to generate the desired information service.

From the tasks of the scenario, section 6.2 derives categories of services that the GI market needs to provide. As a result, this section aims to demonstrate a principle, not a complete catalogue: Generating an information product requires a great variety of services such as intermediate products and the involvement of different types of players from geospatial value chains (data producer, software provider, service provider, integrator, end user).

Section 6.3 designs a test to prove if and how the required GI products are provided by existing Internet solutions. Section 6.4 describes the test results. Section 6.5 analyzes the current mismatch of supply and demand on the GI market.

The major results of this chapter are published in Brox and Kuhn 2004: Demand of Financial Service Providers for GI Products and Electronic Marketplaces. GSDI-7, February 2-6, 2004, Bangalore, India, [www.gsdi7.org.in](http://www.gsdi7.org.in).

### **6.1. SCENARIO**

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The use of scenarios is a method to develop, test, and demonstrate a theoretical concept. Focusing on a small, practical, and known example facilitates the understanding and analysis of a complex problem. First, we define the tasks of the bank in order to integrate geographic information into their business processes. Then, we define the profile of the tested bank, as well the profile of the targeted user who requires GI products.

#### **6.1.1. Tasks of a bank**

We develop a scenario where a bank evaluates branch locations. The evaluation targets a priority list of existent and planned localities by comparing costs and market potential. The final goal is to decide about improvements of branches, shifting or closing of existing localities, and opening new ones. The evaluation is based on enterprise and demographic data, and it shall be supported by geographic information. The bank reevaluates every year. Therefore, the bank needs a tool and working processes for an in-house execution.

The generation of the desired end product includes the following tasks:

- Define requirements and goals within the bank
- Find business partners

- Define needed information from marketing and GI perspective
- Define needed data sets, geographic and non-geographic
- Define needed functionalities, geographic and non-geographic
- Elaborate project plan (detailed definition of end product, processes, milestones, responsibilities)
- Search data sets
- Select needed data from data sets
- Order and pay data
- Buy geographic analysis tool
- Adjust geographic analysis tool to needed functionalities and integrate tool into enterprise system
- Execute the evaluation of existing and planned locations of the branches
- Train employees with the new tool and processes.

### **6.1.2. Bank profile**

We define the following profile of the bank:

**Tab. 7: Scenario bank profile**

Employees	3000
Annual turnover	1.1000.000 €
Branch offices	60
Employees of branch office evaluation	1 IT specialist, no GI experience; 2 marketing experts, expert IT user, no GI experience
Hardware	Sufficient (Internet, Intranet), possibly a server for GI has to be purchased
Software	SAP, Oracle, no GIS
Internal data	Customers data, addresses, business data
Current workflows	Internal cost analysis of branch offices; external customers analysis, external market analysis; internal benchmarking

### **6.1.3. User profile**

Within the test scenario we define an executive manager of the bank as a user and test person. His or her task is to evaluate the costs and benefits of the in-house use of geographic information; he or she has to decide if the bank should start a pre-project to introduce GI or not. The bank manager

has a deep knowledge of the targeted evaluation processes. He or she is an expert IT user, but he has no experience with GIS.

## 6.2. CATEGORIES OF GI PRODUCTS

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The tasks of the scenario imply numerous intermediate products in order to generate the desired information service as a GI end product. In economic theory the term “product” is often used in a generic sense referring to both, the product (or good) and the service.

The bank in the scenario requires the following two intermediate products in the narrow sense: data sets and a software tool. Such physical products are considered as one category of products in the GI market.

The scenario demonstrates the necessity of a great variety of additional services. Based on the tasks of the scenario, we derive services that are essential for generating the desired end product. We classify these services into four additional categories of products (technical, human, organizational, and institutional services) and the following sub-categories:

**Tab. 8: Service-based categories of GI products**

Tasks of scenario	Technical service	Human service	Organizational service	Institutional service
Define in-house requirements and goals			Provision of knowledge about possibilities of GI (marketing)	
Find business partners	Provision of information		Information about GI products and GI providers, Communication	Establishment of business network of potential partners, Quality assurance of business partners
Define needed information from marketing and GI perspective		GI consulting, Marketing consulting		
Define needed data sets, geographic and non-geographic		GI consulting, Marketing consulting		
Define needed functionalities, geographic and non-geographic		GI consulting, Marketing consulting		
Elaborate project plan (detailed definition of end product, processes, milestones,		Integrative consulting		

Tasks of scenario	Technical service	Human service	Organizational service	Institutional service
responsibilities)				
Provide data sets	Data provision		Provide Internet access	Standardization of data, Rules for the use of data, Security
Search data sets	Data search			Standardization of functionalities
Select needed data from data sets	Data selection			Standardization of functionalities
Order and pay data	Data ordering, Data payment		Provide tools, Security assurance	Standardization of functionalities
Buy geographic analysis tool			Sale of software tool	
Adjust geographic analysis tool to needed functionalities and integrate tool into enterprise system	Adjustment of software tool, Integration of software tools	Adjustment of software tool, Integration of software tools	Adjustment of software tool, Integration of software tools	
Execute the evaluation of existing and planned localities of its dependencies in Germany	Execution of analysis	Execution of analysis		
Train employees with the new tool and processes.		Training		

Already this single scenario shows the complexity of the services needed and the contribution of various players of the geospatial value chain for generating an information service.

### 6.3. TEST DESIGN

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The test goal is to prove whether or not a bank executive manager can to introduce geographic information into the bank's workflow. The test was carried out within a students' block course in May, 2003, at the University of Münster, Germany. The author supervised the course, using the scenario described above.

The participants were Geoinformatics students (diploma) between 6<sup>th</sup> and 8<sup>th</sup> semester. Two students screened the Internet for existing GI marketplaces. They used "Google" and entered relevant key words, e.g., "marketplace", "geographic information AND marketplace", "geographic information", "GI services", "bank AND geographic information". The Internet results were compared with the criteria of whether they were marketplaces or not (see section 3.3). Three GI marketplaces or similar Internet-based solutions were chosen to be tested (Tomberge 2003).

Three students served as test persons. They got the task to evaluate marketplaces in the role of a bank executive manager. Each test person tested one marketplace for one hour. The test executives provided questionnaires for evaluation. The questionnaires contained three categories of questions (Gossilin 2003):

- Website (layout, navigation, usability, help, search functions)
- GI products (information about data, data quality, data categories, data formats, providers, data distribution, price, software, integration support, consulting)
- Marketplace services (payment, contact, help, costs).

## **6.4. TEST RESULTS**

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Sub-section 6.4.1 describes the evaluation of GI marketplaces as test objects. Sub-section 6.4.2 shows the result of test persons evaluating the test objects. Sub-section 6.4.3 analyzes the limitations of the test.

### **6.4.1. Evaluation of GI marketplaces**

Screening the Internet for GI marketplaces resulted in few hits. Most of the GI product providers (data, software, services) related to the scenario were single companies. Only some Internet solutions met at least some of the criteria of GI marketplaces (see section 3.3):

- Virtual matching of buyers and sellers
- Openness to many providers and many clients
- No portal, sell-side solution, or extranet
- B2B marketplace.

In addition, we were looking for marketplaces that offer all types of GI products, data and software as well as GI services.

We evaluated five candidates for testing:

1. [www.geodaten-online.de](http://www.geodaten-online.de) is run by the company con terra. They market geographic data sets of their business partners, i.e., government organizations. They offer services for searching and buying geographic data.
2. [www.geodatenzentrum.de](http://www.geodatenzentrum.de) is an initiative of the German Government (Bundesamt für Kartographie und Geodäsie, BKG). They provide authoritative topographic-cartographic data. They also provide a metadata information system. Targeted clients are authorities and others.
3. [www.geomarktplatz.de](http://www.geomarktplatz.de) claims to be “Europe’s first geomarketplace”. They target the marketing of GI and geodata management. They offer online search and ordering as well as help and contact for non-GI experts. They want to link providers and users of geographic data.
4. [www.ingeoic.de](http://www.ingeoic.de) serves as a portal for geographic data. The core is a metadata information system, which informs the potential user about attributes and quality of data sets. In addition, they target gaining information from geographic data.



5. [www.terramapserver.de](http://www.terramapserver.de) serves as a “platform for geodata”. They provide services for data users (search, Web-services, services for geodata integration) as well as for providers offering their geodata.

The business model of [www.geomarktplatz.de](http://www.geomarktplatz.de) fulfills the criteria of a GI marketplace and consequently was chosen for the test. Terramapserver ([www.terramapserver.de](http://www.terramapserver.de)) does not completely fulfill the criterion of providing GI services needed in the test scenario; their business model focuses on geodata. But the lack of alternatives and the services for acquiring additional data provider made them relevant to the test.

[www.geodatenzentrum.de](http://www.geodatenzentrum.de) and [www.geodaten-online.de](http://www.geodaten-online.de) can be considered sell-side solutions. Although marketing data sets of different providers, those are limited to government organizations of a similar business background. The criterion of openness to many providers does not seem to be fulfilled. In addition, the clear focus on data excluded the providers from being chosen for the test.

[www.ingeoic.de](http://www.ingeoic.de) clearly claims a non-marketplace business model. Still we chose the Internet portal for testing. One reason was the lack of alternatives. Another reason is the portal’s statement of “making geoinformation from geodata” and the internally known cooperation with InGeoForum ([www.ingeoforum.de](http://www.ingeoforum.de)). Both encouraged the estimation that the portal could also provide additional services to their core competence in geographic data relevant for the test scenario.

#### **6.4.2. Test results**

The following paragraphs show the detailed test results of [www.ingeoic.de](http://www.ingeoic.de), [www.terramapserver.de](http://www.terramapserver.de), and [www.geodatenmarkt.de](http://www.geodatenmarkt.de). Finally, we present an overview table of the results.

[www.ingeoic.de](http://www.ingeoic.de) (based on (Janowicz 2003c))

Website:

Layout and navigation in the website scored good to satisfactory in the evaluation. The clear structure was a positive point; a negative point was the requirement of using JavaScript and many the pop-up menus. The usage of the website scored sufficient. The navigation bar could be handled intuitively. Negative points were the long loading time, mistakes in map functions, and the lack of background information for non-GI experts. The search functions were described well, but the functionalities were only sufficient. There were missing catalogues, unclear content information, and unclear results.

Product offer:

In the context of the scenario, the product offer was not satisfactory. The product offer consisted mainly of data sets. Metadata data were available, but inconsistent in quantity, quality, and presentation. The quality of data sets was partly good and up-to-date, and the delivery scored very good in the evaluation. But sometimes important information, e.g., contact, information about use, was missing. Quite a few providers were present on the platform, and different application fields of geographic information were hardly covered. Prices for data and services were not available. Also, there was no information about software, software services, and additional services, e.g., data integration.

Services of Internet platform:

The services scored satisfactory in the evaluation. Contact information and contacting were good. The customer had sufficient support for searching data. The billing modalities scored negative in the evaluation.

Summarized results, in German school notes from 1-6 (Gossilin, Janowicz, Knieper et al. 2003):

Website: 3.2

Product offer: 4.25

Services of Internet platform: 2.5

Total: 3.4

In the final results, the test persons could not get sufficient information for deciding whether or not to introduce GI into the bank.

[www.terramapserver.de](http://www.terramapserver.de) (based on (Knieper 2003))

Layout, navigation, and usage of the website scored very good. The clear structure, intuitive navigation, and few user software requirements were positive. But sometimes, the map server was not working reliably.

The product offer scored not sufficient. The offer focused on data. Geodata were offered mostly by surveying authorities, and the lack of competitors was criticized. The data coverage was inconsistent, Germany was rarely completely covered. The marketplace offered some thematic data, e.g., socio-demographic data, which were relevant for the scenario, and available Germany-wide, but again the lack of competitors was criticized. In addition, most of the geodata were offered in TIFF format, which cannot easily be integrated in the offered socio-demographic data. A non-GI-expert like the bank manager in the scenario would not be able to evaluate needed data sets. Some software products were offered, which were not relevant for the scenario. Additional services, e.g., data integration, or links to GI service providers were not offered.

The services of the Internet platform focused on selling data. In this sense, it scored satisfactory in the evaluation. Information about products, help functions such as the map server were good. Unclear or missing contact options were negative. In the context of the scenario, the services were not satisfactory, e.g., links to additional GI providers were missing.

Summarized results, in German school notes from 1-6 (Gossilin, Janowicz, Knieper et al. 2003):

Website: 2.8

Product offer: 3.4

Services of Internet platform: 3.5

Total: 3.3

In the final results, the test persons could not get sufficient information for deciding whether or not to introduce GI into the bank.

[www.geomarktplatz.de](http://www.geomarktplatz.de) (based on (Koch 2003))

Layout, navigation, and use of the website scored satisfactory, especially for the clear structure and intuitive operations. Search functions looked quite usable, but during the test they were not available.

Theoretically, the GI marketplaces offered the broadest variety of GI products, including additional services, e.g., data adaptation, converting, and integration. But during the test, the marketplace was not working. By email the provider provided the information that the marketplace was subject to re-structuring.

In the final results, the test persons could not get sufficient information for deciding whether or not to introduce GI into the bank or not.

### Overview:

The following table provides an overview of the criteria and results of the tested Internet platforms using German school grades from 1 (best) to 6.

**Tab. 9: Test results overview (based on (Janowicz, Knieper and Koch 2003))**

Criteria (Weight of criterion in %)	<a href="http://www.InGeoIC.de">www.InGeoIC.de</a>	<a href="http://www.terra-mapserver.de">www.terra-mapserver.de</a>	<a href="http://www.geo-marktplatz.de">www.geo-marktplatz.de</a>
<b>Webdesign/Layout (25%)</b>	3.2	2.8	4.4
Layout and navigation (20%)	2	2	2
Usage (20%)	4	3	3
Help functions (20%)	2	3	5
Search engine (40%)	4	3	6
<b>Product offer (40%)</b>	4.25	3.4	6.0
<b>Quality (50%)</b>	3.5	3.0	6.0
Metadata (50%)	3	4	6
Data quality (50%)	4	2	6
<b>Quantity and range (50%)</b>	5.0	3.7	6.0
Scale/format (10%)	3	5	6
Provider/assortment (10%)	4	3	6
Delivery (10%)	1	2	6
Price of data (20%)	6	2	6
Software and related services (20%)	6	4	6
Support integration services (30%)	6	5	6
<b>Marketplace Services (35%)</b>	2.5	3.5	5.7
Billing (10%)	6	5*	6
Contact options (30%)	1	4	5
Help for data search (40%)	3	2	6

Registration (20%)	2	5*	6
<b>Total</b>	<b>3.375 (3.4)</b>	<b>3.3</b>	<b>5.495 (5.5)</b>

\* Website without registration

### **6.4.3. Limitations of the tests**

For testing, we chose three Internet solutions, which have different business models. For example, [www.geomarktplatz.de](http://www.geomarktplatz.de) claims to be a geomarketplace, while [www.ingeoic.de](http://www.ingeoic.de) is a portal. Thus, we did not compare the same thing three times. A negative test result was not necessarily negative in terms of the Internet providers' own business models. For example, [www.ingeoic.de](http://www.ingeoic.de) claims to be a portal. Not selling geographic data sets is an obvious part of a portal's business model. The test results strictly refer to the test scenario and the task of a bank manager to decide whether or not to start the introduction of GI in his/her business environment. Still we chose the approach of testing three "marketplace-similar" providers because of a lack of alternatives, and to give some hints to the providers for adding services in order to acquire additional customers.

Time was a limiting factor. The test focused on a limited time for testing websites. The test ignored the (sometimes more, sometimes less obviously offered) contact options via email or phone. We considered this approach justifiable, because executive managers require information in limited time. The setting is relevant for the all-day working practice.

On first sight, a weakness of the test was that Geoinformatics students played the roles of bank managers as test persons. One could argue that students' GI knowledge was too high to play the role of a non-expert in GI. However, the key test results were based on the observation that required marketplace services, i.e., product information, and GI products were almost non-existent. The test results were so revealing that the original plan to acquire real bank managers as test persons was cancelled.

## **6.5. COMPARISON OF SUPPLY AND DEMAND**

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Screening for Internet-based GI products and services for its access showed that most offers come from single companies. The disadvantages are obvious: The customer does not get a market overview, he cannot compare prices and quality, and probably products that are not the best and cheapest ones according to his/her requirements will be offered to him/her. For example, a company with a business partnership with Autodesk is not likely to sell any other GI software, even if it would be better or cheaper. The same problem occurs with the sell-side solutions [www.geodatenzentrum.de](http://www.geodatenzentrum.de) and [www.geodaten-online.de](http://www.geodaten-online.de). They provide a distinct set of data sets. Thus the market is not transparent to a potential user; he/she will not be informed about alternative products. And within the test scenario he/she will not be informed about the other required GI products – GI software and GI services.

Within the test scenario of a German bank, the screening of the Internet resulted in only two providers that can be considered GI marketplaces ([www.geodatenmarkt.de](http://www.geodatenmarkt.de) and [www.terramapserver.de](http://www.terramapserver.de)) and one GI portal ([www.ingeoic.de](http://www.ingeoic.de)).

The test results for website design and navigation were satisfactory (Janowicz, Knieper and Koch 2003). The providers invested ideas and resources in order to design professional websites. This and the Internet-based offers of sell-side solutions and single companies proved that e-commerce has started in GI business.

However, the three tested providers lacked content, which was required for the test scenario. The offer of GI products as well as the access to them was not sufficient (Janowicz, Knieper and Koch 2003):

1. *Data*: The tested providers focused on selling geographic data sets, i.e., government topographic-cartographic data. They provide search and buy functions, and some information about quality (metadata). However, we observed the following impediments:
  - For a non-GI-expert it is difficult or impossible to decide about needed data sets and its quality and usability
  - The geographic data do not necessarily cover the targeted area.
  - The thematic data sets are not necessarily provided.
2. *Software*: There was little information about needed GI software, its utility and prices.
3. *GI services*: There was almost no information about additional GI services, or about the product offer or the access to them. There was a severe lack of information about fulfilling the tasks of the scenario, e.g., GI consulting, integrating data sets and software into the bank's system and business work flows, and training of employees on the new GI environment.

The overall test result is that the bank executive managers could not decide whether or not to start the introduction of GI products. He/she could not even calculate a rough estimation of costs and benefits. He/she could not calculate the costs because he/she did not even know the needed products. He/she could not calculate the benefits, e.g., higher workflow efficiency, or improved quality of evaluation processes. Benefit information, e.g., reference projects using GI, was not presented.

Supply and demand differ widely. The following calculation compares the marketplaces' supply of GI products with the costs to the bank for introducing them. We exemplarily specify the GI products needed within the bank scenario. Cost estimations are based on the prices of online offers and estimations by the author:

**Tab. 10: Offer of GI products and costs of their introduction for the bank**

GI products	Offer of GI marketplaces	Product specification	Estimated project costs (€)
1. Data	Some information, order and pay functionalities	• Topographic data, 1:25.000 (TK 25), 300 km <sup>2</sup> (Münster, Germany)	300
		• Socio-demographic data (GfK data for	2.000

GI products	Offer of GI marketplaces	Product specification	Estimated project costs (€)
		Münster, Germany) <ul style="list-style-type: none"> <li>Purchasing power data (GfK data for Münster, Germany)</li> </ul>	2.000
2. Software	Some information	Single Arc View license	3.000
3. GI services, e.g., <ul style="list-style-type: none"> <li>GI consulting</li> <li>Project planning and controlling for GI introduction</li> <li>Integration of data</li> <li>Adaptation and integration of software</li> <li>Integration of into business workflows</li> <li>Training of employees</li> </ul>	Almost no information	20 man-days 20 man-days  5 man-days 10 man-days  4 man-days  Two employees, one-week training	30.000 30.000  7.500 15.000  6.000  4.000
Subtotal			92.500
<b>Total</b>	-		<b>99.800</b>

Still data sets are marketed as THE GI products. Most information offered by GI marketplaces deals with data. Functionalities for search, order, and payment of data exist. However, data make up less than 5 % of the costs of the GI system. The bank in the scenario did not get information about the most expensive part of its targeted introduction of GI (> 90 %).

The table contains neither the additional costs of the bank for internal personnel introducing the new system within the GI project, nor future costs for data and software updates, system maintenance, and personnel costs of employees working with the system. Including these costs would even enhance the cost relation of GI services vs. data and software.

In contrast to the offers of existing GI marketplaces, generating the needed end product requires the integration of various services. The bank does not want and cannot put all these pieces together. The combination of data and services (“interoperation”) is a key concern for developing a prosperous GI business.

## **7. BUSINESS PROCESSES OF A VERTICAL GI MARKETPLACE**

At this point, the thesis has validated the design principles of GI marketplaces. The previous two chapters validated that also in the specific scenario of a financial service provider, GI marketplaces have to address the needs for aggregated information services, cooperation of business networks, and improved customer access to the GI market. The next goal is to validate the concrete design of a GI marketplace framework and services.

The first step is to validate that the GI marketplace framework and services can be implemented in terms of appropriate business processes.

Section 7.1 provides the theoretical background for the design of a GI marketplace business process model. Section 7.2 re-uses the scenario of a bank requiring a GI product. It designs an online public call for tenders as a business process model for a vertical GI marketplace for financial service providers.

### **7.1. BUSINESS PROCESSES IN GI MARKETPLACES**

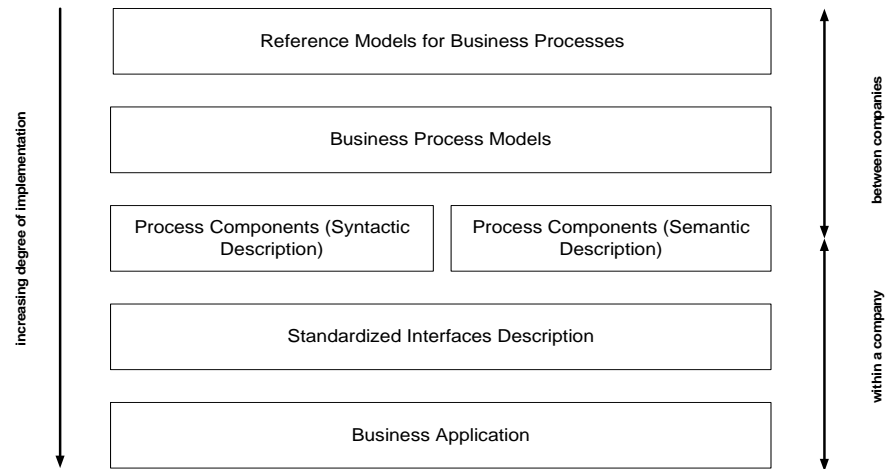
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To highlight the theoretical background, sub-section 7.1.1 describes the principles of integrating business processes within a distributed business environment of business networks. Sub-section 7.1.2 briefly recollects the need for a mixed-mode model of the GI marketplace integrating transaction- and collaboration-oriented services, and it identifies the ad-hoc formation of business networks as a key business process.

#### **7.1.1. Business process integration in inter-organizational systems**

GI marketplaces have to mediate the provision of aggregated information services by business networks. In a technical sense, a GI marketplace can be considered an interface. In an organizational sense, a GI marketplace is an inter-organizational system that enables collaboration between firms (Li and Williams 1999). Within an electronic marketplace, business processes of providers and customers are transferred to and executed by the marketplace (Fischer, Stelzer and Fiege 2003).

Networked cooperation requires an integration of distributed partners' business processes. Voigtmann and Zeller (Voigtmann and Zeller 2003) differentiate implementation levels of business process integration:



**Fig. 7: Implementation levels of business process integration (Voigtmann and Zeller 2003)**

The design of the GI marketplace framework and services can be considered the reference model for business processes. The goal of this chapter is to define a business process model for a vertical GI marketplace. The syntactic and semantic description will partly be addressed in the forthcoming chapters; further levels (standardized interfaces description and business application) would extend the scope of this thesis, but will be part of future work in realizing a specific GI marketplace (see chapter 11).

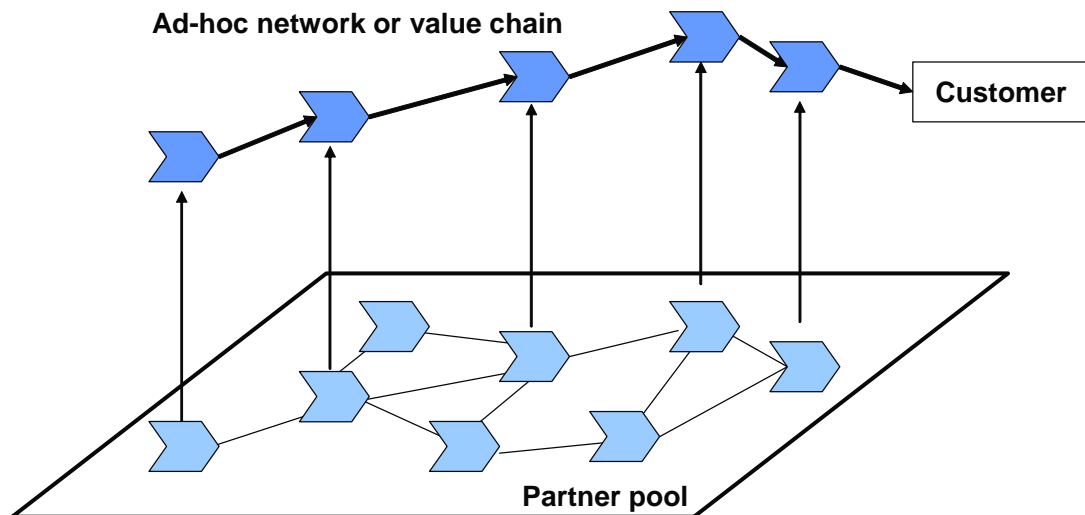
### 7.1.2. Mixed-mode GI marketplace

The first upcoming electronic marketplaces focused primarily on the reduction of transaction costs (Spiller and Wichmann 2000), representing the state-of-the art in economic sciences in the 1990s. In the GI market, transaction costs matter as well. An exchange of geographic data sets affects transactions, and these transactions affect costs, which can be reduced by Internet-based transactions (Krek 2003).

However, as already discussed, the specific need of the GI market is in cooperation with distributed providers in business networks. This need coincides with the general trend of non-spatial marketplaces towards collaboration-oriented models (Gogolin 2003). Collaboration marketplaces extend the service portfolio of transaction marketplaces; they are “characterized by planning capabilities such as continuous planning, forecasting, and replenishment or product life-cycle management” (Christiaanse and Markus 2003). They enable inter-organizational systems integration and provide specialized supply chain collaboration capabilities (Christiaanse and Markus 2003). Various marketplaces, e.g., mySAP.com, Volkswagen Group, and SupplyOn, have already implemented the collaboration services (see section 3.1). In 2000, industry experts predicted that “by 2005, collaboration services could represent 40 – 50 % of the total revenues of the e-marketplaces that provide such services” (Andrew, Blackburn and Sirkin 2000).



The key process in a GI marketplace is the ad-hoc establishment of business networks for providing information services. Gogolin and Klein (Gogolin and Klein 2004) adapt the “virtual factory model” of Göransson and Schuh (Göransson and Schuh 1997) for collaboration-oriented marketplaces.



**Fig. 8: The virtual factory model (Gogolin and Klein 2004)**

“The virtual factory provides customer individual products. In case of a customer order a specific network is formed to process the order. This “project network” is limited in time and is decomposed after finishing the project” (Gogolin and Klein 2004).

Designing the process of forming this “project network” is a very challenging task for implementing GI marketplaces. Therefore, Gogolin and Klein (Gogolin and Klein 2004) suggest the mixed-mode model for GI marketplaces, which extends simple trade transactions by

- Product aggregation and bundling
- Request for quotations, and
- Configuration of GI solutions.

The following section aims to implement the mixed-mode approach in terms of a business process model.

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## **7.2. BUSINESS PROCESS MODEL OF A VERTICAL GI MARKETPLACE FOR FINANCIAL SERVICE PROVIDERS**

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For the design of the business process model, this section uses the scenario of the financial service provider requiring a GI information service again (sub-section 7.2.1). Providing the required GI solution can be compared with building a new school: The customer, a local authority, requires

- An aggregated product consisting of
  - raw products, e.g., bricks, cables, pan tiles, and a bath tub (the GI market equivalent are geographic data), and

- services, e.g., laying the bricks and cables, designing the building and its interior, and getting the finances settled (the GI market equivalent are human and technical services),
- a wide range cooperating companies, e.g., brick-layer, architect, bank, electrician, and gardener (the GI market equivalent are business networks),
- a legal framework (public procurement law) for placing an order by public authorities (the GI market equivalent are institutional services, e.g., technical standards and business rules of a GI marketplace), and
- public procurement, which processes the placing of an order (the GI market equivalent is a business process model of a GI marketplace),

in order to achieve the expected result: a school (the GI market equivalent is the information service, which is ready to use). Therefore, the public procurement solves three issues, which have been identified as the key needs of the GI market (see chapter 2):

- The building trade branch provides aggregated products of raw products and services.
- Within the branch of building traders, companies cooperate in ad-hoc business networks in order to provide the required end product.
- Public authorities have access to the building trade market – or even smarter: The providers of the building trade market come to the customer. By the call for tenders, a public authority creates a single entry point for offers; the building traders provide their product offers directly to the customer according to his requirements.

This section uses this analogy for the design of a business process model for a GI marketplace. The public procurement law evolved over centuries, is very detailed, and can be considered as more than complete for this purpose. Sub-section 7.2.2 describes the public procurement law in Germany. Nowadays, the public procurement process is already implemented in existing marketplaces, e.g., Cosinex, Germany (Cosinex 2004a), see section 3.1. E-Procurement follows the principle of reverse auctions. The key issue of this principle is that the customer defines the products in the auction, and providers bid on them. Reverse auctions are already implemented in existing marketplaces, e.g., by the ZDI marketplace (Sperling 2003), see section 3.1. Sub-section 7.2.3 describes public e-Procurement in more detail. Based on the business process model of public e-Procurement, sub-section 7.2.4 derives a business process model for a vertical GI marketplace for the financial service industry.

### **7.2.1. Scenario**

This section uses the scenario of a bank that requires a GI-supported in-house again (see section 6.1). The scenario is a bank, which targets the evaluation of the locations of its branches. The evaluation targets a priority list of existent and planned localities by comparing costs and market potential. The final goal is to decide about improvements of branches, shifting or closing of existing localities, and opening new ones. The evaluation is based on enterprise and demographic data, and it shall be supported by geographic information. The bank reevaluates every year. Therefore, the bank needs a tool and working processes for an in-house execution.

Generating the desired end product includes different tasks, e.g., finding business partners, defining requirements for needed data sets and GI software, integrating data and software into the bank's business system, and training employees on the new system.

### **7.2.2. Public procurement law**

The public procurement law is binding to all German public procurement, ranging from buying a pencil to building a school. The public procurement law refers to many different laws and decrees. Most important are GWB (Gesetz gegen Wettbewerbsbeschränkungen = law against restrictions of market competition), VOF (Verdingungsordnung für freiberufliche Leistungen = decree for freelancing services), and VOB (Vergabe- und Vertragsordnung für Bauleistungen = decree for procurement and contracting of construction services). In addition, the public procurement law refers to technical standards, e.g., DIN (Deutsche Industrie-Norm = German Industry Standard), and quality standards, e.g., ISO 9000 (International Standardization Organization).

In the context of building a school, the most relevant and business process-describing decree is the VOB/A, which defines the procurement of public authorities (Vertragsausschuss\_für\_Bauleistungen 2002).

The core principles, which are lacking in the GI market (see section 1.2), are transparency, competition, and equality of competitors in a neutrally performed procurement process (Wegener 2004).

Derived from the detailed guidelines for public authorities by Meißner (Meißner 2002), the public procurement process consists of the following steps:

1. Preparation of call for tenders:

The public authority describes their requirements, in this case a public school. Typically, the public authority contracts an architect to design the school. The public authority divides the end product "school" into intermediate products. The product "school" is differentiated into lots, e.g., roof construction, landscaping, wall construction, and heating installation. The lot is differentiated into crafts, e.g., the landscaping is divided into providing plants, planting them, and replacing casualties after a year, and constructing a small goldfish pond. The public authority also provides information to the provider about required quality and quantity.

2. Publication of call for tenders:

The call for tenders has to be published officially at well-known and defined places, e.g., in daily papers and official journals. The call for tenders gives information about the process rules for application, e.g., a deadline. It provides formal documents for bidding offers.

3. Elaboration and provision of bidding offers:

This process is initiated by the public authority, but executed by ad-hoc established business networks. The landscaping company retrieves information about plant prices, calculates its own costs, and requests an offer of a potential sub-contractor for installing the goldfish pond. This consortium lead by the landscaping company provides a bidding offer

for the lot “landscaping”. Other companies or consortia bid for the other lots necessary for aggregating the end product “school”.

4. Evaluation of offers:

The first criterion for evaluation is the price. But it is interesting to observe, that price is not the only criterion. First, an expert of the public authority might evidence, that the offered product is not complete, or the proposed product leads to follow-up costs. Second, an expert might find out that the product quality of a more expensive provider might justify higher expenses. Third, a non-reliable bidder might be excluded from the call for tenders due to a lack of trust, even when offering the cheapest product.

This description of a public call for tenders provides a rough business process model for public procurement. The following sub-section will provide evidence, that even such a complex process as public procurement can be modeled and implemented in an electronic marketplace.

### **7.2.3. E-Procurement and online public call for tenders**

Implementing a process as complex as a public call for tenders, the capability to mediate the provision of services is necessary. In the economy, virtual marketplaces for services are implemented using the following strategies:

- Sell-side marketplace (n:1)
- Reverse auctions (1:n)
- Matching (n:n) (Schoen+Company 2000).

Sell-side marketplaces (n:1) contradict the idea of a GI marketplace. In section 2.2, the need for business networks instead of single, monolithic providers in the GI market was discussed.

A single public procurement matches the model of a reverse auction (1:n). Public authorities define the required product in a very clear, detailed, and defined way, and ask for bids. Although the definition of products by the customer matches the key principle of reverse auctions, the targeted e-Procurement does not match the terminology in economic sciences, because reverse auctions go along with a 1:n-relationship. Theoretically, a GI marketplace could be run, for example, by a bank, using the reverse auction model. However, such a marketplace probably would not achieve a critical mass.

The goal of matching marketplaces (n:n) is to offer the services of many service providers to many customers. For example, Atrada ([www.atradapro.de](http://www.atradapro.de)) hosted about 70 % (~17.000) of the IT service providers in Germany in 2000 (Schoen+Company 2000). The marketplace is capable to mediate even complex IT projects. The number of IT service providers can be considered a proof of success. The n:n-relationship matches the requirements of the GI market (see section 3.3).

However, the author considers the single public procurement process as a reverse auction, while the marketplace model for the GI market operates in a matching n:n-model, executing reverse auctions on behalf of many different customers.

The Internet-based reverse auction is realized, for example, in the ZDI marketplace (Sperling 2003), see section 3.1. Although the ZDI marketplace seems to be successful and provides a

solution for Internet-based reverse auctions, this model does not sufficiently address the needs of the GI market, because it trades with raw products instead of aggregated services.

Marketplaces mediating e-Procurement by calls for tenders are emerging. Their goal is to process complex transactions for projects; processes start directly after contracting, while project management continues after the marketplace transactions (Arndt 2002).

The Gem marketplace, Australia <http://www.gem.wa.gov.au/Gem>, focuses on services of public procurement as well. However, it is rather transaction-oriented than providing collaboration services. The Gem marketplace reduces the transaction costs of publishing the call for tenders, but only indirectly forms business networks of providers.

An existing marketplace close to the concepts of GI marketplaces is the Cosinex marketplace that implements the public procurement law and processes within its marketplace (Cosinex 2004a). The Cosinex marketplace implements the procurement process described in sub-section 7.2.2, and provides tools for its online-execution (Cosinex 2004a; Cosinex 2004b; Cosinex 2004c):

1. Preparation of call for tenders:

The tool “workflow.professional” supports the user in designing her/his individual call for tenders. A knowledge-base checks that laws and decrees are followed. The tool provides workflows for the design of the call for tenders as well as providing standardized forms for its publication.

2. Publication of call for tenders:

Registered users can publish their call for tenders at the marketplace. Plausibility controls check that the calls for tenders follow the public procurement law. Potential providers can be notified automatically.

3. Elaboration and provision of bidding offers:

Bidders can provide their offers to the marketplace directly. The marketplace assures security by providing encoded offers. A system-internal mechanism assures that the offers can not be opened by the customer before the deadline for the call for tenders.

4. Evaluation of offers:

The evaluation is supported by standardized and digital tendering documents. Cosinex provides an automated tool for the evaluation process, e.g., by evaluation of single lots according to user-defined criteria. The processing of the call for tenders is documented and can be evaluated statistically, thus documenting the law-conformant processing of the procurement process.

The Cosinex business model combines two approaches: running a marketplace and selling software for public e-Procurement. Nevertheless, it gives evidence that electronic marketplaces are capable of implementing the complex process of Internet-based public procurement.

#### **7.2.4. Business process model**

This sub-section derives a business process model for a vertical GI marketplace for financial service providers according to the above described scenario (see section 7.2.1), based on the public

procurement law and its implementation in existing marketplaces by online public call for tenders. The model consists of four phases:

1. Preparation of call for tenders:

The business process starts with a bank manager's request for a product offer. The bank manager will need support for formulating his/her request. Therefore, the GI marketplace offers support, either through a software tool similar to that of the Cosinex marketplace (Cosinex 2004c), and/or personal consulting. Finally, the bank manager fills in his request in an electronic form provided by the GI marketplace.

2. Publication of call for tenders:

The GI marketplace publishes the request in the form of an online public call for tenders in the marketplace. In addition, the GI marketplace notifies GI consultants, who - according to the GI Marketplaces' database - could potentially do the job, about the call. Furthermore, the GI marketplace evaluates potential data providers and data integrators according to the customer's request. The GI marketplace then transmits this information along with the notification to the GI consultant.

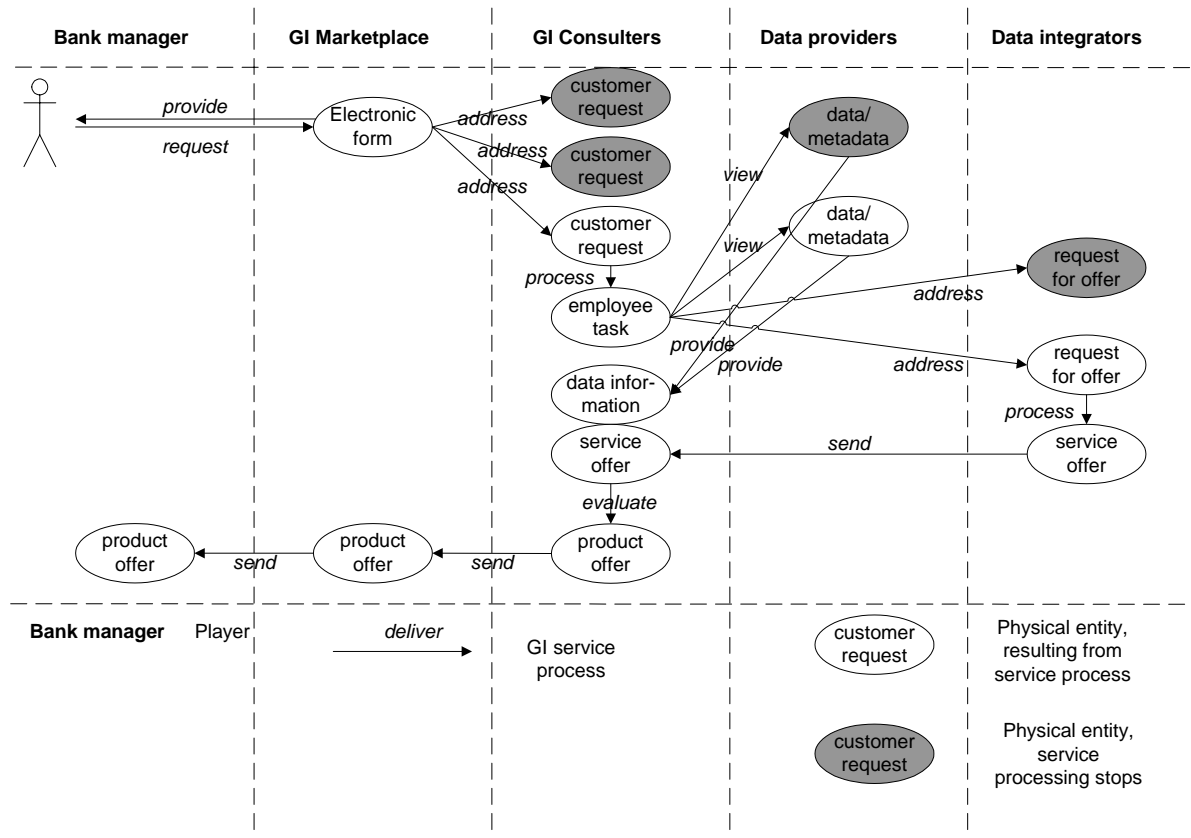
3. Elaboration and provision of bidding offers:

The addressed GI consultants internally decide whether to process the call for tenders or not. An interested GI consultant checks potential data providers by viewing their data and relevant metadata information. After deciding for a suitable data set, the GI consultant addresses the customer's request for data integration to data integrators capable to fulfill the task. One or several data integrators send back an offer for the integration service. The GI consultant evaluates all information and sends an offer for the required end product to the GI marketplace.

4. Evaluation of offers:

The GI marketplace collects the incoming product offers and checks formal issues, e.g., that the quotation was received within the deadline. The bank manager will need support for the evaluation of contents. The GI marketplace can provide this support by two means. For banks with some in-house GI expertise, a software evaluation tool similar to that of the Cosinex marketplace (Cosinex 2004c) might be appropriate. For customers without GI expertise, the GI marketplace itself might evaluate the product offers and provide the results to the bank in terms of an evaluation report. Finally, the bank has to choose an offer.

The following figure illustrates the business process model:



**Fig. 9: Business process model for a vertical GI marketplace for financial service providers**

The business process model demonstrates that the marketplace gives potential customers access to the GI market, and it coordinates and supports the establishment of business networks.

## 8. TECHNICAL IMPLEMENTATION

After the validation of an appropriate business process model in the previous chapter, the next step is to validate the feasibility of its technical implementation. For the implementation of electronic marketplaces, a set of various business process frameworks is already available, e.g., ebXML, RosettaNet, WSCI, BizTalk, WSFL, and BPEL4WS (Otto and Waesch 2003), (Senkler and Remke 2001). Existing marketplaces have already implemented these frameworks, e.g., OracleExchange ([www.oracle.com](http://www.oracle.com)), IBM WebSphere Commerce ([www.ibm.com](http://www.ibm.com)), and Tradeum ([www.tradeum.com](http://www.tradeum.com)) (Ruether and Szegunis 2000b). Ongoing research addresses further challenges to electronic marketplaces, e.g., the decentralized economic coordination in multi-agent systems (Eymann 2001), and legal issues of and contractual models for geographic information (Janssen 2003).

Technical implementation remains a key challenge to the GI market: A typical GI product required by a bank consists of a set of intermediate products: data, software, technical, human, organizational, and institutional services. Current GI Internet platforms sell mostly data, but they offer few additional services integrated in business processes. This leads to interruptions in business transactions.

This chapter addresses the ongoing challenge of how to establish a consistent service chain in a GI marketplace that results in the required end product. A customer requires an Internet-based business process on a single platform. This affects the need to integrate different types of services: technical services, e.g., “view map”, have to be combined with human services, e.g., “evaluate data set appropriate to user’s requirements”.

In markets in general the use of semantic enabling languages and ontologies is increasing. The first level is a semantic description of product catalogues, e.g., by Angele and Erdmann (Angele and Erdmann 2001), and the comparability of product offers via the Semantic Web (Bizer 2003). The more advanced level is to handle more complex objects. Semantic enabling description languages are used for knowledge and content management. For example, the INKASS project (Abecker, Apostolou, Franz et al. 2003) targets the trade of knowledge in electronic marketplaces by using ontologies to describe existing knowledge in the Web and, the more advanced step, to add services for enabling business processes.

In the GI world, we can observe a similar evolution. The need for semantics was first observed in reference to geographical objects in data sets. Then, the need for semantically enabling descriptions of services became the next challenge (Kuhn 2002). Ontologies are used mostly to describe contents and enable technical service chaining, e.g., (Janowicz and Riedemann 2003). This chapter addresses the ongoing challenge of integrating human services into business processes in order to make GI economically more successful.

The integration of technical and human GI services in Internet-based service chains needs a common language for web description and implementation. The most promising candidate seems to be OWL-S (formerly DAML-S) for two reasons:

- OWL-S fulfills the semantic enabling capabilities for technical GI service chaining (Janowicz and Riedemann 2003)



- OWL-S is quite advanced in markets in general enabling web services, e.g., the implementation of the DAML-S Matchmaker, “a Web services registry that enhances the UDDI registry with matching of capabilities of Web services to allow the location of Web services on the bases of what they provide rather than their name, port or other contingent information”(Paolucci, Sycara, Nishimura et al. 2003).

Previous work shows that OWL-S enables service chaining of technical GI services (Janowicz and Riedemann 2003) because it enables semantic description. If OWL-S were also capable of describing human GI services sufficiently, and integrating both types of services to a human-technical service chain, complex GI products could be provided in an electronic GI marketplace. The goal of this chapter is to clarify this question.

Section 8.1 provides a brief overview of OWL-S concepts, and argues why OWL-S enables technical service chaining. Section 8.2 analyzes the business process model defined in the previous chapter. It argues that processing the online public call for tenders requires an integration of technical and human services. Section 8.3 analyzes the requirements of a semantic-enabled description of human services, and the capability of OWL-S to fulfill the need for a semantic web description. In addition, this section analyzes whether OWL-S is capable of integrating human and technical GI services into an Internet-based service chain.

Major results of this chapter were published in Brox and Janowicz 2004: Integration of Human Services into Technical GI Service Chains. AGILE conference, April 29 – May 1, 2004, Crete, Greece, [www.agile-online.org](http://www.agile-online.org). Section 8.1, sub-section 8.3.2, and some aspects of the discussion of results (sub-section 10.2.2) are based on Krzysztof Janowicz’s input and insight into OWL concepts.

## **8.1. SERVICE CHAINING OF TECHNICAL GI SERVICES BY OWL-S**

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This section provides the theoretical background of OWL-S. Sub-section 8.1.1 provides an overview of OWL-S concepts. Then, sub-section 8.1.2 argues why OWL-S enables technical service chaining.

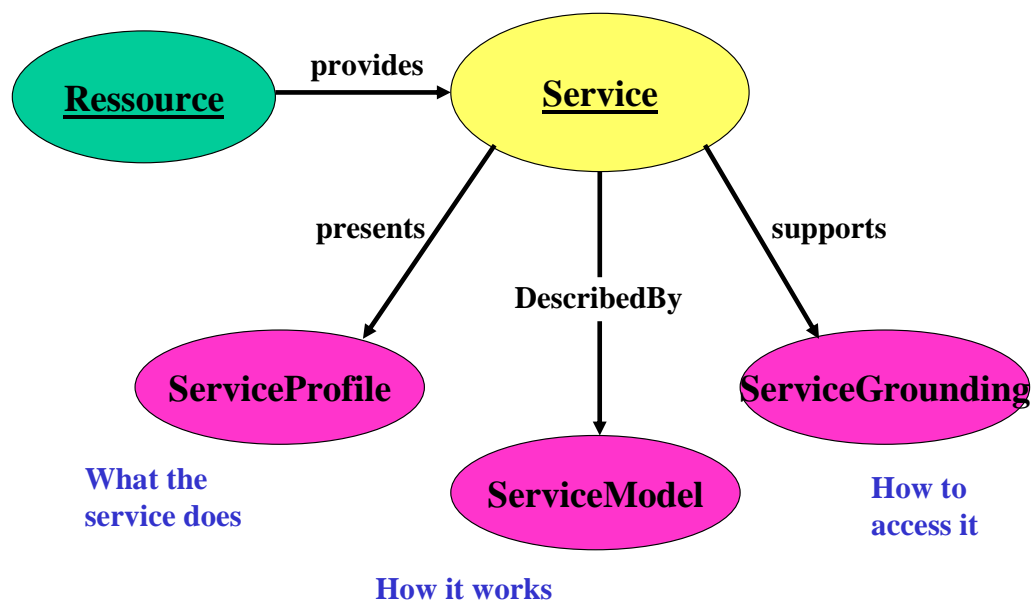
### **8.1.1. Concepts of OWL-S (DAML-S)**

DAML-S is the acronym for DARPA Agent Markup Language for Services (DAML-based Web Service Ontology). It was developed by the DAML Group and the last version in use was 0.9. The current version 1.0 of DAML-S was renamed OWL-S because the Web Ontology Language (OWL) is now used to describe service ontologies (DAML-S-Coalition 2003b). This is an important step, because OWL is the ontology description language developed and proposed by the Word Wide Web Consortium (W3C). In this paper we use the new name (OWL-S) but many tools and published literature use the old term DAML-S. As indicated by the version number, OWL-S is not quite ready yet and there is still a lot of work to do (Sabou, Richards and Splunter 2003), (Janowicz and Riedemann 2003), for example the monitoring mentioned above is not described in the current OWL-S specification

An OWL-S service description consists of three parts: Service profile, service model, and service grounding. These aspects, also shown in figure 1, are described briefly in the following paragraphs:

The *service profile* is the part of a OWL-S service ontology that acts as a kind of yellow pages. It is important for the service discovery and explains what the service does. In addition to some fixed defined properties, e.g., a contact phone number or a URL, it is possible to define additional service parameters or use offered parameters such as geographic radius. In addition to the informational descriptions, the service profile provides functional descriptions, e.g., the specification of the input and output of the service, and its effects and precondition.

The process ontology expresses the *service model* that defines how the service works. There are three types of processes: atomic, simple and composite. Atomic processes are those processes that cannot be broken down into simpler processes; they are executed in a single step. Simple processes are a method of abstraction and therefore cannot be invoked. Composite processes are those that are composed of atomic or other composite processes by the use of control constructs such as loops or if-then-else constructs. The process description plays an important role for the service interoperation, and it is also needed for a more precise discovery of complex services.



**Fig. 10: DAML-S service ontology, from (DAML-S-Coalition 2003b)**

The *service grounding* is the part of an OWL-S service ontology that binds the abstract service specification to a concrete port, protocol etc. It describes how to access the service. Therefore it consists of two parts: a WSDL description and an ontology based description that relates the WSDL part to the service ontology. The service grounding is most important for the service invocation but plays a role in interoperability as well.

A service composition language must be able not only to express the concept of a composite service, but also to specify how the parameters are bounded together and how the data gets from one part of the composite service to the next one. This is still a problem in the OWL-S specifications.

### **8.1.2. Capabilities of OWL-S**

There are several existing and upcoming technologies and frameworks that enable automatic service chaining. By using web description languages such as BPEL4WS (Andrews, Curbera, Dholakia et al. 2003) or OWL-S (DAML-S-Coalition 2003b) it is possible to describe simple, atomic services and their combination to more complex ones. Corcho et al. (Corcho, Fernández-López and Gómez Pérez 2001) provide an overview of technical state-of-the-art in ontology technologies. Otto and Waesch (Otto and Waesch 2003) evaluate business frameworks as ebXML, RosettaNet, and BPEL4WS regarding requirements for inter-organizational business process integration.

Depending on the aim, each framework or language fulfils more or less the criteria that are needed for service chaining. We decided to use OWL-S here, for the following reasons:

First, OWL-S is an ontology-based, semantic enabled markup language that claims to allow automatic discovery, invocation, composition and interoperation, execution and monitoring of web services. Especially in reference to the complex service chains offered on a GI marketplace the importance of semantics is obvious: Without an explicit, shared understanding of the data and services dealt with it is impossible to chain them together. For example, a service will not deliver reasonable results, if input data do not specify what the required service should look like (Janowicz and Riedemann 2003).

Second, OWL-S supports the creation and usage of complex services (Paolucci, Sycara, Nishimura et al. 2003). As mentioned above it supports the discovery of simple and composite services e.g. within registries and catalogs. This is especially important in GI marketplaces, because the user must be able to choose a suitable product out of a large amount of products. Therefore explicit “yellow pages” that both humans and machines can understand are needed. This is in fact offered by OWL-S. Interoperation of services is moreover necessary to describe the model behind a composite service, e.g. to describe which atomic services it is composed of or what effects arise while running the service. This kind of information can be described with help of the OWL-S service model. The next important aspect of service chaining is that it must be possible to track the service in such a way that the user or an agent can detect the actual position of the service and can find out whether there are any problems. This requirement is as well covered by OWL-S.

Summarized, OWL-S is a semantically enabled markup language that covers the most important aspects of automatic, technical service chaining. But, what about the human parts of a complex chain as described above?

## 8.2. GI SERVICE PROCESSES IN A VERTICAL GI MARKETPLACE

Again, this chapter uses the scenario of a bank. The bank wants to evaluate its branch locations. The evaluation targets a priority list of existing and planned localities by comparing costs and market potential. The final goal is to decide about improvements of branches, the shifting or closing of existing localities, and the opening new ones. The evaluation is based on enterprise and demographic data, and it shall be supported by geographic information. The bank reevaluates every year. Therefore, the bank needs a tool and working processes for an in-house execution.

The generation of the desired end product includes different tasks, e.g., finding business partners, defining requirements for needed data sets and GI software, integrating data and software into the bank's business system, and training employees on the new system.

The scenario focuses on the first critical step of a business transaction: information retrieval. Currently, Internet platforms for geographic information often are not able to answer a customer's simple question (Brox and Kuhn 2004): How much do I have to pay for the required product?

To validate the feasibility of technical implementation, this section uses the business process model developed in section 7.2. The following extended version additionally depicts and categorizes the types of the GI service processes:

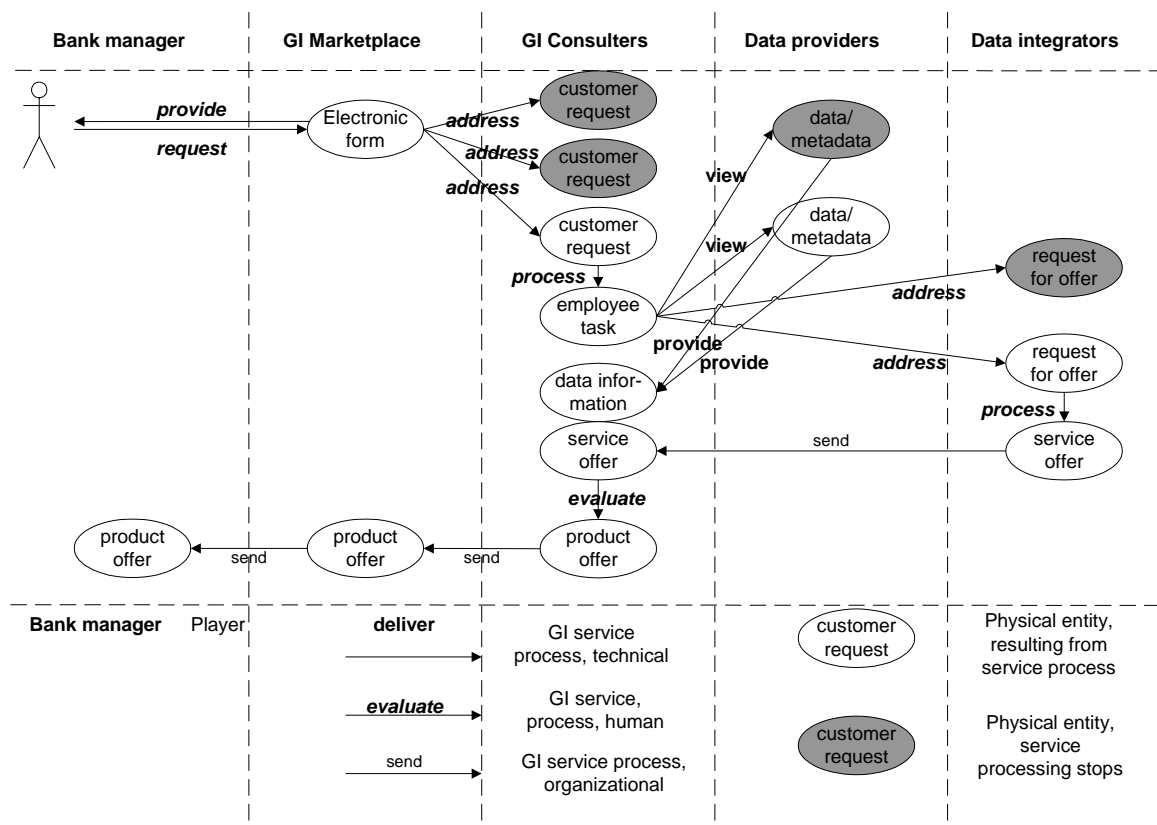


Fig. 11: GI service processes in a vertical GI marketplace

The figure above shows different types of services. They can be classified into three groups:

- Technical GI services allow automated processing by the current state-of-the-art, e.g., OGC-conformant Web Mapping Services, Web Feature Services, and Catalogue Services.
- Human GI services cannot be automated by the current state-of-the-art. Human GI services are provided by human beings, e.g., processing a request for an offer for integrating a data set.
- Organizational GI services are notification services of the players of the scenario in order to inform the business partners about the fulfillment of a request, e.g., by email.

However, differentiation is not pronounced in some cases. For example, a typical business process for the GI market is considering a data integrator who could potentially do the required job or looking for one on the Internet. Technical implementation tries to automate this process by matching specified requests for services with specified offers. Thus, some GI services, e.g., “address”, are classified as human services, although a successful implementation would turn them to technical GI services.

The following section analyzes whether OWL-S is capable of describing the business process of the scenario. It analyzes the requirements of web description and its fulfillment by OWL-S for

- Human GI services,
- And the integration of both types of services in human-technical service chaining.

### **8.3. INTEGRATION OF HUMAN SERVICES IN HUMAN-TECHNICAL SERVICE CHAINS**

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This section identifies the requirements for describing human services by a web description language (sub-section 8.3.1), and analyzes how the requirements are fulfilled by OWL-S (sub-section 8.3.2).

#### **8.3.1. Requirements**

In the scenario, we observe two groups of human services

- Internal processing of user request by employees of GI consultant and data integrator (“process” and “evaluate”)
- Matching of user requests and potential providers (“provide”, “request”, and “address”)

As an example, we take the human services of the GI consultant “process” and “evaluate”. These services are very complex, and they involve the invocation of further services, addressing the technical service towards the data provider, and the human service addressing the data integrator.

However, the human services of the GI consultant have a defined, physical input (customer request) and output (product offer), as well as parameters of the human service itself. The precise, machine-readable description has to enable

- The integration of the human service in an Internet-based business process

- And finding the service in the Web, matching it with the user's request, and thus addressing a "correct" GI consultant who is capable of doing the required work.

A web description language has to describe the following parameters of a human GI service:

- Services offered, possibly deviation from offered prices, e.g., rate of person hour Type, e.g., gather information, evaluate information
- Context, e.g., geographic data, socio-demographic data, data integration, GIS training
- Communities, e.g., providing GI services addressing banks, insurance companies, and local authorities
- Technical requirements for interaction, e.g., hardware requirements, software requirements
- Method of interaction, e.g., input and output, electronic form for customer request and product offer
- Price of required product
- Address of provider, e.g., town, street, telephone number, fax, email address
- Geographical position and possible limitation of service offers to regions
- Time, e.g., opening hours
- Language, e.g., national or international services
- Legal aspects, e.g., time limitation of offered product, location of responsible jurisdiction.

These requirements demonstrate a deep need for semantic description of human services. Simply put, one could divide semantic problems in human interaction into two types. The first is the group of problems that arises when two persons have to communicate personally. This kind of semantic mismatching is not dealt with here because it is not a problem of computer semantics. The second category arises when human users communicate with technical services. It must be clear to the user what kind of input the service needs and what output will result from it. This plays an important role in service discovery but also in the later interaction with the chosen service. For example, even filling out a form on a web interface can be problematic without the needed community vocabulary. Therefore this vocabulary has to be defined in an explicit way, for example by using ontologies.

Consequently, a service chain of technical and human services has to be described in a semantic enabled way. Thus, the demands for a human service description are not as far away from those of a technical service description as might be expected. For example, a human service can also consist of several simple services. These services are also held together by control constructs, e.g. if a GI-consultant is not able to find suitable data from one provider, then he has to search a second one. However, technical services have a concrete grounding to a communication protocol, port number etc.

Matching user request and providers' offers needs a semantic enabling web description language. OWL-S is the best candidate. The following sub-section validates if OWL-S fulfills the requirements.

### **8.3.2. Fulfillment of requirements by OWL-S**

The following paragraphs compare the three main parts of OWL-S service ontology with the needs of human services:

#### **Service profile for human services**

As described above the OWL-S service profile acts as a kind of yellow pages. Service parameters such as geographic radius and phone number are also necessary for human services. Moreover, it is possible to specify additional service parameters that are especially important for human users. For example the legal aspects of a service can be described as service parameter. Input, output, and preconditions are not the concepts we think of when talking about human communication, but we can assume that an interaction between a user and a consultant may look like this (simplified). For example the user describes his required product to the consultant as input; the consultant is looking for solutions and returns an offer as output. Human communication is much more complex and belongs to the first of the problems described above. This section focuses on the description of input and output that a technical service submits to a human service or the other way around. That means that one of the communication partners is always a technical one. And in this case it is possible to speak of outputs and inputs in the way computer scientists do. Regarding the scenario, the service profile plays the most important role when the bank manager is trying to find a suitable GI consultant and when the consultant is looking for integrators and data providers.

Summarized, the OWL-S service profile can be used for human services.

#### **Service process for human services**

The process description proposed by OWL-S is necessary for a more specialized discovery but mostly for the interoperation and composition of simple services to more complex ones. As mentioned above there are two types of human services. Human processes on the one hand and human to technical service interaction on the other hand. The scenario shows both types of services. The first one, for example when the GI consultant delegates a task to his employee; this is not of interest for a representation of the service to third parties. In this case, the human service can be represented by an OWL-S atomic process and a simple process can be used as an abstraction that can act as a kind of black box to be expanded to a complex process if needed. The second type of human service can be also represented in this way. In this case, the aspect of grounding becomes important and will be discussed below. As argued above, human services can also be control constructs; this is true for both types of human services. For example the GI consultant can look for data integrators until he finds one that is suitable to integrate a special data format like ATKIS. This is a kind of loop, which can be represented as OWL-S Repeat-Until control construct. In our opinion input and outputs can be defined in the same way as by technical GI services, especially if one of the both partners is always a technical partner as shown in the scenario above.

The actual OWL-S specifications force grounding for atomic processes and therefore also for composite processes, this is a problem when trying to describe human services. Summarized, OWL-S service processes can be used for human services, too.

#### **Service grounding for human services**

The third part of OWL-S service ontology is the grounding. Because OWL-S focuses on automatic service chaining the grounding is necessary to enable the communication between two technical services. The problems arising here for human services are mostly related to WSDL.

WSDL is a description language that describes web service interfaces in a syntactical way. The WSDL description is related to the service process of OWL-S by a special WSDL grounding class. Human services cannot be grounded in this way. It is possible to describe the input and outputs of a human service by WSDL and also one can argue that a human service can be reachable through a web protocol or by a mail protocol like SMTP. This would mean that the service sends his output per mail to the human service (the GI-Consultant from the scenario) and the service is responding by mail or per web interface. At first glance, this appears to be a suitable way of grounding human services, but most of the web services are not made for asynchronous communication as intended by SOAP as main communication protocol for web services (Simonis and Wytzisk 2003), for example an GI consultant is not available 24 hours a day, seven days a week.

The OWL-S service grounding is the only part of the OWL-S description that is not on an abstract but concrete level. Because OWL-S is especially designed for automated (without human interaction) processing the grounding is the most problematic part of the specification, nevertheless human services can also be grounded.



## **9. BUSINESS PLAN FOR A VERTICAL GI MARKETPLACE FOR FINANCIAL SERVICE PROVIDERS**

After validating the feasibility of GI marketplace concepts in terms of appropriate business processes and technical implementation, the next step is to validate the economic feasibility of running a GI marketplace. A business plan forces the start-up organization to systematically check business ideas and concepts (Heucher, Ilar, Kubr et al. 1999). This chapter elaborates a business plan in a vertical GI marketplace for financial service providers in Germany according to the GI marketplace design described in chapters 3 and 4 (part C). Being able to produce a logical and promising business plan validates the feasibility of a GI marketplace's realization.

Osterwalder and Pigneur (Osterwalder and Pigneur 2002) created an eBusiness Model Ontology (BMO) for modeling business models in electronic markets. According to them, a business model is a “description of the value of a company offers to one or several segments of customers and the architecture of the firm and its network of partners for creating, marketing and delivering this value and relationship capital, in order to generate profitable and sustainable revenue streams”. Therefore, creating value in the Internet is composed of four main pillars:

- Product innovation
- Infrastructure management
- Customer relationship
- Financials (Osterwalder and Pigneur 2002).

A second available ontology on e-business models is e<sup>3</sup>value (Akkermans, Baida and al. 2004). A comparison of BMO and e<sup>3</sup>value showed that they base on the same four pillars described above and complement each other (Gordijn, Osterwalder and Pigneur 2005).

Looking for business plans implementing the meta-models of BMO and e<sup>3</sup>value, the McKinsey guidelines for designing a business model for firms (Heucher, Ilar, Kubr et al. 1999) can be considered an appropriate tool. The guidelines contain most of the elements of the meta-models. A weakness might be too little emphasis on value configuration, which was included into the business model for a vertical GI marketplace for the financial services industry.

The business plan

- Presents the business idea (section 0)
- Presents the core ideas of services to be offered (section 9.2)
- Identifies the innovation and value configuration (section 9.3)
- Describes possible entrepreneurs (section 9.4)
- Designs a marketing concept (section 9.5)
- Designs an organizational framework (section 9.6)
- Conceptualizes the realization of a vertical GI marketplace (section 9.7)

- Estimates a budget (section 9.8) and
- Evaluates risks and opportunities (section 9.9).

Finally, section 9.10 estimates the expected performance of the GI marketplace by analyzing the fit between the transaction-related requirements of marketplace users and the marketplace offerings according to the conceptual model of O'Reilly and Finnegan (O'Reilly and Finnegan 2005).

## 9.1. BUSINESS IDEA

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The business idea is to create a vertical GI marketplace for financial service providers in Germany. The GI marketplace acts as an independent non-profit organization, open to all players of the GI market. The key objective is to exploit the potential, and thus enhances the market volume of the German GI market.

The GI marketplace provides marketplace services in order to achieve this goal.

## 9.2. SERVICES

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This section describes the following aspects of the GI marketplace's services:

- Problem and approach
- Service offer.

### 9.2.1. Problem and approach

The GI market faces major impediments:

1. Potential customers *lack information*. Some potential customers do not even know that GI could potentially be of value to them. Others are hardly able to quantify prices and benefit of a required GI product. In addition, the GI market is not transparent. Potential customers do not have appropriate access to GI providers and are rarely able to compare their offers.
2. We observed a *mismatch of supplied and demanded products*. We tested the mismatch on the basis of a scenario, where a bank manager required a typical GI product of a GI supported evaluation tool for the bank's localities. The costs for data and software were about 10 % of the total costs, whereas the costs of additional human GI services, e.g., consulting, data integration, software integration, and training of employees on the new system, were about 90 % of the total costs. The price is inconsistent with the offer, which consisted mostly of data.
3. The GI market is based for the most part on *outdated business models*. Currently, we observe monolithic business models, where one provider offers many products from the geospatial value chain on its own, from data production, data integration, and software integration, to training of employees. Not focusing on core competences causes a reduction in product quality. An up-to-date business model of regular economy in terms of business networks has not been introduced yet.

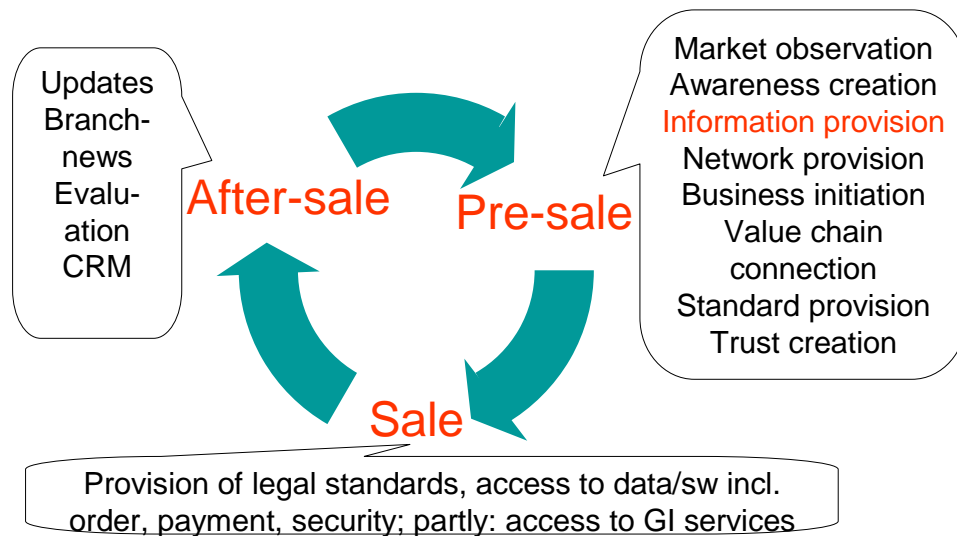
We suggest an electronic GI marketplace for financial service providers as a tool for coordination and cooperation. The GI marketplace provides services that support transactions as well as collaboration between customers and providers, and providers and providers.

### 9.2.2. Service offer

The general concepts (organizational framework and services, see chapters 3 and 4) can be adapted to a specific vertical GI marketplace. Differences to general concepts are:

- More details in organizational and institutional framework
- Prioritizing services described in general concepts, i.e., marketing and information services

A key finding of the test of existing GI Internet platforms (see chapter 6) shows the bottleneck in the first transaction step: information. Consequently, the vertical GI marketplace focuses on providing services that improve the process of information retrieval. The following figure provides examples of services supporting business transactions and collaboration:



**Fig. 12: Services in a vertical GI marketplace (Examples)**

In addition, the GI marketplace mediates the process of generating information services. The vertical GI marketplace addresses a specific branch, thus inside knowledge of the branch is added and sector-specific solutions are sought (Brox and Kuhn 2001).

Tab. 11 describes the services in a vertical GI marketplace for financial service providers in more detail. The starting point is the tasks of the scenario (sub-section 6.1.1) and the various technical, human, organizational, and institutional GI services (= intermediate products, see section 6.2) that

are necessary to generate the scenario's information service (= end product). From this the author derives services a vertical GI marketplace for financial service providers has to provide in order to generate the scenario's information service (see Tab. 11).

For example, the bank has to find a GI consultant. The required intermediate product is a list of companies that could do the job. The GI marketplace connects customer and potential providers through information, e.g., by naming GI consultants with appropriate service profiles.

**Tab. 11: Services in a vertical GI marketplace for financial service providers**

(t) = Technical service  
(h) = Human service  
(o) = Organizational service  
(i) = Institutional service

<b>GI service (= intermediate product) of scenario (see Tab. 8)</b>	<b>Service of vertical GI marketplace in order to support the generation of information services</b>
Provide knowledge about possibilities of GI (marketing) (o)	Advertise GI within the branch of financial service providers
Provide information about GI products and GI providers (t)	Provide an information platform for access to information
Information (o)	Provide information, i.e. by electronic form for GI product request
Communication (o)	Run a call center
Establishment of business network of potential partners (i)	Establish business network of potential partners
Quality assurance of business partners (i)	Provide quality standards and quality assurance of providers of the GI marketplace
GI consulting (h)	Connect GI consultants with users, e.g., by a black board announcing user requests
Marketing consulting (h)	Connect Marketing consultants with users
Integrative consulting (h)	Connect integrator with users and business partners
Provide data (t)	Mediate users' access to functionality
Provide Internet access (o)	Provide Internet access to functionality
Standardize data (i)	Standardize data offered on the GI marketplace, e.g., metadata
Rules for the use of data (i)	Provide rules for the use of data within the GI marketplace
Security (i)	Provide security standards within the GI marketplace
Data search (t)	Mediate users' access to functionality
Standardization of functionalities (i)	Standardize functionalities offered on the GI marketplace
Data selection and adaptation (t)	Mediate users' access to functionality, Connect data adapter with client
Data ordering (t)	Mediate users' access to functionality
Data payment (t)	Mediate users' access to functionality
Security assurance (o)	Guarantee security for all transactions within the GI marketplace

GI service (= intermediate product) of scenario (see Tab. 8)	Service of vertical GI marketplace in order to support the generation of information services
Sale of software tool (o)	Connect software providers with client (end user of information service, or integrator; depending on the business process of putting the pieces together)
Adjustment of software tool (t), (h), (o)	Connect software adjuster with client
Integration of software tools (t), (h), (o)	Connect integrator with client
Execution of analysis (t), (h)	Connect integrator with user
Training (h)	Connect trainer with user

Tab. 11 points out how a GI marketplace can support generate an information service that is produced by integrating a great variety of technical, human, organizational, and institutional services. The GI marketplace

- Supports technical and human services by *mediation*. It provides information about services and providers, connects the end user with providers and providers with other providers, and facilitates transactions.
- *Can execute* organizational services. This depends on the business model of the GI marketplace. For example, the GI marketplace can run an order-and-payment platform for several business partners, or it can mediate the access to the order-and-payment services of each specific provider.
- *Should execute* institutional services. The GI market needs mechanisms and institutions for its regulation, e.g., by data standards and functionalities within a business community, quality assurance for services, and assurance of security of transactions.

GI marketplaces are tools for the transfer from the technical innovation of interoperability to the interoperability for all kinds of services in a successful business model of the GI market.

### 9.3. INNOVATION AND VALUE CONFIGURATION

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Innovation focuses on linking potential GI customers with GI providers, and establishing a modern business model of business networks. Thus, the vertical GI marketplace creates value for financial service providers as well as GI providers:

1. Currently, a bank manager is not able to get sufficient information about price and benefit of a typical GI product within 1 hour of Internet search on an existing GI platform. The vertical GI marketplace provides electronic forms that can be filled in less than an hour. The result is substantial information about the required GI product.
2. Currently, existing GI Internet platforms provide data as GI products for the most part. The vertical GI marketplace provides additional GI services, which proved to be the most cost-intensive components of typical, complex GI products (= information services).
3. Currently, all types of GI services from data production to training of employees are usually offered by monolithic companies. The vertical GI marketplace enables business

networks as new business models. It provides a call for tenders for different types of GI services as components of a complex GI product, where companies with specialized core competences apply, e.g., in integration of geographic data with internal bank data. Thus, the GI marketplace enables a differentiation of the GI market and increases the GI market volume.

#### **9.4. ENTREPRENEURS**

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The GI marketplace is an independent, neutral organization, which is open to cooperation of various players and competitors from the GI market. In addition, we see the GI marketplace as a non-profit organization with the goal of improving the GI market.

By self-definition, SDIs fulfill these requirements (Nebert 2000). Therefore, SDIs are the most appropriate entrepreneurs of GI marketplaces.

In principle, also a data provider, e.g., Teleatlas, could run a GI marketplace (sub-section 3.4.1). However, return of investment and neutrality of the GI marketplace seem to be difficult.

#### **9.5. MARKETING CONCEPT**

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This section describes

- Market environment and competitors
- Targeted customers, and
- Strategy and cost recovery

in the vertical GI marketplace for financial service providers.

##### **9.5.1. Market environment and competitors**

The GI market is expanding moderately, but the market increase lags behind a much higher potential (Fornefeld, Oefinger and Rausch 2003). In addition, the branch of financial service providers is of high interest to the GI market (Fornefeld and Oefinger 2001): Geographic information is of great potential benefit for the branch, and the branch has the financial capacity to pay for it.

In principle, the GI products necessary for providing information services and thus feeding the vertical GI marketplace, are available, e.g., the GI technologies developed in the BRIDGE-IT project.

The GI market is heterogeneous, fragmented, and opaque to potential customers. This makes marketplaces even more promising, because the best chances for marketplaces are expected in fragmented markets with many actors and low transparency (Spiller and Wichmann 2000). Consequently, e-business is emerging on the GI market.

We observe three groups of potential competitors:

- GI companies with Internet presence
- Electronic platforms of SDIs or similar organizations focusing on the entire GI market

- Electronic platforms focusing on financial service providers.

Many GI companies have established their presence on the Internet. However, specialization in terms of core competences is still low. Although some GI companies, e.g., Endoxon AG in Switzerland (Widmann 2001) have key clients (in this case banks), they still offer a monolithic business model by providing all types of GI services from data production to training of employees. For the potential customer this is a major disadvantage: The GI market still is not transparent, and the customer must depend on a single company, rather than being able to compare the quality and price of products.

The goal of SDI initiatives like InGeoForum ([www.ingeoforum.de](http://www.ingeoforum.de)) and CeGi ([www.cegi.de](http://www.cegi.de)) is the improvement of the GI market. They have initiated Internet-based platforms ([www.ingeoic.de](http://www.ingeoic.de) and [www.terramapserver.de](http://www.terramapserver.de)). These organizations provide valuable contributions by addressing marketing GI in politics, legal issues, connecting GI providers, and technological standardization. They also provide GI services, however we see the following impediments for addressing financial service providers as potential clients. The SDIs are

- Mainly regional
- Addressing all branches, providing few offers to the branch of financial service providers
- Focusing on data instead of adding additional GI services.

With on-geo, [www.on-geo.de](http://www.on-geo.de), and Geoport, [www.geoport.de](http://www.geoport.de), two new platforms emerged on the German GI market. They provide GI services for real estate management. Although they address a specific branch, and provide innovative, complex GI services to their customers, the products offered focus on one special type of GI service for appraising real estate objects. Financial service providers with other required products will not be satisfied.

Consequently, there is no competitor on the GI market that matches the profile of the vertical GI marketplace for financial service providers.

### **9.5.2. Targeted users**

GI marketplaces target two groups of users:

- Financial service providers, and
- GI providers.

Financial service providers use the GI marketplace as a central platform for all business transactions in the context of GI. GI providers use the GI marketplace as a central platform for marketing all their GI products addressed to the branch of financial service providers. In addition, GI providers could use the GI marketplace as a customer as well, e.g., a GI consultant ordering a data set for a client.

### **9.5.3. Strategy and cost recovery**

The GI marketplace wants to form a link between the financial service providers and the GI providers in order to achieve a critical mass. Consequently, the goal of the GI market is the cooperation of as many players as possible.

Therefore, we foresee two main strategies for achieving critical mass:

- The GI marketplace is a union of members, for example, InGeoForum, [www.ingeoforum.de](http://www.ingeoforum.de), not a company.
- The GI marketplace starts with a preparation phase before operating the GI marketplace. In this preparation phase, the GI marketplace acquires customers and GI providers through information, workshops, and personal contacts, similar to the procedure of establishing CeGi ([www.cegi.de](http://www.cegi.de)). A key issue is to assure its acceptance. Therefore, the author suggests procedures that create a consensus of members. For this purpose the concepts of the GI marketplace will be made public. The GI market players will be asked to give feedback. This feedback will serve as input for the future work for the GI marketplace implementation.

Strategic advantages of starting up in the near future are positive business perspectives in a young and emerging GI market.

It is not enough to create a “high-quality product GI”. Strategic marketing initiatives, i.e. public relations, have to be executed and targeted on

- Traditional and new users of geoinformation. They have to know about opportunities and chances.
- Traditional and new providers as components of the GI marketplace.

The GI marketplace is a non-profit organization. In the preparation phase, we foresee cost recovery by public funding. In the operational mode, costs will be recovered by

- Annual fees for GI providers, and
- Commission on the traded GI products.

Depending on the business model, GI providers’ advertisements could recover additional costs. However, this will be a political decision for the GI marketplace entrepreneur, and therefore this optional resource for cost recovery will not be discussed further.

In addition, we foresee the execution of publicly funded projects (e.g., by EC, BMBF) in order to finance improvements of the GI marketplace, e.g., semantic matching of user requests and offered GI services.

## **9.6. ORGANIZATION**

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We see the following phases for the introduction of the GI marketplace

1. Project phase for GI marketplace implementation
  - a. Preparation (12 months)
  - b. Prototype implementation (6 months)
  - c. Prototype testing, evaluation, and refinements (4 months)
  - d. Preparation of operational mode (2 months)
2. Operational mode



The GI marketplace is a *member-based organization*, open to all companies and organizations participating in the GI-market. It will be created by a consensus procedure performed during the preparation phase. The rules for a membership still have to be defined, but in general, the GI marketplace executives will be controlled by a member-based steering committee, in the project phase as well as in the operational mode.

The focus of the project phase is on implementation of the organization and technique in a consensus process. The focus of the operational mode is to provide the GI marketplace services described in sub-section 9.2.2. Because it will be an Internet-based organization covering all of Germany, the location of the GI marketplace is not important.

The GI marketplace is a comprehensive approach for improving the GI market. This evokes the need for supporting partners, e.g., DDGI, SDIs, and government. In addition, universities have to contribute research results in order to solve technological and organizational challenges, e.g., semantic matching of user requests and offered GI products.

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## 9.7. REALIZATION OF A VERTICAL GI MARKETPLACE

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Before reaching an operational mode, we foresee a 2-year implementation phase. The implementation phase has the following work packages and milestones:

**Tab. 12: Work packages and milestones of GI marketplace realization (project phase)**

Work package	Milestone	Project month
1. Project management (coordination, communication, project planning, controlling, documentation, evaluation, budgeting)	Project plan, four project reports, homepage	1, 12, 18, 22, 24, 1
<b>Preparation</b>		<b>1-12</b>
2. Analysis of user requirements (financial service providers, GI providers)	Report on user requirements	3
3. Acquisition of users (information, personal contacts, workshop)	Workshop, lists of expressions of interest, and user requirements	4
4. System design (organizational, technological)	System raw concept	6
5. Consensus process (information, personal contacts, workshop)	User workshop, agreement on raw concept, list of additional user requirements	7
6. Detailed system design (organization, technological)	System concept	11

Work package	Milestone	Project month
7. Formal establishment of GI marketplace	Member workshop, agreement on system concept, list of additional user requirements	12
<b>Prototype implementation</b>		<b>12-18</b>
8. Implementation of business processes on Internet platform	Executable prototype	18
<b>Prototype testing and evaluation</b>		<b>19-22</b>
9. User tests	Usability results	19
10. Refinement of prototype	Refined prototype	22
<b>Preparation of operational mode</b>		<b>23-24</b>
11. Establishment of organization	Engagement of personnel, creation of infrastructure	24
12. Establishment of technologies	GI marketplace online	24
13. Dissemination of results (advertisement, personal contacts, email-notification of potential users, publications, opening workshop)	GI marketplace opening workshop	24

## 9.8. BUDGET

This section estimates the costs of the project phase, and the costs and cost recovery of the GI marketplace in the operational mode.

### 9.8.1. Project phase

For the project phase we estimate the costs, according to the work packages (see section 9.7):

**Tab. 13: Estimated costs of GI marketplace implementation (project phase)**

Work package	Cost item	Costs (€)
1. Project management	24 man-months, manager	140.000
	6 man-months, secretary	18.000
<b>Preparation (month 1-12)</b>		
2. Analysis of user requirements	3 man-months, science professional	16.500
	3 man-months, associate science professional	9.000
3. Acquisition of users (information,	3 man-months, business professional	16.500

<b>Work package</b>	<b>Cost item</b>	<b>Costs (€)</b>
personal contacts, workshop)		
	Workshop organization (secretary, 1 man-month, locality)	8.000
4. System design (organizational, technological)	Business professional, 6 man-months	33.000
	Engineering professional, 6 man-months	33.000
5. Consensus process (information, personal contacts, workshop)	Information and workshop preparation, business professional, 1 man-month	5.500
	Workshop organization (secretary, 1 man-month, locality)	8.000
6. Detailed system design (organization, technological)	Business professional, 6 man-months	33.000
	Engineering professional, 6 man-months	33.000
7. Formal establishment of GI marketplace	Information and workshop preparation, business professional, 1 man-month	5.500
	Workshop organization (secretary, 1 man-month, locality)	8.000
<b>Prototype implementation (month 13-18)</b>		
8. Implementation of business processes on Internet platform	Business professional, 12 man-months	66.000
	Associate business professional, 12 man-months	48.000
	Engineering professional, 12 man-months	66.000
	Associate engineering professional, 12 man-months	48.000
	Development system (hardware, software, data)	20.000
<b>Prototype testing and evaluation (month 19-22)</b>		

<b>Work package</b>	<b>Cost item</b>	<b>Costs (€)</b>
9. User tests	Business professional, 2 man-months	11.000
	Research professional, 2 man-months	11.000
10. Refinement of prototype	Business professional, 6 man-months	33.000
	Associate business professional, 6 man-months	24.000
	Engineering professional, 6 man-months	33.000
	Associate engineering professional, 6 man-months	24.000
<b>Preparation of operational mode (month 23-24)</b>		
11. Establishment of organization	Business professional, 4 man-months	22.000
	Associate business professional, 4 man-months	16.000
12. Establishment of technologies	Engineering professional, 4 man-months	22.000
	Associate engineering professional, 4 man-months	16.000
13. Dissemination of results (advertisement, personal contacts, email-notification of potential users, publications, opening workshop)	Research professional, 1 man-month	5.500
	Workshop organization (secretary, 1 man-month, locality)	8.000
<b>Subtotal</b>		<b>89.500</b>
5 % overhead, e.g., consumables, communication		42.025
<b>Total</b>		<b>882.725</b>

The cost estimation of 882.725 € is based on the use of existing know-how and technologies. The author assumes that an existing organization or institution will carry out the project; therefore there will be no additional costs for infrastructure, e.g., office rent. Additional improvements, e.g., an automated semantic mapping of demanded GI products with offered GI services and providers, would result in additional costs by side-projects.

### 9.8.2. Operational mode

For running the GI marketplace we estimate the following annual costs:

**Tab. 14: Annual costs of the GI marketplace in the operational mode**

Activity	Cost item	Costs (€)
Coordination, public relations, marketing	12 man-months, manager	70.000
Secretariat	12 man-months, secretary	36.000
Maintenance of online platform	Engineering professional, 12 man-months	66.000
Consulting	Business professional, 12 man-months	66.000
Consulting	Associate business professional, 6 man-months	24.000
Rent infrastructure	Infrastructure (office rent, hardware, software)	30.000
Traveling	Travel costs	10.000
Subtotal		302.000
5 % overhead, e.g., consumables, communication		15.100
Total		317.000

For cost recovery we foresee two means: Member fees of GI providers and a commission charged by the GI marketplace.

The amounts of fees and turnover percentage are subject to discussion, based on the detailed business models, consensus process of the members, and number of users. The following table provides several examples from worst case to best case:

**Tab. 15: Cost recovery models in the GI marketplace operational mode**

Number of members	Member fees	Income (€)	Turnover per year	Percentage of turnover	Income (€)	Annual cost recovery (€)
50	500	25.000	500.000	2	10.000	35.000

Number of members	Member fees	Income (€)	Turnover per year	Percentage of turn over	Income (€)	Annual cost recovery (€)
100	500	50.000	1.000.000	2	20.000	70.000
150	500	75.000	2.000.000	2	40.000	115.000
200	500	100.000	4.000.000	2	80.000	180.000
250	500	125.000	<b>8.000.000</b>	<b>2</b>	<b>160.000</b>	285.000
50	1.000	50.000	500.000	5	25.000	75.000
100	1.000	100.000	1.000.000	5	50.000	150.000
150	1.000	150.000	2.000.000	5	100.000	250.000
<b>200</b>	<b>1.000</b>	<b>200.000</b>	<b>4.000.000</b>	<b>5</b>	<b>200.000</b>	<b>400.000</b>
250	1.000	250.000	8.000.000	5	400.000	650.000
50	2.000	100.000	500.000	10	50.000	150.000
<b>100</b>	<b>2.000</b>	<b>200.000</b>	1.000.000	10	100.000	300.000
150	2.000	300.000	2.000.000	10	200.000	500.000
200	2.000	400.000	4.000.000	10	400.000	800.000
250	2.000	500.000	8.000.000	10	800.000	1.300.000

The calculation of cost recovery shows that the GI marketplace requires acceptance in the market by a high number of GI providers as members and a high turnover. Member fees of 1.000 – 2.000 € affect the need for 100-200 GI providers participating on the GI marketplace (see marked numbers). A percentage of 2-5 % of the turnover affects a required annual turnover of 4.000.000 – 8.000.000 €(see marked numbers).

## 9.9. RISKS AND OPPORTUNITIES

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This section estimates the risks of the GI marketplace realization on the levels of

- Time deviations in implementation
- Competitors
- Products/services
- Customers/partners
- Cost recovery

as well as the opportunities of a GI marketplace realization.

### 9.9.1. Risks

The author estimates the risks of GI marketplace introduction on various levels. The results will be summarized in Tab. 16.

1. *Time deviations in implementation*: The project phase is calculated with reserves in terms of personnel and time. A first version of the GI marketplace can be established on existing know-how and technologies. Therefore, we estimate the risk as low.
2. *Competitors*: There are no competitors on the GI market matching the profile of the vertical GI marketplace for financial service providers. To the contrary, potential competitors, e.g., InGeoForum or CeGi should be integrated. Therefore, we estimate the risk as low.
3. *Products/services*: In a first version of the GI marketplace products offered and marketplace services are based on existing know-how and technologies. Therefore, we estimate the risk as low.
4. *Customers/partners*: We estimate the interest of financial service providers as high, their interest in GI as well as their interest in the GI marketplace providing access to GI products. We also estimate the interest of GI providers as high. For example, CeGi workshops had attendance levels of several hundred of companies and institutions. The number of interested GI providers is critical. First, the GI marketplace focuses only on one special branch. Second, the GI providers must be willing to pay for the GI marketplace services. Therefore, we estimate the risk as medium – high.
5. *Cost recovery*: The risk for the pilot phase is low, once public funding for this phase is acquired. In the operational mode, there is a need of a high number of customers/partners and annual turnover. We estimate the risk for acquiring 100-200 GI providers willing to pay for the GI marketplace services as high. On the other hand, current big GI projects easily have a turnover of 500.000 € Therefore, a GI marketplace turnover of 4.000.000 – 8.000.000 € can be achieved with a relatively low number of users. In addition, the project phase offers the opportunity of a more detailed analysis of potential customers/partners and models of cost recovery. In the case of a negative prognosis, the operational mode can be cancelled, which reduces the risk. Therefore, we estimate the risk as medium – high.

The risk estimation on the levels of time deviation, competitors, and products/services are low. However, the risk estimations on the levels of customers/partners and cost recovery are critical. Therefore, we estimate the overall risk of the GI marketplace realization as medium – high.

**Tab. 16: Risk analysis of the GI marketplace realization**

Risk level	Estimation of risk (high, medium, low)
Time deviations in implementation	Low
Competitors	Low
Products/services	Low

Risk level	Estimation of risk (high, medium, low)
Customers/partners	Medium-high
Cost recovery	Medium-high
Overall	Medium-high

### 9.9.2. Opportunities

The project phase will deliver valuable results for marketing innovative GI products, and exploiting the GI market potential. Even if the implementation of the GI marketplace operational mode were to fail, this project would be profitable for the GI market.

The realization of the GI marketplace can implement new business models in the GI market, usually common in economy in general. This is a step forward in integrating GI in the business processes of the free market. The GI marketplace realization is a chance to significantly increase the sale of GI products.

We see the realization of a vertical GI marketplace for financial service providers as a pilot initiative. It will enable the establishment of further vertical marketplaces for other potential branches with lower costs. This will provide an additional impact on the GI market, being able to implement further vertical GI marketplaces with lower costs.

## 9.10. PERFORMANCE OF THE GI MARKETPLACE

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This section provides a further validation of the business plan. O'Reilly and Finnegan (O'Reilly and Finnegan 2005) provided a conceptual model for assessing the performance of electronic marketplaces. Though the vertical GI marketplace for the financial services industry does not exist as a physical organization but on the conceptual level, the *expected* performance can be predicted on the basis on the business plan.

O'Reilly and Finnegan (O'Reilly and Finnegan 2005) assume that the fit between the following indicators are crucial for the performance of electronic marketplaces:

- Information processing needs (environmental, partner, and task uncertainty) and information processing capabilities (structure, process, IT),
- Value demanded (industry structure, business strategy) and value added (market reach, pricing, costing, best practices, IT solution),
- Governance (risk, ownership) and investment (contractible, non-contractible), and
- Trust (trust in vendor, trust in application) and trust/security based mechanisms constructs (technology, legislation, online community, third-party assurance seals).

According to the model of O'Reilly and Finnegan, and based on the business plan, the subsequent paragraphs aim to estimate the expected performance of the vertical GI marketplace for the financial services industry.



### **Information processing needs and information processing capabilities:**

The GI market suffers from a range of uncertainties. Due to the applicability of GI to many various application areas, the market is highly fragmented; products are often not usable for potential customers (environmental uncertainty). GI customers hardly find appropriate business partners, and potential GI providers are acting in monolithic value chain structures, whereas business networks of complementary GI providers are needed (partner uncertainty). The task of providing an appropriate information service is very complex, because most GI products are not ready-to-use, but have to be aggregated ad-hoc from various intermediate products (task uncertainty).

According to the high level of needs, the business plan foresees a high complexity of information processing capabilities. The GI marketplace is designed as a vertical marketplace, addressing a specific branch within a fragmented market. The key success factor is to bring together sellers and buyers via a single entry-point (structure). The envisaged e-Procurement process (see also chapter 7) addresses the need of GI customers for finding appropriate GI providers and products, and the need of GI providers for finding appropriate business partners (process). A detailed technical specification or architecture exceeds the scope of this thesis, but as argued before, it can be assumed that appropriate systems for business process frameworks (see chapter 8) and workflows in e-Procurement (see sub-section 7.2.3) are available (IT).

### **Value demanded and value added:**

The GI market demands an improved matching of buyers and sellers on the level of the GI market in general (industry structure) as well as on the level of individual companies (business strategy). The GI market is not fulfilling its potential of expected market growths; the value demanded is high.

As described in sub-section 2.4.1, GI marketplaces have the potential of adding values on several levels. On the macro-economic and innovative level, the vertical GI marketplace has the capability to improve the entire GI market by improving GI product composition and value chain structures, and improving the access of potential customers to the GI market (market reach). By the envisaged e-Procurement, pricing becomes more transparent, and especially costs for GI customers searching for providers and products, and for GI providers searching for business partners are reduced. Currently, negotiation and contracting is in-transparent and uncertain. E-Procurement improves negotiation and contracting by standardized, regulated processes (best practice).

### **Governance and investment:**

It can be considered an advantage of the business plan that the GI marketplace does not target profit, but is a non-profit organization, which “only” targets a return of investments. But still the business plan estimates the financial risks for the owners of the GI market as medium to high. Therefore, the business plan foresees a publicly funded implementation phase. In the operation mode, marketplace participants pay member fees and percentages of the turn-over (contractible financial stake). The ownership structure of a member-based organization in the context of a national or regional spatial data initiative, and accompanying research, assure the expertise, contacts, and knowledge in the marketplace (non-contractible stake).

**Trust and trust/security based mechanisms constructs:**

In the case study of the cotton industry, “achieving trust in the vendors is crucial, with trust in the application being less important (O'Reilly and Finnegan 2005)”. The same can be assumed for the GI market, because technology is more advanced than appropriate business models and processes. The business plan envisages trust into the GI marketplace by creating a member-based organization, managed by a neutral SDI initiative. This can be considered as a “third party assurance seal”, because the GI marketplace itself is not competing with the marketplace participants. The GI marketplace can create trust in vendors by selecting appropriate GI providers participating in the marketplace; using a single entry-point assures that misbehaving marketplace participants will get known and can be excluded. A member forum provides the opportunity for discussion and criticism (online community).

As a result, we can consider an appropriate compatibility between the performance indicators. High needs for information processing needs fit to high capabilities of the vertical marketplace structure and e-Procurement processes. The high level of value demanded fits to the high potential of adding value, addressing individual players of the GI market as well as the GI market as a whole. The crucial mechanisms that control and manage the marketplace (governance) are addressed by the non-profit business model and the member-based ownership structure. Being a neutral organization creates trust into the marketplace. Bundling GI providers in a single entry point enables some controlling of the vendors, thus creating trust of potential customers.

Therefore, it can be assumed that the business plan has implemented crucial success factors of the vertical GI marketplace for the financial services industry.

## **10. SUMMARY AND DISCUSSION OF RESULTS**

The goal of the final chapter of part D is the overall validation of the thesis and its results. Part B identified the major needs for improving the GI market. Addressing these challenges can be considered guidelines for the general design of GI marketplaces. The results of part B were discussed in section 2.6. Part C developed a specific design for a vertical GI marketplace for financial service providers; the results were discussed in section 4.5.

Chapters 5 and 6 aimed at the validation of the design guidelines. Section 10.1 highlights the results achieved. Section 10.2 discusses the validation of the concrete design of a specific vertical marketplace, based on the results of chapters 7 - 9. Finally, section 10.3 discusses the validation of the hypothesis of the thesis.

### **10.1. SUMMARY AND DISCUSSION OF RESULTS OF PART D – DESIGN GUIDELINES**

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Sub-section 10.1.1 discusses the demand for GI products and appropriate GI providers. Sub-section 10.1.2 discusses the need for an improved access to the GI market.

#### **10.1.1. Demand for GI products and appropriate GI providers**

The two case studies of an insurance company and a bank in chapter 5 aimed to validate the demand of financial service providers for GI products and providers. The approach of personal interviews, detailed analysis, and discussion with the employees of the insurance company provided a detailed insight into an insurance company's needs for GI products. Furthermore, the analysis targeted a large company with a wide range of activities. The additional interviews with a consulting company, which has a deep insight to the needs of many banks and insurance companies, supported the approach. The analysis of existing obviously successful GI products - a bank has paid for it - ordered by a bank completed the analysis and provided a good overview of the requirements of the branch of financial service providers towards the GI market.

The findings support the idea of "information services". Geographic data sets and software are not the required type of products. Financial service providers require GI solutions to be established in their information systems and workflows. GI services (human, organizational, institutional, technical) have to be added to data and software in order to provide GI products that will be successful in the market.

Therefore, the results validated the need for information services. In addition, the need for business networks can be inferred. The need for a wide spread range of information services requires a wide range of GI providers with specialized core-competences as well. The bank case study supported this conclusion, because the existing GI products did not cover the range of potential GI products by the insurance company. In addition, it can be assumed that even a monolithic GI provider like Endoxon integrates external partners for the fulfillment of specific tasks, thus creating business networks in the traditional way without mediation of GI marketplaces.

The findings also support the general design of GI marketplace services. However, they put a more urgent emphasis on the following services of a GI marketplace:

- Marketing, in order to create awareness of the potential benefit of GI
- Information about GI products, in order to enable access to and transactions of GI products
- Interoperability of intermediate GI products, in order to support the provision of information services
- Connecting GI providers, in order to support cooperation of business networks.

#### **10.1.2. Access to GI products and providers**

Chapter 6 tested three existing GI Internet platforms in Germany. The access of financial service providers was tested within a specific scenario: A bank required a GI supported system for the in-house evaluation of the locations of its branches. The tasks necessary for the aggregation of the required end product (= information service) yielded a set of the required human, technical, organizational, and institutional services, which are essential intermediate products. The test simulated bank managers trying to retrieve sufficient information about price, quality, and benefit of the required product from three existing GI Internet solutions.

The test yielded a mismatch between supply and demand. The tested GI Internet solutions lacked content in terms of required intermediate products. Although the Internet solutions almost exclusively focused on data provision, even this offer was not complete and difficult to access for non-GI-experts.

In contrast to the supply, the demand was reverse. More than 90 % of the estimated total costs of the required system consisted of human services and less than 10 % of the costs were in data and software. Therefore, a bank manager was not able to decide whether or not to buy the required GI product: He was not able to retrieve information about costs and benefits, or even that the required product exists. Consequently, the urgent need of improving the access of potential customers to the GI market was validated.

## **10.2. SUMMARY AND DISCUSSION OF RESULTS OF PART D – DESIGN OF A VERTICAL GI MARKETPLACE**

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Chapters 7 - 9 aimed at the validation of design of a vertical GI marketplace for the financial services industry. The results are discussed on three levels:

- Implementation of appropriate business processes (sub-section 10.2.1).
- Technical implementation (sub-section 10.2.2).
- Organizational and financial feasibility of GI marketplace realization (sub-section 10.2.3).

### **10.2.1. Business processes**

Chapter 7 started by pointing out the relevance of the integration of business processes within inter-organizational systems. A key business process is the coordination and establishment of business networks. Based on the GI marketplace design (see part C), which can be considered to be a reference model for business processes, this chapter designed a business process model for a vertical GI marketplace for financial service providers.

The design approach rested on the scenario of a bank requiring a GI-supported in-house system for the evaluation of its branch locations. Public procurement is complex and well explored process in the economy, and it served as a source model for deriving a GI business process model. Based on the processes in public procurement, well defined by the public procurement law, the author gave evidence for the feasibility of implementing e-Procurement. Existing marketplaces perform e-Procurement in terms of an online public call for tenders.

The final result was a business process model for a vertical GI marketplace for financial service providers, derived from public e-Procurement processes. It consists of four overall phases:

1. Preparation of call for tenders
2. Publication of call for tenders
3. Elaboration and provision of bidding offers
4. Evaluation of offers.

The overall methodological approach was to draw analogies from public procurement. This approach can be justified for the following reasons. Public procurement

- Has developed and been working successfully for centuries.
- Is well defined by public procurement law.
- Is a complex process considered to be more than complete in terms of addressing the requirements of GI market processes. In its branch, public procurement seems to solve the three issues, which have been identified as the key needs of the GI market (see chapter 2).
- Can be implemented in electronic marketplaces by e-Procurement.

The business process model defined a GI marketplace as an interface for inter-organizational processes. It matches many buyers with many sellers of the GI market by an n:n matching model. The online public call for tenders addresses the need for the reduction of transaction costs as well as includes collaboration services.

In principle, all services listed in the GI marketplace design (see chapter 4) have to be implemented in a concrete business process model. This chapter focused on an essential core part of the business processes: A customer requests and receives a GI product offer.

In this sense, the achieved business process model is not complete, because it lacks the product delivery. However, the business process model validates the capability of GI marketplaces to support overcoming the key obstacles in the GI market identified in section 1.2 and addresses the needs of the GI market identified in chapter 2.

By the means of an online public call for tenders via a GI marketplace

- The required end product is specified by an intermediary.
- Several ad-hoc business networks establish themselves (of which one business network will be chosen for providing the required information service).
- The potential GI customer accesses the GI market via a single entry point and receives sufficient information about price and quality of the desired GI product.

In analogy to public procurement, it can be concluded the *GI marketplaces are capable of bringing the market to the customers*. Therefore, e-Procurement validated the implementation of the GI marketplace design by appropriate business processes.

### 10.2.2. Technical implementation

The business process model shows that complex GI service chains need human interaction. Consequently, the integration of technical and human GI services in Internet-based value chains is crucial to enhance business in the GI market.

In chapter 8, the first group of human services consisted of services in terms of the internal processing of user requests. They cannot be automated. These services, e.g., the GI consultant evaluating the required information in order to provide a product offer, will remain “manual labor” in the GI world. However, the evaluation of the required information is an essential service for providing the desired end product and consequently has to be integrated into the service chain.

The second group of the scenario’s human services matched user requests with potential providers in order to address potential providers that are able to execute the required service in an appropriate way. This is a human service in GI business. This service can be automated and implemented as a technical service; recent approaches such as DAML-S Matchmaker (Paolucci, Sycara, Nishimura et al. 2003) demonstrate feasibility.

OWL-S is a semantic markup language that supports automated service chaining. By its concepts, OWL-S is capable of describing human-technical service chaining in an appropriate way. However, in the current version 1.0 it cannot be adapted one to one for the needs of human service description. The requirements of human services are close to those of technical services. When the human services are chained with technical services, OWL-S service ontology can be used for their description. This is mostly due to the fact that the OWL-S description is made on an abstract level and only the grounding is on a concrete level.

The integration of human actors within such services is the next step to enabling the creation of complex, non-trivial services that need human expert knowledge. OWL-S focuses on automated services and is not made for human services, but it can be adapted when necessary.

OWL-S is still in an early phase of specification. With the change from DAML+OIL to OWL it comes closer to the semantic web world and the W3C. This will make OWL-S the leading standard for semantic service chaining. A lot of research groups are working on tools and frameworks for this language that will enable a more effective and comparable way of service annotation (Lab 2003), (Klein and König-Ries 2003), (Sabou, Richards and Splunter 2003).

An OWL-S service ontology is only the first step to enabling service chaining. Even more important is a clear and complete specification of the concepts of those objects that are used or manipulated by the services. For example, a bank manager may have a completely different opinion than the GI consultant about what maps or statistics are. While human actors are able to exchange their arguments and find a common definition for things like maps, this is not the case for software agents and services. Therefore local ontologies are needed to specify services or providers (Uschold 2000). These ontologies must contain the specification of all resources (DAML-S-Coalition 2003) in a machine-interpretable way, for example, by using OWL. This is the only way

for technical services to be able to interact in a meaningful way because they “understand” the each other’s world view. In fact the problem is even more complex, because it is not enough to just know or understand each other’s world view to interoperate. Before communicating a service has to map its conceptualization to that of the following service in the complex service chain, so that they speak a common language. This mapping can be supported by relating the local ontologies to global ones (e.g. SUMO (<http://ontology.teknnowledge.com/>)). In this case it is possible to analyze in which neighborhood or relation the different concepts stand to each other.

Recently a lot of research has been done in this area (Maedche, Motik, Silva et al. 2002; Magnini, Serafini and Speranza 2002; Silva and Rocha 2003) and there is still a lot of work to be done. Information on the recent work in the context of “E-Business Interoperability through Ontology Semantic Mapping” can be found in (Silva and Rocha 2003).

Although many aspects of semantic-enabled service chaining of human and technical GI services are subject to further research, this chapter validated the principal capability of OWL-S to fulfill this task.

### **10.2.3. Business plan**

Chapter 9 evaluated the organizational and financial feasibility of a vertical GI marketplace according to the GI marketplace design described in chapters 3 and 4 (part C).

The economic interest in establishing a vertical GI marketplace is to exploit the GI market potential. The GI marketplace provides services in order to overcome

- Lack of information of potential customers about GI products and GI providers
- Overcome the marked mismatch in the supply and demand of GI products by information services
- Replace outdated monolithic business models by business networks.

The GI marketplace is an independent non-profit member organization. We suggest a 2-year project phase for implementing the GI marketplace. The project phase has to be financed by public funding (~ 880.000 €). The ongoing operational mode recovers its costs by member fees and commission charged by the GI marketplace.

The business plan proves the feasibility of the GI marketplace realization. However, the risk of the operational mode can be considered medium – high. The risk has to be weighed versus the potential benefit of the GI marketplace realization.

The realization of the GI marketplace not only has the potential to increase the sale of GI products to the branch of financial service providers, but also to have a significant impact on the entire GI market. The project phase will provide deep insight into new marketing strategies for innovative, interoperable technological GI products as developed in the BRIDGE-IT project. The GI marketplace operational mode can be considered a pilot for the realization of further vertical GI marketplaces, e.g., for transport/traffic, ecology, and authorities. Therefore, it can be considered a justified risk. Even if the full-cost recovery business model failed, it would be worth a discussion whether the start up phase could be publicly funded due to the potential of expanding the GI market.

Section 9.10 estimated the expected performance of the GI marketplace by analyzing the fit between the transaction-related requirements of marketplace users and the marketplace offerings according to the conceptual model of O'Reilly and Finnegan (O'Reilly and Finnegan 2005). The results yielded a high compatibility between

- Information processing needs and information processing capabilities,
- Value demanded and value added,
- Governance and investment, and
- Trust and trust/security based mechanisms.

It could be argued that the GI marketplace is not an existing organization, but only a concept in terms of a business plan; therefore, there were lacking details for an assessment of the marketplace performance. However, the future performance could be *estimated* to some extent: By addressing the needs of the GI market, crucial success factors have been implemented into the business plan.

Consequently, chapter 9 validated the organizational and financial feasibility of a vertical GI marketplace realization.

### 10.3. VALIDATION OF THE HYPOTHESIS

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The results of the single steps have been presented and discussed in the respective chapters and summarized in the previous section. The following section aims at validating the overall results of the thesis. Sub-section 10.3.1 discusses the validation concept focusing on the overall methodological approach. Sub-section 10.3.2 discusses the validation of the hypothesis focusing on the results of the thesis.

#### 10.3.1. Validation concept

The discussion of the overall methodological approach focuses on three issues: Does the approach

1. Allow a generalization of results,
2. Achieve the most complete results, and
3. Provide significant results?

*Ad 1. Generalization:*

The validation concept relied on focusing on the financial services industry. Any validation of concepts needs to focus on something, but we have to consider whether the results can be generalized.

The market study of Fornefeld and Oefinger (Fornefeld and Oefinger 2001) identified prosperous branches for the GI market. Amongst them is the financial services industry. Other prosperous branches are, for example, energy providers, logistic and traffic companies, and telecommunication providers. The commonality among them is that they are business customers of the GI market. Addressing consumers is not suggested. In this sense, the financial services industry is a typical branch within the GI market's target group. Although there are specific requirements if looked at in great detail, there is evidence that the principle results of this thesis can be generalized for the GI



market. Verification would require more detailed scenarios of different types of branches and users. This would have gone beyond the scope of a single thesis.

*Ad 2. Completeness:*

The methodological approach was two-fold. First, it addressed the validation of the design guidelines, and then it addressed the design itself. Going back to the basic thesis results and validating the key needs of the GI market can be considered a strength of this thesis in terms of completeness. The validation of the GI marketplace design addressed business processes, technical implementation, and organizational and financial feasibility of realization. These issues addressed the success factors of the GI marketplace concepts developed in this thesis. The goal of this thesis was not to validate the more detailed aspects of GI marketplaces, e.g., technical architecture and implementation models. Targeting these issues would have been beyond the conceptual approach of the thesis.

Therefore the author concludes that the methodological approach achieves the most complete results within the scope of the thesis.

*Ad 3. Significance:*

The validation concept achieves two levels of significance.

- Empirical analysis and tests of the design guidelines extended the level of “validation” towards “verification”.
- Theoretical analysis validated the GI marketplaces design.

Therefore, the author concludes that the methodological approach achieves significant results, at least on the level of “validation” in the specific branch of financial services industry. In addition, there is strong evidence for the significance to the entire GI market of addressing a bank as a typical GI customer.

The methodological approach of validation – not verification - is justified, because this thesis deals with a detailed integration of two topics for the first time: electronic marketplaces and geographic information. Therefore, the thesis is on a conceptual level, and the validation of concepts is an appropriate result.

### **10.3.2. Hypothesis**

Part D addresses the hypothesis of this thesis: *Electronic marketplaces for geographic information give decision-makers from the German financial services industry faster and cheaper access to complex GI products than current Internet-based and other business models.*

The hypothesis consists of several aspects, which will be discussed in the following.

1. The comparison of “electronic marketplaces for geographic information” and “current Internet-based and other business models” implies a problem with the latter. Recent market studies, e.g., (Fornefeld and Oefinger 2001), validate deficiencies in traditional, non-Internet-based business models. This thesis provides a detailed analysis and validation that current monolithic business models are not appropriate for the GI market. Emerging Internet-based solutions still lack success in the market. The test of existing Internet-based

marketplaces or similar solutions shows the reason: Internet alone does not change a monolithic business model. Potential customers might have access to data providers, but not to geospatial value chains. A key success factor in the economy is the trend towards collaboration in business networks. The thesis validates the need for the GI market for business networks within the GI market as well as the capability of GI marketplaces to address this need with collaboration services. The online public call for tenders is an appropriate tool to establish ad-hoc business networks. Therefore, the author concludes the validation of the first aspect of the hypothesis.

2. The second aspect addresses “complex GI products”. As a first step, the thesis validates the need for complex GI products designated as information services. In the economy, “complete” products are provided to the customer rather than a set of raw products. The thesis validates that the typical GI product for the typical GI business customer consists of intermediate products in terms of human, technical, organizational, and institutional services. Tests of existing Internet-based GI solutions showed a marked mismatch between demand for information services and supply of data sets. As a second step, the thesis validates that GI marketplaces are capable of providing information services. The business process model of an online public call for tenders splits the request for the required end product into intermediate products and supports their aggregation to the ready-to-use information service. Therefore, the author concludes the validation of the second aspect of the hypothesis.
3. Finally, the hypothesis focuses on faster and cheaper access. Fast and cheap can be considered to be two sides of the same coin. Saving time means reducing costs. In the first step, the thesis validates the need for an improved access of potential customers to the GI market. Non-Internet based business models cause the market to be opaque, to lack competition, and might lead the customer to choose a non-appropriate GI provider in terms of quality and price. The tests of existing GI Internet solutions yielded the most urgent need for the improvement of access: Potential customers currently are not able to retrieve sufficient information about quality, price, and potential benefit of the desired product, or even that the required product exists. In this case, the transaction costs for information retrieval can be considered infinite. In the second step, the thesis validates the capability of GI marketplaces to address this need. Electronic marketplaces per se provide a single entry point for the customer, thus reducing time for accessing the market. Electronic marketplaces per se provide access to a transparent and competitive market, thus avoiding additional costs rising from insufficient information and monopolistic providers. This thesis suggests and validates the online public call for tenders as a tool for changing the current situation: The potential customer no longer needs to look for the market, but GI marketplaces bring the market to the customers. Therefore, the author concludes the validation of the third aspect of the hypothesis.

Having validated all aspects of the hypothesis, the author concludes that the hypothesis of the thesis has been supported.

## **PART E: OUTLOOK**

Part E, equivalent to chapter 11, provides an outlook to future work in an implementation project and accompanying research.

## **11. OUTLOOK TO FUTURE WORK**

GI marketplaces evidenced their capability to improve the GI market. The thesis provided organizational and technical design characteristics as well as a business plan for establishing and running a GI marketplace. The author suggests national or regional SDIs to initiate a realization project for implementation of a specific vertical GI marketplace. Potential project partners are companies representing the respective national GI market, and research organization addressing the fields of information systems, (semantic) interoperability in GI, economic and socio-economic sciences, and legal issues.

The thesis already forms the basis of a project proposal. The following future work should be addressed within the context of a specific project and accompanying research:

- Extension of concepts to vertical GI marketplaces apart from the financial services industry, and to horizontal GI marketplaces (section 11.1)
- Detailed user requirements analysis (section 11.2)
- Cost recovery models for reimbursement of marketplace services (section 11.3)
- Pricing of GI products (section 11.4)
- Legal issues (section 11.5)
- Semantic-enabled service chaining of human and technical GI services (section 11.6)
- Notification services (section 11.7).

The author targets a combination of both approaches: realization and research. A realization project for the implementation of a vertical GI marketplace provides an excellent case study and realistic users for accompanying research.

### **11.1. EXTENSION OF CONCEPTS**

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The concepts provided by this thesis focus on a vertical GI marketplace for the financial services industry. There is evidence that the marketplace concepts can be generalized (sub-section 10.3.1). However, concepts will have to be detailed looking closer at the requirements in other branches than the financial services industry. Branches such as energy provision and traffic/telecommunication are also important potential customers of the GI market (Fornfeld, Oefinger and Rausch 2003). Therefore, it should be investigated, if a vertical GI marketplace for the financial services industry should integrate a second or third vertical marketplace into its business model, going into the direction of a horizontal marketplace.

The first step is a case study comparing the financial services industry with another branch, e.g., energy providers. A comparison starts with an investigation of the demand for GI products. As in the thesis, methods are personal interviews with energy provider representatives and an analysis of existing products. A second step is to verify the lacking access of energy providers to GI products. The thesis used a specific scenario for deriving a single typical GI product required by the financial services industry. Further work should address a set of typical products and test the access to these

products via existing online GI platforms. The result is a list of GI intermediate and end products that should be traded on a vertical marketplace for energy providers.

Further work targets the business model of the GI marketplace. A GI marketplace for the financial services industry is feasible financially, although with a medium to high risk. An open question is if running a second or third vertical marketplace – either from the beginning or introducing new vertical marketplaces successively – would be a more promising business model and lower the financial risks.

## **11.2. DETAILED USER REQUIREMENTS ANALYSIS**

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The thesis provided a list of mandatory and optional services a vertical GI marketplace should provide. So far, the service offer focused on information provision, because this is a key impediment of the current GI market. Further services, e.g., standard provision, customer relationship management, market observation, evaluation of providers and products have to be analyzed in more detail.

Based on a more detailed knowledge of traded products (see chapter 5), personal interviews and questionnaires provided to potential users of the GI marketplace provide a deeper insight into the user requirements. Two groups of users should be investigated: GI providers and GI customers, e.g., energy providers. The result will be a more detailed and prioritized list of GI marketplace services.

## **11.3. COST RECOVERY MODELS**

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After a publicly funded implementation phase, a GI marketplace should run cost-neutral. The thesis suggests three strategies for cost recovery:

- Annual fees for GI providers
- Commission on the traded GI products
- Advertisement (see section 9.5.3).

These strategies have to be analyzed in more detail. The main question is: How much are GI providers and customers willing to pay for GI marketplace services?

A first step is to integrate this question into the personal interviews and questionnaires for the detailed user requirements analysis (see section 11.2). A second step is to verify the number of potential GI providers trading via the marketplace. Sub-section 9.8.2 calculates 100-200 GI providers participating on the GI marketplace and a percentage of 2-5 % of an annual turnover of 4.000.000 – 8.000.000 € A detailed market study should

- Verify the number of potential GI providers,
- Suggest strategies for member acquisition,
- Analyze the option of addressing several branches by running two or more vertical marketplaces in order to achieve a critical mass, and
- Verify the annual turnover.

As a result, the market study should suggest concrete numbers for member fees and commission on the traded GI products.

## **11.4. PRICING OF GI PRODUCTS**

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Pricing of GI products is rather a matter of GI providers, but appropriate pricing schemes are success factors of running a GI marketplace. Therefore, accompanying research on this topic is required.

Current pricing schemes of GI products rather reflect production costs than the value for a specific customer (Krek and Frank 2000). A customer is only willing to pay a price, if the benefit is higher than the costs.

Competing with other firms, a company has two potential strategies for achieving profit: either producing the same or similar product at lower costs as the competitors, or providing differentiated products the customers are willing to pay for (Grant 1995). In the GI market, there are few products that are ready-to-use. GI products have to be customized according to many different requirements of customers. Therefore, the non-price competition by product differentiation can be considered as the primary strategy in the GI market.

Further work targets two major research questions:

- How can GI products be differentiated efficiently?
- What are customers willing to pay for GI products?

A case study should start with the definition of 3-5 typical GI products for financial service providers. Krek (Brox and Krek 2002) claims that “there is no limit in opportunities for differentiation; a firm can compete on product and service design, location of sale, quality, time of sale, etc. The critical issue is whether the differentiation creates value for buyers”. An analysis of few specific GI products will show parameters for product differentiation. A simple example is the product differentiation of data sets. Few customers will need a complete data set of German ATKIS data (Authoritative Topographic Cartographic Information System), but only certain objects, e.g., streets, certain areas, e.g., the City of Münster, and certain formats, e.g., an Oracle Spatial database excerpt. Personal interviews with financial service providers analyze how much the potential customers are willing to pay for these “extras”, according to their benefit. The analysis of product differentiation and willingness to pay for it in a case study will reveal guidelines for an appropriate and competitive pricing within the GI market.

## **11.5. LEGAL ISSUES**

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The basis of the GI market is geographic data. In Germany, most data have been produced by public authorities. It is an ongoing discussion about usage of public information; in 2002 all European member states had legislation for accessing public information – except Germany (Fornfeld, Oefinger and Rausch 2003). A GI marketplace organization will not be able to solve these problems, but it has to deal with it and take care of license agreements and usage rights for databases and software traded via the marketplace.

Part of license agreements is liability for errors in data, software, and services. The GI marketplace should provide guidelines for transactions between providers and customers. And it is crucial for the GI marketplace itself to clearly define its liability for mediating the business transactions.

For the provision of an information service, partners of a business network cooperate, e.g., a software developer and a GI consultant. Both will have to contribute and share their respective know-how. Intellectual property rights will have to be protected by contracts or confidentiality agreements between business partners (Janssen 2003).

An additional aspect is security. The thesis suggests a complex business process model similar to public e-Procurement. This involves a transfer of confidential data, e.g., product offers of different providers, which include information about prices, quality, and know-how. This not only requires a very high security standard on the technical side, but also a strict confidentiality of the GI marketplace staff.

A first step is to analyze the legal requirements of a GI marketplace is a detailed case study analysis of the provision of 3-5 typical GI products via the GI marketplace business process model (see subsection 7.2.4). For the cooperation of providers, Janssen (Janssen 2003) provided licensing models between data suppliers and geographic service providers, software suppliers and geographic service providers, and end users. These contract models have to be applied on the business relationships in the case study. As for the business processes on the GI marketplace, public procurement law is a starting point for legal regulations of the GI marketplace organization and processes.

## **11.6. SEMANTICALLY ENABLED SERVICE CHAINING OF HUMAN AND TECHNICAL GI SERVICES**

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Semantics is crucial to the GI marketplace for performing one of its key services: matching buyers and sellers. The business process model for GI marketplaces defines the following key processes:

- The potential customer describes his/her request by an electronic form.
- Based on the customer request, the GI marketplace publishes an online call for tenders. In addition, the GI marketplace notifies GI providers that could potentially be interested in and capable of fulfilling the request.

This evokes the need for semantically enabled service chaining. The starting process is the customer formulating his request for an information service. Within the public procurement process for building a new school, the local authority defines the service chain by defining the required intermediate products: We need an architect for planning the school, we need a bricklayer for constructing the walls, and we need a landscaper for landscaping. In analogy, the GI customer defines the required GI product – the information service. The information service consists of several human and technical services. Thus, the customer defines the service chain for fulfilling his/her request. The potential customer is probably not a GI expert. Therefore, the key challenge is a semantic matching between the service conceptualizations of the customer and the GI marketplace. The matching has to take place in the “tool for understanding each other”, the electronic form.

Semantic matching requires the ability to measure semantic differences (Pires and Brox 2003). Therefore, future work primarily addresses these two features within the context of matching buyers and sellers.

### **Measuring semantic differences**

Pires and Brox (Pires and Brox 2003) addressed measuring semantic differences of experts' and non-experts' conceptualization of geographic entities. Pires used Formal Concept Analysis (FCA) that permits the formalization and integration of hierarchical, overlapping geographical categorizations (Kokla and Kavouras 2001), combined with the Matching-Distance Similarity Measure of Rodriguez and Egenhofer (Rodriguez and Egenhofer 2003). Based on a survey of 167 test persons, consisting of a group of Portuguese experts and non-experts, domain ontologies of the two bodies of water were constructed and measured according to their differences.

This approach can be used by

- Surveying GI customers' and GI experts' conceptualizations of human and technical GI services
- Constructing service domain ontologies
- Measuring semantic differences of service conceptualizations.

### **Semantic matching**

Future work on semantic matching will focus on providing a prototypical implementation of the scenario of GI service processes in a vertical GI marketplace (section 8.2) with the OWL-S. A major challenge will be the ontology-based formalization of input and output of human services.

The Web Service Matchmaker (follow up of the DAML-S Matchmaker mentioned above) can be considered as an appropriate tool for formalization of services (Kawamura, De Blasio, Hasegawa et al. 2003). Based on the scenario of section 8.2, ontologies

- of users (the user request of the bank manager), and
- providers (human services of GI consultants, and data integrators as well of the technical services of data providers in terms of providing metadata)

have to be developed. Afterwards, it has to be tested if the service ontologies of users and providers can be matched based on their semantics.

### **Agent-based automation**

A medium-term research challenge is automated service chaining. Agent-based solutions are already available, e.g., for decentralized economic coordination in eMarketplaces (Eymann 2001), negotiations of suppliers and demanders (Meyer and Eymann 2003) and contracting (Fink 2003), and matching suppliers' agents with demanders' agents (Ouksel, Babad and Tesch 2004).

Mostly these approaches address the matching of suppliers and demanders of ready-to-use products. The challenge is to adapt and extend these approaches according to the specific requirement of semantic-enabled service chaining of human and technical services.



## **11.7. NOTIFICATION SERVICES**

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In the business process model, the GI marketplace notifies potential GI providers. Semantic matching is the prerequisite for a GI marketplace to be able to notify the appropriate GI providers, because “matching a user’s requirement description against the capability descriptions of available services is crucial for the discovery of appropriate services” (Sahlmann and Schade 2004).

The business process model describes the notification of potential GI providers by the GI marketplace. Therefore, after successfully matching the customer’s request with the service offer of GI providers, the appropriate providers have to be notified. However, it usually is not a synchronous notification with basic request-response mechanisms. Notifications are more complex and need to handle delays and failures. Simonis and Wytzisk (Simonis and Wytzisk 2003) provided an OGC conformant Web Notification Service (WNS). Although focused on technical GI services, in principal WNS can handle several types of notification, e.g., email, SMS, phone call, and letter. The WNS is in the process of becoming an OGC standard. Therefore, such a standard should be integrated into the business processes of a GI marketplace.

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## **DECLARATIONS**

The thesis entitled “Electronic Marketplaces for Geographic Information” was composed by myself and bases on my work. Where work of others has been used it is fully acknowledged in the text.

The thesis has not been submitted to obtain any other educational qualifications.

I have never been sentenced for a crime of abusing my scientific qualification.

Münster, July 27, 2005

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