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EVALUATION OF LOCATION INTELLIGENCE EXPLOITATION IN CAPTIAL-INTENSIVE BUSINESS

Master's Thesis

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ABSTRACT

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As technology has developed it has increased the number of data produced and collected from business environment. Over 80% of that data includes some sort of reference to geographical location. Individuals have used that information by utilizing Google Maps or different GPS devices, however such information has remained unexploited in business. This thesis will study the use and utilization of geographically referenced data in capital-intensive business by first providing theoretical insight into how data and data-driven management enables and enhances the business and how especially geographically referenced data adds value to the company and then examining empirical case evidence how geographical information can truly be exploited in capital-intensive business and what are the value adding elements of geographical information to the business.

The study contains semi-structured interviews that are used to scan attitudes and beliefs of an organization towards the geographic information and to discover fields of applications for the use of geographic information system within the case company. Additionally geographical data is tested in order to illustrate how the data could be used in practice. Finally the outcome of the thesis provides understanding from which elements the added value of geographical information in business is consisted of and how such data can be utilized in the case company and in capital-intensive business.

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Työn nimi: Paikkatiedon hyödyntäminen pääomavaltaisella toimialalla

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Diplomityö. Lappeenrannan teknillinen yliopisto, tuotantotalous.
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Hakusanat: Paikkatieto, Liiketoimintatiedon hyödyntäminen, Business Intelligence, Location Intelligence, Informaatio Teknologia, SDSS, SOLAP, GIS, Paikkatietojärjestelmä, Tiedolla johtaminen

Teknologian kehittymisen myötä liiketoiminnassa tuotetun sekä hyödynnetyn tiedon määrä on kasvanut valtaisasti. Yli 80 % tästä tiedosta sisältää jonkinlaisen viittauksen maantieteellisen sijaintiin. Kuluttajat ovat hyödyntäneet tätä paikkatietoa käyttämällä Google Maps sovellusta tai erilaisia GPS laitteita. Kuitenkin paikkatiedon hyödyntäminen liiketoiminnassa on ollut hyvin vähäistä. Tämä tutkielma tarkastelee paikkatiedon käyttöä pääomavaltaisella toimialalla aluksi tarjoamalla teoreettista taustaa tiedosta, tiedolla johtamisesta ja mahdollisuuksista parantaa liiketoimintaa ja tuottaa lisäarvoa asiakkaalle. Tutkielma hyödyntää empiiristä case aineistoa tarkastelemalla kuinka maantieteellistä informaatiota voidaan todella hyödyntää pääomavaltaisella toimialalla ja mistä elementeistä paikkatiedon tuoma lisäarvo syntyy.

Tutkielma sisältää osittain jäsennellyt haastattelut joiden avulla on kartoitettu organisaation uskomuksia ja asenteita paikkatietojärjestelmää kohtaan sekä pyritty löytämään sovelluskohteita, johon tietojärjestelmää voisi soveltaa case yrityksessä. Lisäksi paikkatiedon hyödyntämistä testattiin käytännön tiedolla havainnollistamaan kuinka tietojärjestelmää voi käytännössä soveltaa. Lopuksi tutkielman johtopäätökset tarjoavat käsityksen siitä, mistä elementeistä paikkatiedon tuoma lisäarvo lopulta syntyy ja miten yritys paikkatietoa voidaan hyödyntää case yrityksessä ja pääomavaltaisella toimialalla.

FOREWORDS

Master's thesis is supposed to measure student's ability to use acquired knowledge and skills in order to prove the professional competence. I must say that this work has indeed fulfilled these requirements as all of my professional knowledge and skills that I have gained during the recent years have definitely been examined during this process. Fortunately LUT has provided outstanding facilities and environment to start my professional career and therefore I would like to express my gratitude for my supervisor Kalle Elfvengren for all the academic support that I have received.

I would also like to thank my instructors Vesa Saarinen and Jaakko Virevesi from Andritz who have made the topic of this thesis possible and guided me through this process with high professional experience, knowledge and wisdom. Moreover I would like to thank all the interviewees who have contributed to this thesis and all of my colleagues and coworkers who have always helped me with my practical problems that have occurred during this period. Finally, most of all I would like to thank my family; mom, dad, my sister and my brother who have always believed and supported me even in my weakest moments during the studies and this thesis project.

Long and time-consuming project has now finally come to an end and I must say that I feel glad, relieved and kind of sad at the same time. I am glad because I am finally getting the degree that I have been working on for the last five years, relieved because this thesis is finally ready so that I can really graduate and kind of sad because this eventually means that I actually have to graduate. While I think back to the recent years I must be grateful for my trusted friends who have supported and helped me during these memorable last five years, which have been the time that I will not forget.

26.11.2014, Kotka
Ville Kemppinen

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ABBREVIATIONS

BA – Business Analytics

BI – Business Intelligence

CAD – Computer Aided Design

CRM – Customer Relationship Management

EBITA – Earnings before Interests, Taxes and Amortization

ETL – Extract, Transform, Load

ERP – Enterprise Resource Planning

GIS – Geographic Information System

GIS-T – Geographic Information System for Transportation

GPS – Global Positioning System

HR – Human Resource

IT – Information Technology

LI – Location Intelligence

OLAP – Online Analytical Processing

OPE – Overall Product Efficiency

R&D – Research and Development

RBV – Resource Based View

SaaS – Software as a Service

SDSS – Spatial Decision Support System

SLA – Service Level Agreement

SOLAP – Spatial Online Analytical Processing

1 INTRODUCTION

Geographical information is everyday information for all of us. It is no big deal to check out the location of specific store or the nearest gas station and if some address sounds unfamiliar Google Maps will help you to find it. This is how individuals use location information but the question relies in how companies can utilize increased number of geographical information to enhance business operations.

One of the world's leading information technology Research Company Gartner publish annually the hype cycle for emerging technologies to illustrate new technological trends and innovations. In 2013 the term of Location Intelligence (LI) hit to the cycle without being noted in previous cycles in 2011 or 2012. This only illustrates the rapid diffusion of Location Intelligence solutions and the increasing importance of geographical information. (Smith, 2014; Gartner, 2013) So, more and more companies are starting to understand that in global business environment the ability to know where your customers and competitors are can be a major asset as business operations can be redesigned in order to gain competitive advantage.

Erskine et al. (2014) argue that while the mobile devices such as smart phones or tablet computers increasingly network and gain capabilities to detect their location, the collected data will more and more include geographical references. According to Erskine et al. (2014) as the wide amount of geospatial data is available to decision-makers, it is essential that Information System professionals and researchers broaden their knowledge of geospatial systems and better understand its special characteristics, benefits and drawbacks especially in terms of business.

1.1 Research objectives and limitations

Despite the increased number of geographical information and enhanced power of Information Technology (IT) and computer science it still remain unclear if Location Intelligence has true business value for the companies or if it is just another business buzzword used by Business Intelligence agencies and consultants. *This study aims to define and understand the contemporary concept of Location Intelligence and examine how Location Intelligence could be utilized effectively under the global business context.*

Research scope of the study notes three major aspects in which this study is focusing on. As Smith (2014) defines in his blog, Location Intelligence can be considered as an extension of business analytics, which connects it to the traditional field of Business Intelligence (BI). Moreover the study presents the main technological approaches to Location Intelligence solutions emphasizing the role of spatial data and Geographical Information System (GIS). Final aspect of the study illustrates the nature of business by focusing international capital intensive business. Location Intelligence has successfully applied to the various fields of business e.g. retail, insurance, real estate, banking, marketing and media (Esri.com, 2014). However, very little studies have been made related to capital-intensive business with large capital projects. These aspects provide guidelines to the study delimiting the research scope illustrated in figure 1.

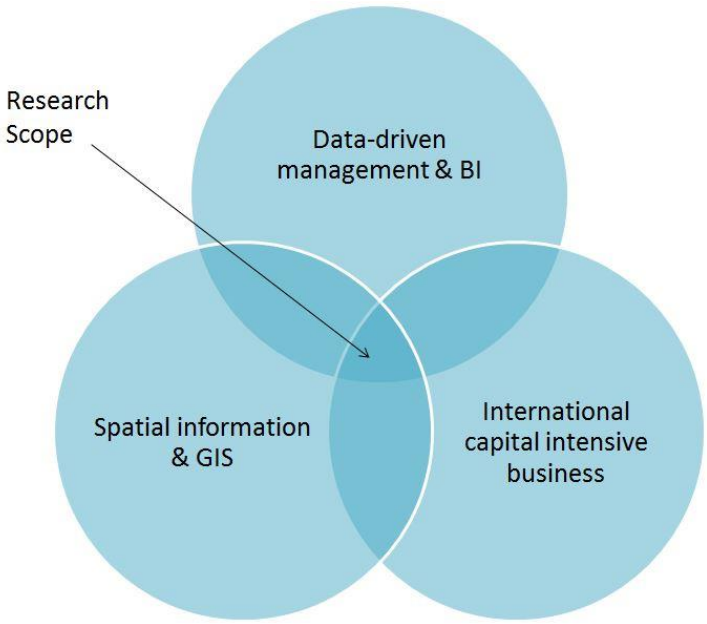


Figure 1. Research scope of the study

This study approaches the role of geographically referenced data in business management from the business point of view, thus focusing less on required technology or technical challenges. The central in defining the role of spatial information is to understand the nature of business, structure of the industry and special characteristics of the business. However technology has naturally a key role as it provides access to the data and platform to manipulate and interpret spatially referenced business data, which is why the main technologies are briefly introduced in order to provide deeper understanding of opportunities that Information Technology enables in the field of Location Intelligence.

Often business data used in management and decision-making is originated from various sources e.g. from enterprise resource management systems or market database, which poses challenges for data management, analysis and interpretation of data. Therefore Business Intelligence and information-driven management are in central while identifying the meaning of spatial information in business management. Identification of characteristics of information-driven management and managerial implications of spatial information helps organizations to recognize and enhance decision-making processes and to make better decisions. *Therefore this study aims to broaden information-driven management literature to the field of geographically referenced information in order to understand opportunities that spatial information provides for managerial decision-making.*

Technology and information help organizations to find new ways to interpret nature of business. However, all industries and businesses have their special features that are characterized by established practices and organizations. Spatial information has major implications to global competition since it allows companies new ways to identify where current and new potential customers are located. So far academic literature of spatial information and Geographic Information Systems in business is mainly focused on studying opportunities in consumer business and marketing or other industries that breath through location e.g. real estate or transportation (see e.g. Anselin, 1998; Hess et al., 2004; Thill, 2000). However capital-intensive businesses have received very little attention in academic studies. *Thus, this study seeks to understand the opportunities and solutions of exploiting spatially referenced information from the point of view of capital-intensive business and to find fields of applications that could benefit from geographical information.*

Under these circumstances the results of this study are to find realistic means for exploiting existing technology and spatially referenced business data to enhance business processes and thus answer the following research questions:

1. *How Location Intelligence can be exploited in global capital intensive business?*
2. *What are the value adding elements of Location Intelligence in global business context?*

1.2 Research strategy

As research scope illustrates there is an obvious need for research, which requires closer attention. The research strategy of how this study is approached includes four main parts. First, introduction addresses the research problem by defining the research scope, determining the research method and providing theoretical background from strategic perspective. The output of the first part is to formulate objectives and limitations for the study and provide direction for the theoretical approach. The overview of the research strategy is illustrated in figure 2.

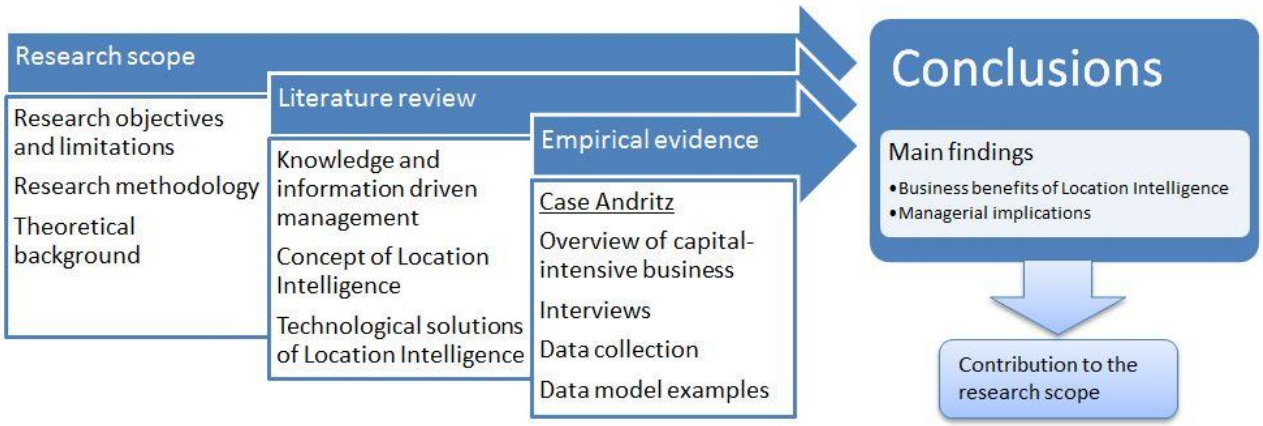


Figure 2. Overview of research strategy of the study

The second part provides deeper theoretical knowledge of information-driven management, concept of Location Intelligence and the key technologies and techniques of Location Intelligence by reviewing theoretical literature from each subject. Knowledge and information-driven management literature provide insight into information based knowledge management and the nature of information as a resource while the concept of Location Intelligence is presented and main technologies and techniques are reviewed to illustrate technological opportunities. The output of the second part is to provide theoretical perspective and understanding of the nature of data-driven management and Business Intelligence and that are guided by technological opportunities and limitations of GIS solutions.

Thirdly, empirical part connects theories presented to the capital intensive business by reviewing empirical evidence from the high-technology company operating in the field of forest industry. Execution of the empirical research includes qualitative interviews that exposes current state of the company's business and determines organizational expectations and opinions about the usefulness

of the Location Intelligence. Based on the results of the interviews a spatial data is modelled by utilizing structured market data collected from the database of market information provider. The purpose of the data model examples is to illustrate how Location Intelligence can be exploited in practice and to complement the results of the interviews.

Finally fourth, the discussion part presents results of the study by providing key findings of the interviews complemented with data model example. Outcome of the key findings is to clarify how Location Intelligence can be exploited in capital intensive business. Additionally this part takes a stand for managerial implications of Location Intelligence, thereby contributing to the field of study by supplementing the research scope. More detailed descriptions and contributions of different phases of the study are shown as input-output process in table 1.

Table 1. Input-output structure of the study

Input	Process	Output
Research problem Methodology Theoretical background	1. Introduction	Objectives and limitations Research strategy Theoretical approach
Information as a business management driver Information as a resource	2. Knowledge and information management	Managerial approach to information Value of information resources
Concept of Location Intelligence Link to the business intelligence	3. Location Intelligence	Implications to value chain Focus on spatial information in BI Organizational development of information systems
Geographic Information System in business LI techniques and technologies	4. Technologies and techniques of Location Intelligence	Functions and applications of GIS Special featured sub-systems of GIS
Organizational overview and business context	5. Empirical evidence	Current state and value drivers of the case company
Organizational objectives and main business actions	6. Location Intelligence Solutions	Applications of Location Intelligence
Structured market data	7. Model construction	Test of LI solution examples
Solutions (from chapters 6-7)	8. Main findings	Business benefits of LI Managerial implications
Benefits and implications of LI to the organization	9. Conclusions and discussion	General overview and contribution to research scope

1.3 Research methodology

The research method chosen to support this study is a case study research method, which allows testing the results of qualitative interviews with structured data. According to Eisenhardt (1989) the case study research approach is especially suitable for new topic areas as the resultant theories are often novel, testable and empirically valid. However the aim of this methodology is not only to generate theory but also to test it or provide descriptions about the theory.

The confusion surrounding the case study method reflects to the distinction among the qualitative data, inductive logic of conclusions and the case study research as the steps for theory building are difficult to address (Eisenhardt, 1989). However, as the research strategy outlines this paper primarily tests the existing theories with structured data in new context with no major ambitions to build theory further. So, for such testing the case study method allows to focus on understanding the dynamics of present with single setting related to the context defined by research strategy. Moreover the case study allows employing an embedded design to study multiple levels of analysis within a single case (Eisenhardt, 1989), which in this study provides possibility to not only analyze exploitation of specific information system but also implications of spatial information to organization and its managerial processes.

The primary sources of unstructured data in this study are qualitative interviews that are executed as semi-structured interviews in order to stimulate rich discussion around the topic. According to Myers & Newman (2007) the semi-structured interviews follow only incomplete script, where the researcher may have some questions prepared to keep the discussion within the theme but having the possibility for improvisation. Barriball & While (1994) summarized number of advantages to use interpersonal interviews as the method for data collection. Interviews overcome the problem of poor response rates of questionnaire surveys and ensure that respondents have no assistance from others available while formulating the response. Additionally, interviews are well suited when attitudes, values or beliefs in the topic are examined. Especially if the topic is sensitive the interviews provide the opportunity to evaluate the validity of the respondents' answers by observing non-verbal indicators.

Semi-structured interviews were selected to this study because the true benefits of new information system can be discovered when organizational attitudes and beliefs towards the new technology can be observed while interviewing the possible users of the information system. Moreover the study

seeks to identify new possible fields of applications for the information system, which can be done more successfully via open discussion.

1.4 Theoretical Background

Increased business information has set new challenges as data flows are digitalizing and rapidly growing. Moreover, the market environment of the companies is becoming more and more dynamic, which highlights the importance of real-time business data. Right type of data can be an important asset for the companies if it can be utilized effectively since it provides valuable insight not only into company's internal operations but also into the market and competitors.

Information gathered from the market environment plays indeed an important role when companies are analyzing industry structure, its attractiveness and their own position among the rivals. Porter (1979) developed the five forces framework, which aims to explain the sustainability of profits under different forces affecting to the competition of an industry. According to Porter (1991) these market forces that are the rivalry among the competitors, bargaining power of the buyers, bargaining power of the supplier, threat of substitute products and threat of new entrants illustrate the sources of competition and dynamically shape the business environment. Fundamental idea behind Porter's framework was that through these forces, companies are able to analyze attractiveness of new business markets and to find market driven possibilities to influence competition in their favor in order to achieve sustainable competitive advantage. Framework helps to analyze technological influences in the market and helps companies to link their strategy to their competitive position in the market.

The distinction between the industry structure and company's relative position in the market is necessary since companies are able to choose and adapt their strategy according its relative position in the market or to find new competitive forms of strategy by analyzing industry structure through these five forces. In an ideal situation, company's chosen strategy triggers responses by rivals allowing company to gain competitive advantage as the rivals are unable to imitate the chosen form of strategy. These shifts and triggers in competitive forces may cause new business drivers in the industry and enable competitive advantage for the company.

Porter (1991) defined competitive advantage as a result from firm's ability to perform necessary activities at a collectively lower cost than competitors or to perform some activities in unique ways

that produce more value for the customer and thereby provide more revenue for the company. However, customer value and sources of competitive advantage are more complex than just performing necessary operations. In order to define the concept of customer value Porter (1991) defined the value chain framework (figure 3) to provide a conceptual tool for analyzing how customer value is created through company's operations.

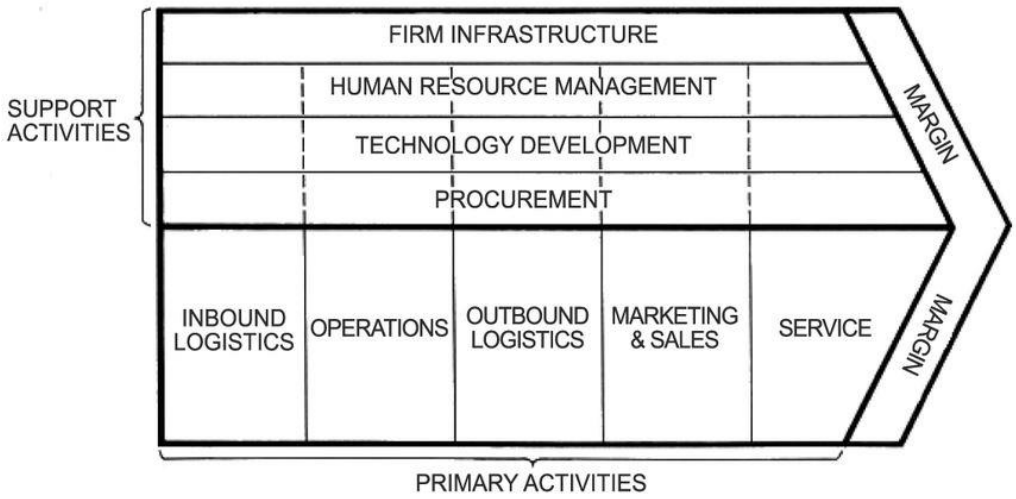


Figure 3. Generic value chain (Porter, 1985 p. 37)

The framework notes that a company is a collection of discrete but interrelated economic activities that shape company's strategy as they form configurations of activities that interrelate further. Customer value, in turn, is according to Porter (1991) the source from which the potential profit eventually derives as this value increases not only company's profits but also its assets in the form of organizational skills, routines and knowledge that are generated through performing value creating activities. Through the value chain analysis companies are able to understand their cost position and eventually analyze which activities generate the highest value since the customer value is created if company either lowers its customer's costs or enhances its customer's performance.

Porter (1991) argues that the sustainability of competitive advantage respect to rivals depends on the number of competitive advantages in the value chain and more explicitly underlying drivers of each operation of the value chain. The drivers in the value chain are structural determinants of differences among the competitors in the operations. The most important drivers in an activity include characteristics such as the scale, cumulative learning in the activity, activity's location, institutional factors affecting how the activity is performed, linkage between the activity and other, the pattern of capacity utilization in the activity and the extent of vertical integration in performing

the activity. These drivers determine the underlying source of competitive advantage and make it operational. However, these drivers do not necessary guarantee the success of the company because the success requires the choice of an attractive position in desirable industry structure, company's circumstances and relative position of competitors.

Porter provides a market base view of how to analyze sources of competitive advantage. However, company's activities require resources in order to be performed, which provide another way of reviewing competitive advantage. The Resource Based View (RBV) theory, presented by Barney (1991) argues that competitive advantage is created through company's resources that are valuable, rare, imperfectly imitable and non-substitutable. Leading idea behind RBV theory is that a company is able to gain competitive advantage by implementing a value creating strategy, which cannot simultaneously be implemented by competitors or potential competitors and company's resources are the main source for implementing such a strategy.

Barney's (1991) theory, however include some inconsistencies since the sources of competitive advantage are not only dependent on having more valuable or rare resources because any competitive advantage based on particular resource can be competed away over time. Additionally, rareness or value of resources may change over time or make resources easy to imitate or substitute. So, competitive advantage is not only dependent on the characteristics of resources but also dependent on the effective accumulation, exploitation and bundling of resources over time.
(Eisenhardt & Martin, 2000; Sirmon et al., 2007; Teece et al., 1997; Dierickx & Cool, 1989)

Bundling of resources increases the complexity of company's structures but the same time it increases the value of organizational processes as resources are coupled into capabilities that are further used in order to generate competencies and eventually core competencies. Finally core competence of an organization illustrates the ability of collective learning of an organization, harmonized streams of technology and organization of work with value delivery. Core competences are especially characterized by communication, involvement and deep commitment to working across the organizational boundaries. (Prahalad & Hamel, 1990) Hierarchy of the competencies by Torkkeli et al. (1999) is presented in figure 4.

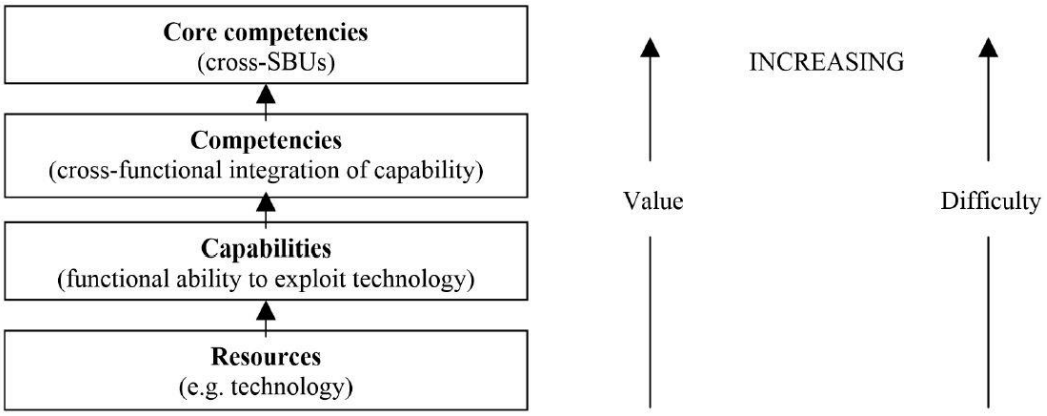


Figure 4. Hierarchy of competencies (Torkkeli et al., 1999 p.2)

Information have influenced to the capture of competitive advantage since through information flows organizations can greatly enhance the ability to exploit linkages between different value adding activities both internally and externally (Porter & Millar, 1985). Moreover, companies are becoming to be more careful for whom the information is shared and at what cost, since the knowledge is certainly not passed around without any compensation. Therefore, knowledge assets are often inherently hard to imitate especially while some of them are carefully protected. The importance of intellectual property has indeed increased as the use of information technology has grown, which have shifted whole concept of intellectual property into new context. (Teece, 1998)

Recently, developed countries have experienced a transformation from traditional raw material processing and manufacturing activities to the coupled processing of information and development, applications and transfer of new knowledge, which have consequently affected to such development where activities with diminishing returns have been replaced with activities characterized by continuously increasing returns. Added value i.e. increased returns are usually major driver for knowledge based industries. Capturing profits from knowledge based value adding activities involves identification and combination of relevant complementary assets that support business. High profits are available for the companies characterized by entrepreneurship, flat hierarchy, clear vision and high powered incentives that rapidly sense new ways for such value adding activities. (Teece, 1998)

2 INFORMATION-DRIVEN MANAGEMENT

Data-driven management generally refers to utilization of data in business management. However, companies rarely understand the actual meaning of data-driven management even though companies either suffer from massive dataflow or major lack of business data. Commonly used notion considering data-driven management states that companies need right data for right people for right time. This interpretation sounds legitimate, however it can be misunderstood since companies may think that they need constantly more data for everyone, which of course is not the case. (Laihonen, 2013) Organizational success indeed depends on knowing of which kind of data, information or knowledge one need instead of the amount of data since these concepts are not interchangeable (Davenport & Prusak, 2000). Companies rarely are aware of the true meaning of these concepts, so they need to be clarified.

Data can be defined as a set of individual and objective facts about events, which, in corporate context are most usefully, described as structured records of transactions. These records of transactions, however, will not provide any further details of the events or background of the events, so data itself has quite little relevance or purpose. Companies' data evaluation depends on the form of datasets that can be either qualitative or quantitative. Quantitative data management focuses usually on costs, speed and capacity, which are variables easily measured by numbers, while qualitative data metrics are usually timeliness, relevance and clarity. (Davenport & Prusak, 2000) Especially in terms of unstructured data, Pirttimäki (2007) highlights that user receives the true meaning of data only if data have certain context.

At simplest, raw data are symbols or other kind of individual non-interpreted facts that illustrate some discrete events without any relation to other data and without any meaning of itself. Spatial data differs from traditional concept of data by illustrating physical locations of objects or numeric relationships between objects. In widened perspective this definition includes not only physical existing things that have location of the Earth's surface but also events e.g. traffic congestions or floods, which all share the same aspect by existing or happening in somewhere on Earth's surface and having spatial extent. (Smart, 2008; Keller & Terga, 2005; Bartelme, 2012) Spatial data allows access to the data records by location or attributes. However, attribute data may cause spatial dependency as attributes nearby may have propensity to influence each other or to share similar attributes (Anselin, 1989).

Context, in which data is reviewed plays important role as information is created by structuring data so that managers are able to analyze and resolve critical problems. (Thierauf, 2001) Pragmatic context and relational connection create interpretations that give meaning to the data, and thus enable effective analysis. However, information is the same only for those actors that share same meaning of data. (Keller & Tergan, 2005) So eventually it is dependent on the receiver if data is truly information or not because in order to be information, data should change the way the receiver observes something (Davenport & Prusak, 2000). Information can be characterized by different categories e.g. its features, origin or format or by different format of representation e.g. print, visual or audio-visual. These characteristics affect to the determination if information is abstract or concrete (Keller & Tergan, 2005), which is important notion when discussing how information transforms into knowledge.

If definitions of information highlight the assumptions of context related data, knowledge in turn emphasizes more the role of knower. Davenport & Prusak (2000) define knowledge as a fluid framed combination of experience, values, contextual information and expert insight, which provides window for evaluating and assimilating new experiences and information. These experiences and information emerge are applied in the minds of knowers and in the organizations become embedded in routines, processes, practices and norms. Keller & Terga (2005) make an important notion by arguing that information is outside the brain, while knowledge is inside. So, knowledge is owned by a person, organization or society, when information can be available to everyone.

These definitions clearly show that the concept of knowledge is not simple or easy to understand. It includes various elements that are formally structured but fluid at the same time. Moreover, knowledge is hard to capture or understand completely in logical terms because of its intuitive nature. Nonaka & Peltorkorpi (2006) describe beliefs, commitment, perspectives, intentions and actions as fundamentals of knowledge, which illustrates well how hard knowledge assets are to specify (Davenport & Prusak, 2000). If data and information can be regarded as company's resources, knowledge illustrates company's capability to exploit information in order to create data driven competencies, which enhances organizational learning and development of core competences.

2.1 Information as an enabler of business management

Business drivers are traditionally determined based on business environment and macro-economic factors. Depending on the nature of business, drivers are determined by analyzing competitive environment of an industry or political, economic, social, technological, environmental or legal (PESTEL analysis) factors of business environment. Business data plays an essential role in the determination of business drivers as these analyses can be considered as accurate only if the information, which the analysis are based on is reliable. Accurate information enables coherent and correct conclusions and decisions of how company should react on the drivers of change. Moreover signals referring to the drivers of change usually determine what kind of data is relevant in terms of dynamics of business environment. (Johnson et al., 2005)

Strategic intentions traditionally determine the need of business information required in successful strategy execution. Strategic, tactic and operational objectives can be set and alternatives can be evaluated with suitable information in order to make right decision in terms of competitive environment. Sources of business information can be roughly divided into external and internal sources. External information illustrates the information out of company's boundaries e.g. information of business environment, technological development of an industry, competitors, partners and customers. Internal information in turn, illustrates the company specific information e.g. information of production, sales and know-how of employees. In addition to division of information all decision can be classified as strategic, tactical or operational decision. Although, classification may be difficult it is necessary since the type of information required at each level vary from each other. (Pirttimäki, 2007)

As figure 5 illustrates the need of information varies depending on the level of managerial decision making. The level of strategic planning emphasizes the importance of external information while operational monitoring requires accurate internal operative information. However, operational monitoring is not executed only at the lowest level or strategic planning at the highest level since the question is more about the matter of weighting the effects of decisions. Decisions of strategic planning are seeking for long-term effects, so the information needed at this stage mainly consider upcoming possibilities and new approaches to business. Decisions of the operative monitoring in turn focus more on detailed prevailing business operations where operative management is often based on experience and the aim is to execute tactical and strategic guidelines. Both internal and external information are always needed in order to make successful strategic decision in the

organization. Although, diversity of information needs certainly complicates information exploitation in business management since information needs depend not only on decision-maker but situation and time as well. (Pirttimäki, 2007)

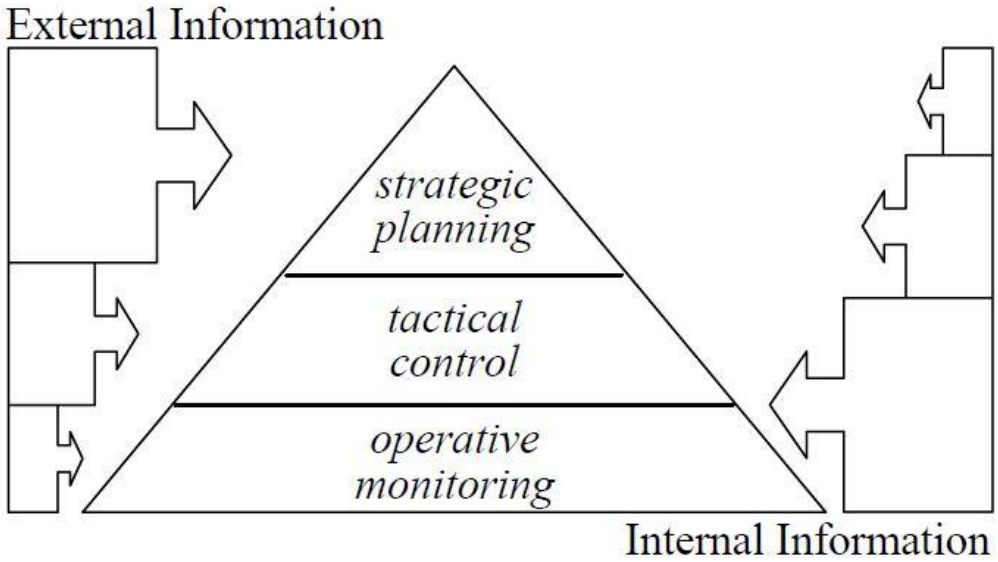


Figure 5. Information needs in different levels of management (Pirttimäki 2007, p.45)

When considering successful decision making, it is obvious that both quantitative and qualitative information is needed. Additionally, business information reflects to the hierarchical classification of information according to which business information can be data, information, knowledge or intelligence. However in order to identify information needs of managers in real business situations three dimensions of information needs classification have to be identified. Frist dimension is the source of information. Information sources can be either internal or external, where internal sources are e.g. operational databases or employees of an organization and thus illustrate the information generated inside the organization. External sources in turn, illustrate market information generated outside the organizational boundaries. External sources are e.g. newspapers, research papers or white papers, the Internet sites or trade publications.

Second dimension is the subject of information, which illustrates the content of the information explaining if information relates to the organization itself or if it relates to the out of organization's boundaries. Naturally internal information refers to organization itself and external information on the contrary outside the organization's boundaries. Third dimension is the type of information, which illustrates if data is quantitative structured data or qualitative unstructured data. Quantitative data is typically characterized as to be easily managed and processed like statistical information

while qualitative data is defined as cognitive structures or ideas and vision that are more difficult to communicate formalize or share. (Pirttimäki, 2007; Frieshammar, 2003)

2.1.1 Information as a business management driver

Notwithstanding the successful classification of information dimensions Pirttimäki (2007) notes as well that internality and externality in various dimensions is subjective since it is possible to receive same information from both internal and external sources and it can reflect to either external or internal subjects depending on the factors of information user e.g. receiver and his position. Additionally internal and external sources are not carved in stone therefore the line between these sources is vacillating especially in terms of networking since the general aim of networking is to have transparent information flows.

As it has been explained previously, there are several information needs, which are dependent on decision-maker, prevailing circumstances and time. Naturally this diversity and increased complexity affects to the exploitation of information in business management. Business key drivers and dynamic changes in market forces guide company's strategic and operative decision making by establishing issues that managers have to consider. Therefore, in order to make successful decisions top managers have to have all the essential information to the greatest extent possible at hand, which requires teamwork that include several people from different organizational levels and units to participate. Only then individuals and their tacit know-how act in significant roles and support decision-making in company's processes. (Pirttimäki, 2007)

Additionally, customer needs have to be taken into consideration by integrating company's decision-making processes to the customer interface since the changes in the business environment can be fatal to the company if these changes cannot be responded in time. Thus, top managers should be able to foresee the changes and acquire relevant, real-time information that then, can be used to make right decisions. Top managers should sense, recognize and estimate changes of the industry better and faster than ever in information society, which only increases the importance of information as an enabler of business management. (Pirttimäki, 2007)

Information in business represents the majority of the cost structure, where more specifically, information is the force that compresses business structures together. Value chain represents these structures that company need in order to produce offerings. Various value chains of the suppliers,

buyers and other actors form an industry value chain that is a certain configuration of competitors, suppliers, customers and distribution channels. Industry value chain includes also information flows within inside the company but also within the suppliers, customers and potential customers. This information is often referred as in definition such as the value of customer relationship, which actually refers to the information that company holds on to its customers or to the information that customers have on the company's actions or products. (Evans & Wurster, 1997)

Information does not only determine and constrain the relationships of different actors in the value chain but in many businesses it may also be a source of competitive advantage, even if the cost of information is trivial but the product or offering itself is physical, because for example in buyer-seller relationship information can determine the relative bargaining power between the parties. So, information and its distribution mechanisms are stabilizing company and industry structures highlighting competitive advantage and enabling business management. However, value components of information are so seamlessly embedded into the physical value chain that value of information is difficult to define or acknowledge. New information does not necessary only threat established business but it can also provide new business opportunities as industries are shifting according to its dynamic drivers addressing strategic implications. Existing value chains may fragment into new separate value chains with their own sources of competitive advantage. (Evans & Wurster, 1997)

2.1.2 Managerial implications of information driven management

Information management has traditionally emphasized the importance of information selected within a specific business problem related context. However Pirttimäki (2007) highlights that decision makers actually need a comprehensive bundle of up-to-date information from various contexts. This bundle requires information from both external and internal sources in order to create sophisticated and proactive decision making process. So, decision-making should not be only about having the right information but more allowing decision-maker to make the best decision to solve the problem. Information, thus provide solid ground for the decision making, which aims to solve specific problems. However, only well-structured and well-defined particular problems can be solved with statistical data, so in practice decision-making process always requires some of tacit knowledge from decision-maker. (Pirttimäki, 2007)

Moreover, decision-maker has an important role as he has to hunt out new information sources himself if the information needs at hand are not met well enough (Davenport & Prusak, 2000). Pirttimäki (2007) highlights the meaning of continuous interaction between the decision-makers and information producers to be essential in terms of assuring the transparency of information needs and information available. However, it is organizational advantage that everyone does not know everything, thus information needs should be carefully considered and unnecessary distribution of information be avoided (Pirttimäki, 2007). Edmunds & Morris (2000) emphasizes the importance of value added information as a solution for increased information overload. According to them it is essential to identify and recognize the ways of how information processes add value to the information in order to prevent the failures from which information overload occurs. Simultaneously, as the amount of information available increases, it addresses the problem of depositing the information because it is not rational to gather and produce large amounts of information if it cannot be storage and processed effectively. So in general, the quality of the information should be appreciated instead of the amount of data. (Pirttimäki, 2007)

Information quality can be determined by its relevance, reliability and validity (Fleisher, 2001). Pirttimäki (2007) amplifies that information needs to be valid, i.e. as correct and comprehensive as possible, which however, not necessarily mean that company is able to gather all-inclusive information because of its high price. Moreover, information should include all of the essentials and be reliable by meaning that it should not be random but comparable to the existing information. Finally, information should be collected and analyzed with timely manner in order to be useful for the company as business environment is often hectic and changing rapidly. (Pirttimäki, 2007) These characteristics emphasize the importance of information as it aims to reduce uncertainty in managerial decision-making processes (Frieshammar, 2003). Due to this uncertainty, which so often causes the failure of successful business strategies, it is hard to identify real problem that is the understanding of how to filter the essential information from information flows to generate knowledge for recognizing notable events, predicting difficulties and observe opportunities. (Thierauf, 2001; Pirttimäki, 2007)

Thierauf (2001) notes that huge amount of information available can rather impede manager's decision-making capability than simplify it. Therefore Thierauf (2001) highlights the problem of increasing information flows that managers are dealing with. The amount of information can increase so high that it becomes almost unmanageable. However good planning, control and

decision-making requires quality up-to-date information, which transforms working habits while business conditions together with accelerating pace of business change.

According to Johnson et al. (2005) business information management implicates to the managerial processes in two ways. First, managers need to understand that capability of effective information processing may transform the organization instead of slim fine-tuning of managerial or operational practices, which means that managers have to take distance from seeing information driven management as a supportive function but place it to the center of business. Second, mangers have to understand the full potential but also the limitations of IT and to what extend technology can be utilized in business management as it cannot completely replace certain professional knowledge e.g. intuition or knowledge sharing provided by personal networks. Managers have to be credibly involved in on business strategy and actively seek new opportunities how IT could support business development and information driven management. Additionally, managers need to have skills to enlighten, educate and influentially persuade colleagues for information driven management and decision making. (Johnson et al., 2005)

Information can also automate decision-making, which however does not mean that management should be automated because all decision-making is not management. Information driven management is complicated as it should not be seen only as the same as knowledge management but instead it should be seen as continuously series of decisions and actions, where information is monitored as an active part of management processes. Thus, information driven management actively monitors actions and makes necessary decisions based on relevant information. (Hakanen, 2014)

2.2 Information as a resource

As it has become clear companies need different kind of information from various sources and by exploiting information in decision-making processes the information can be a valuable asset for the organization. Company's information and knowledge resources illustrate data, information and knowledge that are controlled and owned by the company. Like other resources, information can also be both tangible and intangible resource that can appear in structured from (databases) or tacit non-transferable information or knowledge. As mentioned, successful bundling of resources forms capabilities and therefore successful coupling of information flows also enables new capabilities and competences. In case of information management, these capabilities and competences refer to

firm's capacity to exploit information and knowledge resources by using organizational processes to affect and emphasize desired outcome, which eventually is an individual's or the whole organization's ability to learn from the context of information. (Pirttilä, 1997)

Thierauf (2001) presents that recently, information has acknowledged being the sixth resource of the organization among the people, machines, money, materials and management. However within the context of Information Technology organizations often consider technology as an expense rather than as a valuable asset, although quality and timely business data and information provide deeper insight for managers, which still remain undervalued, underestimated and underused. (Thierauf, 2001) Hovi et al. (2009) suggest as well that organization should see information as a valuable asset and resource that have required investments for information systems, hardware and training of employees, without forgetting hours of work. Information as a resource should be effectively illustrated and available for the organization as whole. However, in basic structure information is scattered or information is inadequate, which addresses challenges in analysis or reporting of information. (Hovi et al., 2009)

Moreover, information as a resource includes some features that make it difficult to treat as other corporate resources. The problem is that information does not possess value the same way as traditional tangible resources. The value is traditionally connected to capital value, which information obviously lacks because from the point of organizational view information does not have inherent value but the value of information is connected to its exploitability or applicability. (Pirttilä, 1997)

According to Pirttilä (1997) the amount of information is not essential. However, more important is the way of how effectively information is utilized in pursuing to achieve organizational goals or objectives. Thus, from the organizational point of view the value of information is generated through its usability and relevance for the organization and only if it can additionally be adjusted to serve the needs and interests of the members of the organization. This implicates that new information is always scaled and reviewed from the basis of already existing knowledge or information in the organization. For example the sales information receives its relevance and adds value only if it is submitted to the person in responsible in order to be interpreted and exploited in decision-making. (Pirttilä, 1997)

Information as a resource can provide successful base for competitive advantage, which however requires successful coupling of information with other resources. Davenport & Harris (2007) suggested that companies that are seeking competitive advantage through analytics should use analytical methods with caution and execute those initiatives well and improve them continuously. Davenport & Harris (2007) recognize few competences that illustrate analytical organizations. Analytical organization is able to create processes and culture that is hard to imitate since analytics and information processing are embedded to traditional organizational functions, and thus these processes are difficult to identify. Organizations are developing unique ways of how to use analytics and information which are determined by the strategy and market position of the organization that however increases the complexity of analytics.

Analytical organization is able to cross organizational boundaries by applying analytical competence and thus discover new fields of application for analytics. Although analytical competence and consistent data gathering may be current practice of an industry, still some organizations are performing it better than other competitors. However no competence can be outperforming indefinitely, so analytical competences like any other sources of competitive advantage should be developed and invested in continuously. (Davenport & Harris, 2007) These notions infers to the resource based view suggesting that analytical skills can be considered as organizational competence that is generated by exploiting functionally various resources.

Although the Porter's value chain illustrates mainly physical actions of how value is created through company's operations Porter & Millar (1985) acknowledge that information technology is permeating the value chain at every point. Information transforms the way of how actions are performed and the nature of how information linkages among the actions. Moreover the phenomenon affects the competitive scope as it reshapes products that meet new customer needs. Porter & Millar (1985) explain few effects why information and information technology has acquired strategic significance differentiating from many other technologies business use. They argue that every value adding activity possess both physical and information-processing component and that every value adding activity creates and uses some kind of information. When the value of an activity increases so does the difficulty as well (Torkkeli et al., 1999), thus physical or information-processing components may be simple or even quite complex (Porter & Millar, 1985).

So, Porter and Millar (1985) emphasizes the role of information as a component that not only increase complexity but also enables opportunities to have more value adding activities that along

the value chain provide more value to the end customers and thus creates competitive advantage. In this development information technology has also major contribution as for most of industrial history, technological progress has eventually affected to the physical component of what business do.

3 LOCATION INTELLIGENCE

As data flows are increased it has created pressure towards the companies to develop new ways to analyze and get more out of their business data that they receive from customers, suppliers, market and other sources. Now recently new critical element has brought to Business Intelligence, a location. Location Intelligence aims to organize and understand complex business events and trends by examining geographic relationships in information. In essence, Location Intelligence adds geographic, demographic and similar types of data to the traditional information already used in Business Intelligence, which moreover reflects to the increased development and use of reasonable technology that capture and identify spatial data. (Ortiz, 2014)

Development of information systems and IT has shaped the way of how companies react and approach existing business environment. Technological advances have enabled the increased availability of geographic services that has led to the development of turnkey applications, which automatically process traditional tabular data as suitable to be plotted on maps and coupled with advanced analytics software, and eventually brought to Location Intelligence to be utilized in many organizations. (Ortiz, 2014)

3.1 Concept of Location Intelligence

As Geographic Information System has become more common and accessible among the private companies, location analytics have increased and created new field for the interpretation of business data. While traditional Business Intelligence breathes through business data, which is used to analyze business operations, very often this data include objects with spatial attributes that is easier to review when it is displayed on the maps. Location Intelligence is a business intelligence solution, which provides spatial insight for managers. As a definition Location Intelligence refers to techniques and solutions that integrate geographical dimensions to traditional BI solutions. Location Intelligence capabilities can reflect to both operational and strategic actions in order to facilitate decision making process and enhance the capability of better monitoring and interpretation of business events. (Hovi et al., 2009; Esri, 2012a; PitneyBowes, 2012; Golfarelli et al., 2013)

Location Intelligence tends to answer the business questions of “where” and thus help decision makers to analyze spatial issues, which is why it is often executed by using Geographic Information

System (Esri, 2012a). Bouckaert (2010) notes that Location Intelligence as a term is more and more used to describe the new generation of GIS. Additionally, need of spatial information has increased exponentially as many geographical online application solutions e.g. Google Earth, navigation equipment and mobile Global Positioning System (GPS) devices have made the use of that information easier. However, analytical use of spatial information has not yet achieved success in most of companies. (Hovi et al., 2009; Esri, 2012a; PitneyBowes, 2012; Golfarelli et al., 2013) Many commercial sources (see e.g. Esri, 2012b; PitneyBowes, 2012; Thompson & Patterson, 2010) have highlighted the emergence of this new wave of business analytics and intelligence, while traditional BI as a concept is maturing. Hovi et al. (2009) mention Location Intelligence to be the new trend of BI, which will provide interesting additional functions to already existing BI solutions.

It has been estimated that approximately 80% of all data include spatial references (Pitney Bowes, 2006; Grimshaw, 2000; Mennecke, 2000), which emphasizes the importance of spatial analysis in business decision making. Pitney Bowes (2006) and Hovi et al. (2009) share simple examples related to retail business, where location intelligence is used to determine optimal store locations, quantify and avoid cannibalization among various stores, precisely match media and marketing messages to target households and identify under-performing stores in order to determine, which stores should be closed and renovated. These are of course pretty obvious examples, yet they give a good perspective to which Location Intelligence can be used for.

Winslow (2007) in turn, defines Location Intelligence as an awareness of relationships between location information, business analysis and operations. Additionally, Location Intelligence provides the ability to use the understanding of spatial relationships to predict how it influences on a business or organization. Location Intelligence illustrates the capability to react on these influences by changing business processes in order to minimize risks and maximize opportunities. Through Location Intelligence companies are able to measure, compare and analyze business data from operations along with external data such as transportation networks, market characteristics or customer relationships. Location Intelligence covers the areas of analytical capabilities to quantify, compare, analyze and predict spatial data patterns with technology that is scalable and integrated into business application or systems and reference data with both geographic and attribute features. In addition, Location Intelligence comprises the knowledge of business-specific operational and analytical issues together with competence in understanding and applying location analysis techniques. (Winslow, 2007)

Location Intelligence combines successfully GIS technology and spatial business data. With Location Intelligence solutions companies are able to answer the questions e.g. where the marketing efforts will be the most or least successful or are there location-based patterns related to company's business operations in order to achieve strategic benefits. Successful integration of BI and GIS provide capability for visual analysis of key BI figures, correlation of BI data and spatial attributes e.g. demographic factors, geographical customer classification or consumer information to analyze and optimize product and service sales. (Esri, 2012; Golfarelli et al., 2013)

Core capabilities of location intelligence are mapping and visualization, spatial analytics and information enrichment. Mapping and visualization refers to intelligent mapping that enables users to explore information on an interactive map. Spatial analysis refers to ability to analyze information through a map i.e. information can be analyzed by using geographical maps and additional charts of spatial attributes together. Information enrichment refers to ability to add key attribute data to a map in order to enhance analytics. (Esri, 2012)

3.2 Value of Location Intelligence

General assumption is that Location Intelligence is nothing but dots on a map, which is why it is important to go beyond the map in order to achieve the true value of Location Intelligence. After all, the main idea is to share enriched business data within the organization. Commercial sources propose that the actual value of Location Intelligence for the companies is created by the more detailed level of business analysis that geographic approach provide. This added value is created by visualization of BI data and by combination of spatial data and spatially referenced attributes that cannot be done with traditional BI analysis or geographic analysis alone. So, true value of Location Intelligence is the comprehensive analysis, not just the ability to see objects on the map. (Milton, 2011)

Killick (2014) presents different characteristics that help to understand possible ambiguities of Location Intelligence in business. First characteristic is that Location Intelligence includes several different ways of presenting spatial data. It is not just the map with dots, but data can be presented in the form of heat map, clustering, data aggregation or color coding data. These forms of visualization help to understand spatial relationships and disclose new information from structured data. Second important characteristic of Location Intelligence is to learn more about the geographical areas in which company is operating. Geographical enrichment of information can be

done either with map enrichment or data enrichment. Map enrichment means that different layers including different business information are mapped into one map to make the map more informative. Data enrichment, in turn, means the addition of new columns of information to the database records so that the information can be analyzed in new ways. (Killick, 2014; Esri, 2014c)

Third characteristic emphasizes the mapping of data, which provides new perspectives to review data and may uncover new patterns or relationships and together with data enrichment maps become analytical tools that can be used to determine statistical anomalies. For example hot spot analysis may help to reveal statistical misconceptions as maps are used together with other visual tools. The fourth characteristic emphasizes the organizational collaboration with maps. As core competence is developed through collaborative organizational learning, maps can be used to enhance organizational development and thus increase the value of Location Intelligence by sharing dynamic maps rather than static maps, maps across devices or maps in presentations as dynamic instead of static maps. In addition value can be created by sharing maps across business systems and using multilayer maps in other business systems. (Killick, 2014)

In order to better understand how the value can be added to different business functions table 2 illustrates factors of how Location Intelligence solutions can contribute to the different business functions. Table 2 includes different business functions typically supported by Location Intelligence feature. Functions illustrated in the table 2 are related to suppliers, customers, Human Resources (HR), service, pricing, business development and logistics. Value adding factors are operative actions enabled or supported by Location Intelligence solutions. (Lainiola & Ukkonen, 2014)

Table 2. Added value of Location Intelligence applications (Lainiola & Ukkonen, 2014)

Business function	Value adding features of Location Intelligence
Suppliers	Supplier selection based on geographical location Subcontractor optimization at the site Warehouse locations Geographical allocation of suppliers compared to competitors
Customers	CRM data visualization Analysis of customer potential in specific region Understanding of customer actions and behavior
HR	Work force management, planning and optimization Effective management of employee mobility Analysis of human resources in terms of the market size and development of market
Service	Determination and analysis of SLA Location of service branch Leveraging of Installation base through visualization Analysis of the impact area of service branches
Pricing	Regional dynamic pricing based on other functions e.g. logistics or service (SLA)
Business Development	Growth Planning Competence mapping
Logistics	Optimization and planning of logistic routes and transportation
Product management	Geographical product portfolio management Analysis of product trends regionally

In global business it is the matter of cost efficiency to choose suppliers that are able to supply materials effectively and often physical location have major implications when considering supplier options. Location Intelligence solutions provide added value by brining geographical dimension to the supplier selection. If construction site is located in specific region, by using Location Intelligence solution optimal suppliers can be selected from that specific region based on their location and thus achieve cost savings. Moreover Location Intelligence is useful in optimization of subcontractors at the site based on same reasons. (Lainiola & Ukkonen, 2014)

Customers are the most important interface in sales and marketing activities. With Location Intelligence solutions Customer Relationship Management (CRM) data can be illustrated on the map and thus find and analyze the most important customers in specific region based on the number and the value of customers. Additionally, analysis of customer potential in specific region can be analyzed with Location Intelligence solutions since geographical information provide insight into the development of customer base in specific region. CRM data provides various possibilities for

data display. CRM data can be illustrated as hot spot or heat map displays that provide new points of view for customer relationship management. Together with CRM activities the pricing plays an important role in sales operations. Location Intelligence supports pricing as Service Level Agreements (SLA) can be used as a pricing criterion, for which Location Intelligence provides an effective tool to manage. (Lainiola & Ukkonen, 2014)

Location Intelligence can quite surprisingly provide valuable support to the human resource management by enabling new ways to plan and optimize work force management especially if considering high work force mobility. Moreover, LI supports analysis of human resources optimization in terms of the market size and development of market e.g. number of employees in a certain service branch can be optimized according to the size of service area or according to service activities in that region. Location Intelligence adds value to HR function by assisting work planning and work allocation, routing, mobile solutions and situation awareness as human resources can be visualized on map. (Lainiola & Ukkonen, 2014)

For service activity LI provides a good tool to determine SLA areas and analyze the effectiveness of SLAs. Additionally, LI enables effective leveraging of own installation base since service offerings can be targeted regionally. Visualization supports the analysis of the service area clarifying if the impact is regionally wide enough. Moreover, geographically referenced information and LI solutions help companies to analyze and decide the optimal number of service units and their locations in relation to regional customer base. Thus Location Intelligence driven network planning creates value to the business operations through cost efficiency (Lainiola & Ukkonen, 2014)

Location Intelligence solutions help companies to identify new needs of competence by comparing the potential growth of demand and existing resources and competences and analyze if business development initiatives are possible to execute with existing resources. These analyses may also include subcontractors or subsidiaries. Moreover Location Intelligence solutions enable effective planning of expansion planning as it can assist with geographical issues like where to start or where to go. In expansions or mergers and acquisitions it is also important to analyze and determine networks and existing installation base for which LI solutions can be used. Network planning includes the same features as human resource operations and service operations i.e. determination of the number and location of branches and determination of the number of employees and optimization of service area. (Lainiola & Ukkonen, 2014)

Supply chain resiliency and risks, in turn, play an important role in global business operations. Location Intelligence adds value to the supply chain management and risks by allowing companies to design optimal routes by taking into consideration and analyzing different geographically related risk factors. Additionally Location Intelligence provides situational information from specific areas and thus helps companies to prepare better on supplies. (Lainiola & Ukkonen, 2014)

3.3 Link to traditional Business Intelligence

The concept of Business Intelligence was originally presented by Luhn (1958) who defined Business Intelligence to be a communication facility that serves the conduct of business. As information technology has been developed the term of BI has been updated. Later, Business Intelligence was used to refer rather to the system that includes business information, software and hardware, which together are used to gather and storage data and analyze information from the business point of view with analytical tools presenting both internal and competitive information to decision-makers. (Negash, 2004)

According to Kemper et al. (2013) Business Intelligence is a collective definition for combination of data analysis, reporting and various query tools that aim to help business users navigate through information flows and generate valuable information to support management. Naturally leading companies in the field of management adopted the term summarizing all the necessary tools e.g. data warehouses, data marts and Online-Analytical Processing systems under this collective umbrella term. Therefore the original Business Intelligence illustrates the heterogeneous cluster of isolated tools supporting business management and decision-making.

Typical BI architecture includes three main layers that are data support layer, information generation, storage, distribution layer and information access layer. Data support layer is responsible for storing transformed, harmonized, structured and unstructured data for decision-making, while information generation layer enables functions to analyze structured data or unstructured contents and supports distribution of relevant knowledge. Final, information access layer allows users conveniently access to all relevant BI functions. Often information layer is executed with some sort of portal software, which provides graphical user-friendly interface. (Kemper et al., 2013)

Pirttimäki (2007) approaches the concept of BI more from managerial perspective suggesting that BI is defined as a concept or tool to manage and enrich business information that produce real-time knowledge for operative and strategic decision-making. Kemper et al. (2013, p.6) notes that in initial discussions regarding the enterprise BI researchers were supporting the vision of*" Single point of truth"* that could provide consistent support for all managerial decisions. However, recently general attitude has shifted more on towards the approach where BI provides support for heterogeneous decisions in separate strategic business units with often highly focused information needs. Therefore modern BI systems include different data storing systems, diverse Extraction, Transforming and Loading (ETL) procedures and adequate analytical tools in order to meet various user needs across the organization. (Kemper et al., 2013) However, the shift on towards more specific information needs has not removed the nature of BI to refine information and knowledge that describe the business environment, a company itself and its position in respect to markets, competitors, customers and economic issues. (Pirttimäki, 2007)

Although BI has focused on analyzing and monitoring data, geographically referenced information has received less attention. Reason for this development may be historically separate development and implementation paths between BI and GIS. However, recently users have requested more complete operative display and ability to be more proactive, which has led to the combination of these two technologies. Combination of BI and GIS were developed as the IT landscape was evolving to absorb different ways to compiling, storing, using and distributing data. Today's GIS recognizes the location component of data and connects data with geographic features e.g. roads, rivers or forests that in addition may have significant relevance in business as well. (Esri, 2006) More recently BI environment has been redefined as new analytical approaches to business have been developed. Today Business Analytics (BA) include traditional BI but also more advanced tools e.g. predictive analytics or even prescriptive analytics that provide support for business decision-making. (Esri, 2012b)

3.4 Development of information system project

Naturally information needs require the collection of information from various sources that may not be easily accessed. Moreover different functions require different information systems for data collection and management. Information systems allow effective exploitation and engaging of data into the company's business operations in order to become true resource for the company. However, no information system is straight forward ready to use for organizations but it requires careful and

continuous development. During the development and integration phases several issues can interfere with the project and lead to unsuccessful outcome. Hovi et al. (2009) reminds that successful implementation of Business Intelligence share the same characteristics common to any IT project, however having the focus on few specific issues. The special characteristics are according to Hovi et al. (2009) the maturity of company's BI capability, the development methodology, support of management, inclusion of end users, data quality, cross-functional data, scalable technology with right tools, business driven development and acknowledging that BI is not a project but a process. Therefore the success factors and pitfalls of an information system project are addressed and the organizational evolution of information system illustrated.

3.4.1 Success factors

Rapid development of technology has led to the increased number of various BI systems that use fragmented data from different sources. Continuous desire to develop new technology has created isolated islands of existing BI modules that need to be taken into account while acquiring new information system or BI module. Successful Information System (IS) implementation project utilizes existing systems as much as possible instead of investing brand new BI systems, which reduces end user's resistance to change. As the decision of implementing new BI system has made, it is essential to agree the methodology of how to approach the project. All project members need to have clarified roles and the implementation process needs to be two-way dialogue between business function and IT. Moreover the dialogue needs to be as clear and straightforward as possible so that misunderstanding can be avoided. (Hovi et al., 2009)

Just like in any other projects, in IS projects the support of management is also essential. As BI systems use operational data it requires support from both IT and business side. Moreover it is important that the end users provide their opinions in early designing phase but also later in execution phase since the end users are in the center during the whole life cycle of the system. All organizations have problems having accurate and solid data. So, one of the characteristics of successful implementation project is high quality data used in analytical processes. If there is a possibility where the process allows incorrect input of data, then the effectiveness of information system naturally diminishes. Therefore the aim of the projects is to ensure the quality of the data transferred to the data warehouse over ETL process so that the quality is not the issue in reporting. Moreover the information is diverse, which emphasizes the cross-functional need of data over the whole organization. Different functions of an organization use different data location to different

databases and the coordination of this diverse data set challenges to the data management but provide cross-functional opportunities to create new information and knowledge while organized effectively. (Hovi et al., 2009)

Technological solutions determine the capability of a BI system as the number of end users and the use of system increases. Therefore scalability and integration possibilities of solutions should take under considerations. Open interfaces to the various information sources and options with user interfaces allows possibilities for system suppliers to provide tailor made solutions for specific needs of a company. However the most important is to remember that BI is for the business and thus new information projects should be business driven initiatives and the development of BI solution needs to be strongly linked to the business. New needs for analytics or reporting should be user driven and the role of IT should only be supportive enabler of new technology. Moreover, it is important to acknowledge that organizations need continuously improved and up to date information and with BI solutions continuously improve the opportunities to produce such information. (Hovi et al., 2009)

Davenport & Harris (2007) identified additional characteristics of analytical organization that truly has taken data driven management and analytics as part of its business. According to them, analytical organizations have straight and immediate access to data and the knowledge intensive employees understand the importance of data gathering and use time to analyze and interpret the data. Managers focus on grinding the business processes in order to improve results, not scraping independent data sets together from different transaction systems or reports. Moreover managers do not argue who has correct numbers but the data is managed consecutive through its whole life cycle from the generation always to the archiving and destroying. Analytical organization can analyze and test various hypotheses rapidly without prolonged preparations. Moreover frequently used decision-making actions are automated and integrated enabling organization to share information form a routine basis and automatically with its customers and suppliers. In such an organization reports and analysis integrate and embed information flows from various sources seamlessly together and data warehouse projects or Business Intelligence initiatives are not separate projects but information is managed as a strategic resource and the change of an analytical environment is the result of strategic change. (Davenport & Harris, 2007)

3.4.2 Pitfalls

Successful implementation projects are often easier to plan than execute. Hovi et al. (2009) and Davenport & Harris (2007) are also identified some pitfalls that may lead to the failure of the project. Hovi et al. (2009) note that even if new technology is tempting and new BI solutions and trends seem effective the utilization and deployment of the technology is far more complicated than it first may appear. So, in order to avoid the pitfall of taking shortcuts and being too eager to build BI initiative around the metrics more sustainable solution is to focus on having accurate quality data to the warehouses. Organizations should remember that Business Intelligence is not just technology. Although new technology helps BI initiatives to be executed better the most part of the time is used to data management and technological deployment. In terms of success of BI initiative organization should still emphasize the importance of taking end users and organizational needs into account, since BI projects eventually affect to the organizational culture and processes. End users represent various organizational layers with special needs that need to be considered while designing solutions, which ensure that new technology adapts to the organizational needs. (Hovi et al., 2009)

Other major issues considering any development project are the costs and return on investment of the project. It is essential to understand that BI initiatives do not differ from other projects in respect to this notion, so they can be justified by increasing revenue or better profitability. However addressing the economic value of information can be often difficult. Naturally it can relate directly to the enhanced effectiveness of production or better focus on sales assets, which are quite easily quantified data. However it may also relate to comprehensive information diffusion across the organization. Thus the real return on investment in such projects is generated through organizational learning when new enriched information improve knowhow as organizational experiences and business knowledge receive input from BI solutions and business data in order to develop more competitive organization. (Hovi et al., 2009)

Davenport & Harris (2007) note that every organization is different, which makes it hard to create any detailed description of the pitfalls of BI project, however the authors suggest few threats that may occur at any stage of system integration. By avoiding these common missteps organizations should be able to perform successfully. Companies should avoid focusing on only one analytical dimensions e.g. technology as it may narrow the scope of the project. Moreover companies should not be trying to make everything at the same time but focus on the each task at hand. Often companies are investing to the analytical performance without thinking to what extent they should

be investing, then investments are either too big or too small respect to demand of a company. In addition the issue is the investments targeted to the subjects not so relevant to business. Problems arise as well if the business problems are not defined well enough, the problem is not correct or it is understood only partly or the solutions or techniques are not used properly. What it comes to decision-making companies need to make sure that applications related to decision-making processes are not automated without careful review of basic assumptions. (Davenport & Harris, 2007)

3.4.3 Evolution of information systems

All information systems have same features in common, they all include some sort of data bank, facilities to manipulate, retrieve, update and report data. Moreover, all information systems evolve the same way regardless the field of application they are related. These phases of evolution of information system can conveniently be divided into three different stages, which are typical and perhaps even necessary for successful information systems. Information systems rise and fall mainly for their ability or disability to follow this pattern of evolution. However some exceptions may occur that does not follow this pattern. Geographical Information Systems are not exceptions and in order to be successful they have to be capable of following the same evolutionary pattern. (Crain & MacDonald, 1984)

The evolution of information systems includes three characteristic stages that are named by the principal functional purposes as inventory stage, analysis stage and management stage (figure 6). The characteristics of these stages illustrate how the relationship between the user and the system supplier services changes as the system evolves functionally. The first phase is the inventory phase where the reason for the existence or the development of information system is addressed. At this phase the system provide answers to the simple data queries of how much, how many or where? Emphasis is traditionally on reports that derive directly from the data based on outlines, counts and other minor manipulation of raw data. Therefore the main activities of this phase are data collection, input and editing, thus those activities that lead to the development of accurate and high intensive primary data. (Crain & MacDonald, 1984)

When considering Location Intelligence and more specifically GIS the first phase represents a system where the primary task is the development of integrated collection of mapped or geocoded data that cover broad area with well-defined scope in order to execute direct queries or to redisplay

data in various ways. During this phase the relationship between the user and the supplier is often a classical customer- client relationship with well-defined separated functions. (Crain & MacDonald, 1984)

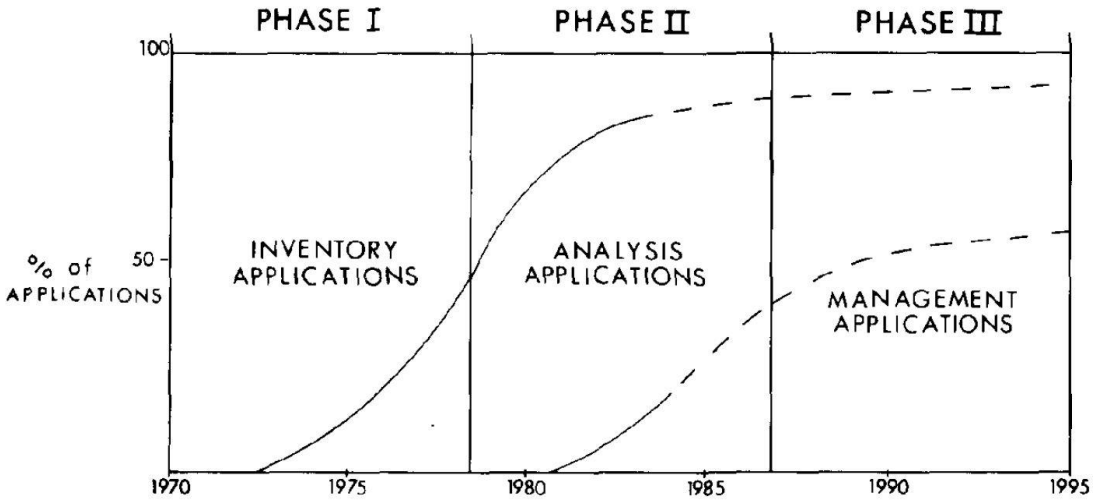


Figure 6. The evolution of Information Systems (Crain & Macdonald, 1984, p.42)

The shift from the first phase to the second analysis phase has mainly driven by the user's desire to extend the use of data from traditional tabulations and summaries to relationships in order to expose problems, to help to confirm assumptions or to provide data for research and modelling. This phase emphasizes complex retrievals and queries that are expected to generate additional queries used in unstructured context. Therefore the implications are the needs of extensive user interaction. In this phase queries relate less to the raw data, which highlights the requirement for advanced statistical tools. Meanwhile the principal activities move from traditional data gathering more to the data retrieval and manipulation. In this phase new data inputs are less likely to be broad and comprehensive but more specialized and focused on particular business issues. They may represent large volumes of data that cover small areas with detailed information. Especially in the case of GIS primary requirements relate to user interactions with data on the basis of complex geographical, topological or statistical criteria. In this phase the system supplier has to become more involved and evolve organizationally in data context issues as the level of analysis shifts more detailed. Necessary system tools should meet user requirements with considerable emphasis on determining and anticipating user information needs both in short and long term. (Crain & Macdonald, 1984)

Third phase with the evolution of information system is the managerial phase where the system starts to implicate on managerial decision making by providing supportive tools assisting directly

decision-making process. The essential factors of how systems evolve to this phase are the addition of forecasting and planning facilities i.e. the ability to perform what if analyses, which implicates the need for more advanced statistical, modelling and mathematical forecasting capabilities. In terms of GIS this phase provide answers to the questions related e.g. to alternative land use or various strategies for optimized use of geographical areas. With such tools as modelling and planning used with broad base of data information system like GIS is able to evolve to the third stage and to become trustworthy resource management system. As the system reaches this phase the distinction of suppliers and customers virtually disappear and users are integrated into an overall system management process. (Crain & Macdonald, 1984)

4 LOCATION INTELLIGENCE TEGHNOLOGY AND TECHNIQUES

Information Technology and computer technology are highly involved to Location Intelligence since IT has had a huge impact on business management as it provides totally new platform for business transformation, cost savings and more effective decision making. So, it is necessary to define and illustrate different technologies and techniques how Location Intelligence solutions are executed. Deeper understanding of technologies and techniques provide better knowledge how Location Intelligence and spatial information can be applied in business context as technological opportunities and limits are understood. Additionally, dynamic and rapidly changing business environment has increased the need of accurate and real-time information of business activities. When monthly or quarterly updated information used to be enough, today companies need information from yesterday or even current daily situation. To support modern business operations, IT has developed several information systems to help managers in their actions. However, Geographic Information Systems has had a whole different premises compared to another information systems. Although, today GIS applications has become widely used in business to support managerial actions from another point of view. (Keenan, 2005)

Previously Geographic Information System has not been as popular as other information systems and it has mainly been used by geographers, governmental intelligence agencies and other commercial agencies related to land management. GIS has focused on environmental or other data, which have been broadly observable across wide geographic areas e.g. water, temperature or vegetation density. Later private companies in different industries have understood the importance of well executed spatial analysis through which they are able to enhance decision making in strategic and also in operational level. Additionally, when the number of business data has increased the need of solving spatially related business problems has become essential in terms of effective decision-making. Instead of answering typical business related questions of what should be done, why and how, GIS tends to answers to the key business issues of where e.g. where to locate facilities or to target new customers. One might argue that in the future GIS will become useless since the work can be done anywhere without having a specific fixed location. However this development only highlights the value of such a geographic system since dynamic business environment is not site-specific but companies need to locate the important business events in order to perform and succeed in the market. (Grimshaw, 2000; Goodchild, 1992)

4.1 Geographic Information System overview

Spatial data is very useful in business decision-making as it can be used to visualize and interpret business related geographically referenced data in order to make location driven business decisions and to illustrate spatially reflecting trends, patterns and relationships. Geographical Information System includes hardware and software that are used to capture, store, analyze and display data, which are spatially referenced to the Earth. So, GIS is a system that provides data with geographical dimensions. (Grimshaw, 2000; Hess et al., 2004; Esri, 2014) Fundamental idea behind GIS is to link attribute database with digital maps in order to illustrate where something is and what is somewhere. In scientific research GIS has received several definitions and each of these definitions note that GIS not only provide users a set of tools for managing and linking spatial data and attributes but also and advanced modelling functions, tools to design and plan and capability for advanced imagining. (Mennecke, 1997; Grimshaw, 2000; Keenan, 2005; Esri, 2012c)

Much because of historical premises GIS research has mainly been contributed by first geographers who used maps in pre-computer age and then information scientists who have later explored methods for geographic calculations. As computer science and especially technological performance e.g. necessary speed and storage capacity have developed it has provided new ideas and more sophisticated GIS applications that can be used in private business environment as well. However, even today technological performance creates boundaries for effective GIS applications since large amount of spatial data requires powerful hardware. (Mennecke, 1997; Keenan, 2008)

GIS share the same fundamental characteristics as any other information systems. However there are four different functions that distinguish it from the other information systems. These functions are spatial visualization, database management, decision modelling and design and planning. Spatial visualization refers to ability to represent data and display it correctly in spatially defined system. (Mennekce, 1997) This function represents the essence of GIS in business as it allows users to visualize both spatial coordinate and attribute data on a digital map and thereby do interpretations and analysis based on spatial adjacencies. Visualization provides a strong capability to classify and represent information and objects that are otherwise difficult to outline, on a map. Visualization can be seen as a process that create holistic view and helps to reveal hidden causalities that otherwise would remain unseen. However, mapping or visualization should not be seen as competing option to other visual alternatives such as charts or other graphics but various alternatives should support

each other in order to create comprehensive view that effectively support business operations. (Dodge et al., 2008; Keenan, 2008)

Database management, in turn, refers to the capability to store, manipulate and provide access to the data. This function has important role since one of the major distinctive difference respect to the other information systems is spatially referenced data, which require powerful database management. Spatial data can be represented in two different ways, which have implications to the database management. First approach is the raster approach where the whole geographical area is represented by pixels on a grid. This is a bitmap representation, where the accuracy of the map is dependent on the size and number of the pixels. Vector representation can be assimilated to Computer Aided Design (CAD) drawing since it builds geometric representation based on basic lines and shapes. In this approach objects on the map are not tied to a certain scale and thus is suitable in particular for representation of sparse data or line features like boundaries. Vector approach requires powerful processing capability of hardware but is widely used as computing technology has developed. (Mennecke, 1997; Keenan, 2008)

Decision modelling refers to the ability of GIS to support decision making and analysis. Several other information systems have been developed to support decision making as well. However these traditional systems often lack the function of proper and comprehensive spatial analysis. (Mennekce, 1997) GIS provides an opportunity to analyze spatial data as it enables collection and measurement of geographic information that can be edit and overlay from different maps. Especially capability to storage spatial data distinguishes GIS from other more traditional decision support systems. (Keenan, 2008) Mennecke (2000) notes that even if data capture, manipulation and management are important function of GIS the systems are eventually used to support decision making and various analyses. Spatial Decision Support Systems (SDSS) can be considered as GIS which have ability to process geographical data and also have necessary tools to analyze spatial data appropriately. Crossland et al. (1995) have proposed that instead of GIS the companies actually need Spatial Decision Support System, which focus more on managers' specific problems. SDSS is not entirely same as GIS; however both of them are based on the same GIS technology.

Design and planning refers to capability to create, design and plan business actions (Mennecke, 1997). Although GIS is not meant to be used as similar designing system as CAD it still can be used to design and plan objects and location of objects. Other capabilities of GIS such as

visualization and capability to illustrate attribute data enable GIS to support designing of routes or locations e.g. for the branch or for fleet management. (Keenan, 2005)

4.2 Geographic Information System business applications

Currently GIS applications used in business have mainly ad hoc nature that supports operational decision making in different organizational functions e.g. marketing or transportation. Early adopters of GIS have mainly been functional specialists since GIS has first seen as a system that enhances productivity or effectiveness of the specific functional area rather than implicates to the business as a whole. However, problems in which GIS provide support are becoming more and more strategic, and thus real business reasons are increasingly influencing to the implementation of GIS. (Grimshaw, 2000) Mennecke (1997) provides a conceptual model of GIS used in business including functions discussed before and more in depth applications. The model is presented in figure 7.

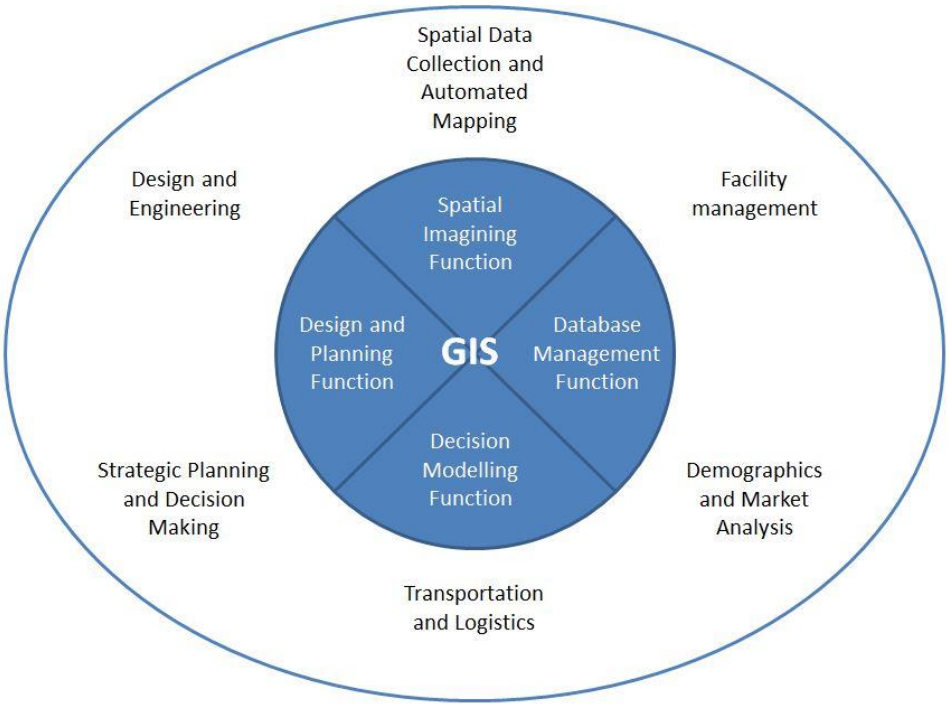


Figure 7. GIS functions and applications (Adapted from Mennecke, 1997 p.46)

Four main functions of GIS enable various applications that help business managers and other users to make more effective decisions and support companies with strategic planning, design and engineering, collection of spatial data, facility management, market analysis and logistics. These

applications illustrate more focused areas of business in which GIS is useful. Design and engineering refers to the possibility of using GIS as engineering software. GIS and spatial database allow end users to make environmental design and landscape engineering or residential construction related engineering. Traditional design and engineering applications have been widely used in public sector e.g. to design waste management or water consumption where GIS is especially useful to design plans, layouts and maps. (Mennecke, 1997)

Bansal and Pal (2007) studied if GIS can be used to estimate building costs and visualize designing of new building. The study utilized the capability of GIS to store data, which later can be manipulated in order to estimate building costs and then design 3D- visualization of a building based on construction materials, labors and equipment data. Cheng and Chang (2001) in turn, studied the capability of GIS to be used for suitable route planning and designing of an underground power supply system in civil engineering project. Such studies provide excellent example how designing and engineering application of GIS can be utilized.

Like any information system, GIS is designed to help operational actions, which is why spatial data collection and automated mapping is extremely useful application of GIS in business. Spatially related data is essential part of GIS and when this data can be automatically illustrated on maps it helps organizations to use GIS effectively. Automated mapping allows organizations to generate spatially referenced data locally in-house, which eventually leads to faster decisions based on accurate spatial data. However, in house generated data may include some problems in terms of data accuracy. These problems relate to definition of positional accuracy i.e. is the object where the map says it is, or attribute accuracy i.e. is the object classified and identified correctly or completeness of data i.e. does the map include all the relevant objects. (Mennecke, 1997; Goodchild, 1992)

Automated mapping and spatial data collection utilize imaging function of GIS, which provides visualized updated real-time presentations for operational decision making. (Mennecke, 1997) Keenan (2008) notes that GIS has informative nature that increases the interest in to use GIS in business purposes. The traditional form of GIS is to provide graphical information with overlapped attribute data. Such a mapped presentation generates a presentation that cannot directly be queried but which can be indirectly modified by using pie or bar charts alongside. In this way GIS shifts more on towards the business intelligence application and thus is more useful in business environment.

Facility management application illustrates more operative application of GIS since facilities are easy to manage when GIS illustrates both locational and attribute information. GIS support real-time monitoring of facilities e.g. manufacturing plants or distribution centers by providing information of which facility is under control and what kind of information this specific facility possess. Together with visualization and database management this application in is powerful tool for operational asset management and decision making. (Mennecke, 1997) According to Esri (2014a) facility management application may include the management of land infrastructure and office space, safety and security related monitoring or traditional collection and integration of data with other enterprise systems.

Rich & Davis (2010) suggest that facility management application can add value for the construction project management when multiple projects are managed at the same time and that facility management application is especially useful when project management continues throughout the facility life cycle as maintenance services. Additionally, facility management application is effective when companies are choosing new site locations since GIS provide repository of construction data. Added value is also created through the analysis and planning of impacts of construction, materials warehousing and traffic interruptions. Facility management application can be used for resource allocation and materials sourcing as well. (Rich & Davis, 2010)

Another area, where GIS can be usefully exploited is demographic and market analysis. As competition has tighten organizations are forced to reduce number of products or services and focus more into niche market which requires more detailed information compared to mass market. So, GIS can be used to analyze and understand the size and characters of marketplace, which applies especially to the retail market. However market analyses need to be done in every industry and GIS provide a platform for representing spatial data between competing forces of suppliers, competitors and customers. (Mennecke, 1997) Although, retail has successfully managed to use GIS in order to enhance marketing and business operations. It has used GIS especially to determine catchment areas, identify retail sites and calculated current and future shopping trips. (Toppen & Wapenaar, 1994) Amos (2009) suggests that GIS can be used for marketing purposes, based on the same remarks of market analysis and demographics as Toppen & Wapenaar (1994) noted on their study. According to Amos (2009) GIS is useful to enhance marketing and advertising since customer data along with GIS mapping can be used to identify customer segments and optimize new promotions.

GIS for transportation (GIS-T) is one of the most popular fields of application that use GIS since even an own definition has developed for such a discipline (Miller & Shaw, 2001). GIS can be used to both support logistic or transportation decision making and also display results of these analysis, which makes it effective application for transportation and logistics issues (Mennecke, 1997). GIS has used in the field of transportation and logistics especially to manage routing and scheduling effectively and to track mobile assets in real time. (Esri, 2014b) Transportation and logistics application can also be exploited in viewing and analyzing route performance. These analyses can be based on e.g. scheduled and actual times or percentage of late deliveries. (Esri, 2012b) Amos (2009) suggests as well that transportation and logistics application can be used to improve delivery schedules and fleet management but also for vehicle tracking. Additionally, Amos (2009) refers to the case study where Sears implemented GIS to automate route planning and to improve home delivery. In addition, Miller & Shaw (2001) note that GIS is used in intelligent transportation systems e.g. intelligent vehicle highway systems and automatic vehicle location systems, which combine GIS technology and communication technology to broad transportation services.

Strategic planning and decision making requires wider scope and longer time period than tactical or operational business planning. So, information systems designed to support strategic planning usually includes tools to support decision making, analysis, modeling and communication. However, traditional information systems e.g. management information systems or decision support systems lack of spatial dimension, which is why Spatial Decision Support Systems have been developed to support strategic approach of GIS. (Mennecke, 1997) Grimshaw (2000) notes that the collection of spatial data and increased realization and use of that data enhances the strategic use of GIS since such data can be considered as corporate resource of significant value. According to Mennecke (1997) planning of corporate downsizing, organizational restructuring, site selection and competitive analysis present practical areas where GIS can be used to support strategic planning or decision-making. The examples of how GIS applications can be utilized are summarized on table 3.

Table 3. Examples of the use of GIS business applications

Business Application	Example of use
Design and Engineering	Environmental design and landscape engineering or residential construction related engineering Design waste management or water consumption where GIS is especially useful to design plans, layouts and maps Capability of GIS to be used for suitable route planning and designing of an underground power supply system in civil engineering project Study of GIS if it can be used to estimate building costs and visualize designing of new building
Spatial Data and Automated Mapping	Automated in-house update of data leads to faster decisions when data is automatically illustrated on maps. Informative use of attribute data
Facility Management	Real-time monitoring of facilities Effective tool for operational asset management Effective tool for choosing location for branches or other facilities In construction projects several projects can be managed at the same time
Demographics and Market Analysis	Tool to analyze and understand the size and characteristics of the marketplace Retail has successfully managed to use GIS in order to enhance marketing and business operations. It has used GIS especially to determine catchment areas, identify retail sites and calculated current and future shopping trips
Transportation and Logistics	GIS can be used to both support logistic or transportation decision making and also display results of these analysis, which makes it effective application for transportation and logistics issues GIS has used in the field of transportation and logistics especially to manage routing and scheduling effectively and to track mobile assets in real time Transportation and logistics application can also be exploited in viewing and analyzing route performance. These analyses can be based on e.g. scheduled and actual times or percentage of late deliveries
Strategic Planning and Decision Making	Corporate downsizing Organizational restructuring Site selection Competitor analysis

4.3 Spatial Decision Support System

Although GIS include important features that support managers with their spatially related problems, GIS is not directly designed to support decision making, which is why Spatial Decision Support Systems have been developed in order to enhance managerial decision-making with

geographical features included. SDSS has a role as an important subfield of GIS by contributing many other fields, which have utilized GIS technology e.g. agriculture, resource management, civil engineering, transportation and business. It focuses on guiding the search and evaluation of decision options characterized by geographical and spatial relationships (Jankowski et al., 2014). Spatial Decision Support Systems are explicitly designed to support complex spatial problems with capability to provide geographical information analysis, which traditional Decision Support Systems or Geographical Information Systems cannot execute. (Densham, 1991; Crossland et al., 1995; Keenan, 2003)

SDSS rely on GIS technology, which is traditionally included to SDSS as one of its components (Crossland et al., 1995; Simao et al., 2009), although it is originally rooted in the Decision Support System (DSS) literature and eventually emerged due to the technological development that enabled computers to process spatial information. So, SDSS allows the input of spatial data, representation of the complex spatial structures or relationships and output of results as in variety of spatial forms including both maps and other graphical figures. Some analytical techniques that are unfamiliar to spatial or geographical analysis are enabled by SDSS, which shifts it more towards traditional decision support systems. (Densham, 1991; Simao et al., 2009)

While Geographic Information Systems have been developed to organize and analyze spatial data, Spatial Decision Support Systems are explicitly designed to support decision making of complex specific spatial problems. SDSS integrates database management systems, analytical models, graphic displays and tabular reporting capabilities with the knowledge of experienced decision makers. So, SDSS can be seen as spatial parallel to decision support systems originally developed to address traditional business problems. (Densham, 1991; Crossland et al., 1995; Keenan, 2003)

SDSS facilitates a decision-making process, which can be described to be iterative, integrative and participative. A set of alternative solutions generated during the process that are evaluated by decision maker illustrates the iterative nature of SDSS. These alternative solutions are used as input for further analysis. In SDSS users are playing an active role since they need to define specific problem that decision research process are seeking solutions, executing analysis and evaluating outcomes. These activities refer to the participative nature of SDSS. The benefits of this participation appear as integration when expert knowledge of decision maker integrates with quantitative data and qualitative features of information. (Densham, 1991)

Crossland et al. (1995) studied managerial implications of SDSS founding that addition of GIS technology to the spatially referenced decision-making processes reduced the time of decision-making and increased the accuracy of individual decision-makers. In the study, the authors found three possible reasons for reduced time for decision-making. First, the interactive and color graphical displays of information instead of static, black and white information provided by SDSS supported faster decision-making. Additionally, and probably more importantly, in accordance Image Theory, SDSS indeed provided more efficient displays compared to the one without SDSS. Third major implication according the authors was that better visualization of the problem provided better insight considering the task at hand. (Crossland et al., 1995) The study strengthens the role of GIS to be used as an illustrative tool in spatially referenced business problems. However, Simao et al. (2009) note that SDSS lacks the analytical modelling capabilities and thus not support multiple decision-making strategies, which may reduce the use of SDSS in companies.

4.4 Spatial Online Analytical Processing

Ultimately GIS aims to support BI systems in spatial decision making. However GIS is not necessary suitable analysis tool to take temporal aspects into consideration although temporal aspects play a key role in managerial decision-making. Rivest et al. (2005) argue that GIS is not designed to support decisional needs of managers or to support fluent navigation through spatial data or different levels of aggregation same way as traditional Online Analytical Processing (OLAP) tools, which is why Rivest et al. (2005) suggest that GIS should be coupled with OLAP in order to create specialized Spatial Online Analytical Processing (SOLAP) solutions.

OLAP is an effective technique to analyze business data. The definition refers to the technological solution that provides multidimensional approach to data for business analytics. Central idea with this technology is that the user has direct “On-line” access to the necessary information without any determining queries or other intermediate steps. (Hovi et al., 2009) Spatial Online Analytical Processing is similarly to OLAP, a multidimensional technological solution to analyze business data, which is developed to meet the specific needs of geographic information. In SOLAP technology hierarchies are geographically referenced locations e.g. county, municipality, city or suburb. Data storage type allows data typical to GIS e.g. coordinates to be saved into data warehouse. (Hovi et al., 2009)

Rivest et al. (2001) propose that SOLAP can be define as visual platform, which is especially designed to support rapid and easy spatio-temporal analysis and exploration of data that is followed by multidimensional approach including coupled levels available in cartographic, tabular and diagram displays. Bédard et al. (2001) note that SOLAP is desirable data exploration technology in spatial warehouse since it provides fast and flexible multidimensional way to execute spatial analysis without having complex queries, which is why to some extent some non-experts may also see SOLAP solutions as a new type of user interface for traditional GIS application or web based mapping solutions (Rivest et al., 2001). Appendix 1 illustrates the position of SOLAP and GIS respect to three axes of requirements for spatial decision-making (Rivest et al., 2001).

SOLAP technology includes three dimensions that are non-geometric spatial dimension, the geometric spatial dimension and the mixed spatial dimension (Rivest et al., 2001; Rivest et al., 2005). These dimensions are necessary to take into consideration while designing SOLAP application as the choices between the dimensions need to be done based on user needs (Rivest et al., 2001). Non-geometric dimension illustrates the nominal spatial references i.e. the name of the places e.g. Finland, province of South-Karelia or city of Helsinki. Such dimension is only supported by conventional non-spatial OLAP technology and treated in SOLAP like the other descriptive dimensions. However, spatio-temporal analysis done based on such dimension may be incomplete as certain spatial relationships or correlations may remain unrevealed. The other two types of dimensions aim to reduce this potential problem. Geometric dimensions comprise all geometric shapes e.g. country boundaries for all dimension members, in all levels of detail to enable dimension members to be cartographically visualized and queried. (Rivest et al., 2005)

Without the possibility for cartographical visualization the traditional OLAP lack an essential feature of completion of spatio-temporal analysis processes. As Rivest et al. (2005) highlight the notion of Bédard et al. (2005) the SOLAP however, allows better presentation and visualization of the data, improved diffusion and communication of information, enhanced analysis and support of decision-making since implicit spatial relationships between the events turns into explicit and visually evident and therefore generates new realizations in the user's mind.

4.5 Web-Based GIS

Previous chapters have discussed the development of IT as a driver of increased use of GIS. (Keenan, 2005) The importance of IT is essential in business since new web-based GIS

applications have been developed in order to ensure seamless access to the data for all users. According to Peng & Tsou (2003) web based GIS is geographical information system that allow access to geographical information, spatial analytical tools and GIS web services by utilizing both wired and wireless internet connection. So, GIS does not necessarily have to be local at the user's desktop but it can be used anywhere and still have the same accessibility to the spatial data. This transformation has implied a paradigm shift from traditional data collection to the universal accessibility to remotely distributed data with mobile analysis functions (Peng & Tsou, 2003).

One major individual driver for the diffusion of web-based GIS has been the Internet and three major areas that Internet is affecting to GIS can be highlighted. First, the Internet provides very easy platform for GIS users to acquire data from different providers. Public and private spatial data warehouses provide content for the GIS which are easily accessible through the Internet. Second, web-based GIS enable the exploration and visual sharing of spatial information and analysis. Through Internet the results of a spatial analysis is easy to share across the organization because other users have access to the same data as well. Additionally internally shared reports, maps and other results are safe to diffuse if GIS is integrated to the IT systems of an organization. Moreover other users are able to explore spatial patterns and relationships by themselves and develop shared analysis even further. Third, the Internet provides a platform to dynamically download and upload GIS processing components, which enhances the accessibility and reusability of GIS. Additionally, GIS software providers are able to provide better real-time support for customer problems over the Internet and so enable better search and query analysis for spatial objects without using expensive local GIS software. (Peng & Tsou, 2003; Dragicevic, 2004)

As Internet driven solutions have become more common and IT has developed, the new wave of web-based solutions is provided as SaaS (Software as a Service) that is also widely utilized in web-based GIS solutions. Cloud computing is an approach to information processing where computing technology is provided as a service. The benefit of SaaS is that it offers speed, flexibility and scalability, which are much appreciated in current modern world. What it comes to location-based information there are several benefits of SaaS delivery that are relevant to geographic information. Acquiring GIS as a SaaS lowers the total cost of ownership as organizations have fewer servers to maintain, less data to manage and no need to support constant updates or backups. Moreover no hardware installation is required and applications are almost immediately available to the users regardless of location. (Winslow & Jackson, 2010)

SaaS enables more flexible reaction to the changes in GIS requirements. With SaaS based solution the organization is able to expand, modify or end service without any major financial exposures, thus SaaS provides greater resource utilization as it allows rapid scale of software access to respond to market opportunities. Additionally SaaS solutions are continuously developed by the service provider; therefore the organization has always access to the most current version instead of waiting new releases. With regular data updates the application produces reliable and accurate information providing incremental development instead of major changes in information flows. (Winslow & Jackson, 2010)

5 EMPIRICAL EVIDENCE: NATURE OF CAPITAL-INTENSIVE BUSINESS

Information-driven management turns out to be crucial in terms of facing the industry forces shaping the business environment and generating business drivers. Especially, as the business turns into a global, location receives a whole new meaning. However, together with market drivers and market dynamics, the nature of business guides the spatial information-driven management to the certain directions. The nature of capital-intensive business is illustrated by examining a case company operating in high investments requiring project based business in global context where not only physical assets but also information and knowledge have major impact on the successful operations. This empirical evidence provides a business context that later is applied in order to review how spatial information can be exploited in such business environment.

In capital-intensive business the essential factor is the capacity of machines. If the industry is specifically workforce or knowledge intensive, the capacity of man is the dominating element. However, especially capacity of the workforce is difficult to determine, which is why it is often useful to consider the capital investments of the companies as retaining capacity requirements, replacement investments and capacity expansions of growing demand. Production processes of such industries are capital demanding having the need for massive investments for factories, production lines or equipment, additionally including major capacity enlargements. (Kärri, 2007)

Berends and Romme (2001) studied the cyclicality of the capital-intensive industries by exploring the paper industry, while Kärri (2007) also notes forest industry, chemical industry and base metal industry to be remarkable examples of capital-intensive industry in Finland. Although, no widely accepted limits have been set to define when a firm or industry is knowledge-based or capital-intensive, when a certain industry matures the share of capital in the cost structure of firm increases, which turns the industry more towards on capital-intensive business (Kärri, 2007). Therefore the case company selected to this study for the collection of empirical evidence is suitable to illustrate capital-intensive business as it is to some extent a part of all industries mentioned by Kärri (2007).

5.1 Case company overview

The Andritz Group was established in 1852 when it focused large capital goods, such as cranes, pumps and water turbines. Andritz Group listed to the stock early in the 20th century and after the World Wars in 1949 focused on to water turbine sector with cooperation with Escher Wyss Group of Switzerland. In the process the product portfolio was revised and the group continued steady growth during the following decades. Since 1990s Andritz Group has maintained its growth through acquisitions and Research and Development (R&D) activities. In 2001 Andritz Group listed on the stock exchange of Vienna and achieved its current position of global supplier of plants, equipment and services for several industrial sectors including e.g. pulp and paper, metalworking and steel industry and hydropower stations. (Andritz, 2014)

In Finland Andritz Oy, (in this study later referred as Andritz) the subsidiary of the Andritz Group is global supplier of systems, equipment and services focused on to pulp and paper industry including wood and fiber processing, chemical recovery and stock preparation. Additionally Andritz operates in the field of energy production by providing solutions for biomass boilers, biomass pelleting plants and gasifiers. (Andritz Oy, 2014a) It is, therefore an international company that is able to supply complete chemical, mechanical and recycled pulp and paper production lines from woodyard to finished bales, complete recovery islands including recovery boilers, evaporator plants and white liquor plants. (Andritz Oy, 2014b; Andritz, 2013) This study focuses more deeply in three major divisions of Andritz that are Fiber Technology division, Recovery and Power division and Kraft and Paper Mill Services division. These three divisions cover the Pulp and Paper industry quite generally, and therefore provide good baseline to review capital-intensive business.

Fiber Technology includes four different product groups that are Wood Processing, Fiberline, White Liquor Plant and Bio Fuel. Wood processing product group is globally leading supplier of advanced wood, chip and bark processing plants and equipment for the pulp and paper, panel board and power industries. Wood Processing product group provides solutions for all steps required in a wood yard of a mill from the arrival of logs to their subsequent preparation into wood chips and eventually for the production of chemical and mechanical pulp. Fiberline product group, in turn, is focused on supplying systems, equipment and processes for the production of chemical pulp worldwide. The products include continuous cooking systems, washers, screens, bleaching systems and equipment related to these processes. White Liquor Plant product group provides process solutions and equipment for production of cooking liquors and other modified delignification

liquors for modern kraft pulping. Moreover White Liquor Plant product group covers complete recausticizing including lime burning and white liquor oxidation systems. (Andritz Oy, 2014b; Andritz, 2013)

The main business of Recovery and Power division is to provide energy solutions mainly for the pulp and paper, power and municipality, steel industry together with chemical regeneration technology for all pulping technologies. Division provides a full range of air pollution control systems for power stations and industrial applications. Division has a solid global market position and it is one of the most reliable suppliers. After the organizational changes Kraft Paper division has focused to the service business by offering spare parts for equipment, field service projects and Overall Product Efficiency (OPE) services. This global mill service division works in close cooperation with customers providing safety and enhancing performance throughout the lifetime of the mill processes and equipment by seeking to improve reliability, availability and production while reducing overall operating costs of the mill. (Andritz Oy, 2014b; Andritz, 2013)

5.2 Business environment of Andritz

Global market environment of Andritz naturally covers interfaces of the customers, suppliers and competitors, which further reflect to the sales activities that can be roughly divided into three main functions. These functions are Market management & Business development, Project selection & Bid preparation and Bid review. Market management & Business development mainly covers the business planning and high level guidance of sales activities while the Project selection & Bid preparation mainly focus on discovering new projects by contacting customers and preparing the project bids. Bid review, in turn, covers the feasibility studies or other pre-engineer activities related to contract negotiations that aim to ensure that customers are satisfied with information related to offering and eventually closing the deal. Moreover this function includes the approval and internal transfer to contract execution. Figure 8 illustrate the business context of Andritz including external market environment and internal streams of sales, operational, and supportive actions.

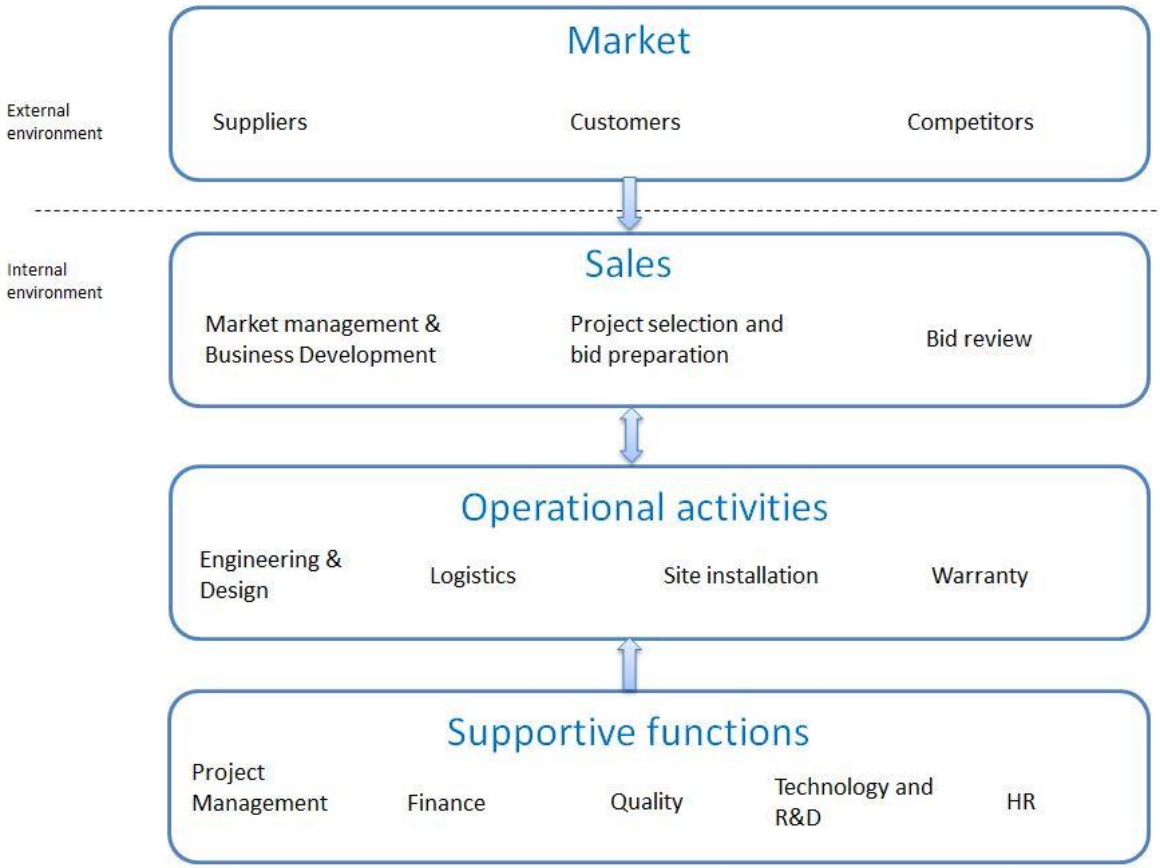


Figure 8. Business environment of Andrtiz Oy (Adapted from Andritz Oy, 2014b)

Operational activities contain product and process engineering and design activities according to customer needs. Logistics include supply chain management and procurement with freight and shipping management activities, however without actual transportation of goods. Site installation refers to the installation and construction activities at the site, also including the start-up and commissioning. Warranty function, in turn, refers to both financial controlling of warranty assets and claim handling and maintenance tasks as well.

Supportive functions include project management that supervises the operational activities ensuring seamless cooperation among the functions of operational activities. Additionally, project management administrates the cost structures of the capital projects by estimating and forecasting project costs. Unlike project management, financial function focuses more on the finance of capital project by estimating financial risks and estimating project revenues from the customers. Quality function aims to ensure the quality of the products and processes by supervising operational activities and dealing claims with customers.

Health, safety and environment function provide support in an environmental issues and helps with health and safety issues related to e.g. site installation or logistics. Human Resources function enables the work force management by ensuring the projects are covered with the optimal number of employees all over the world wherever they are needed. In addition HR is continuously looking for new competencies in terms of organizational development. Technology and R&D function closely support sales function with feasibility studies and pre-engineering needed in bid preparation. Moreover R&D function is responsible for the technological development ensuring that provided solutions are the state of art.

5.3 Value drivers and business objectives of Andritz operations

Value drivers are entities that arise from changes in market structure and industry forces, therefore the origins of value drivers can be inside the organization or outside the organizational boundaries. Global competition set challenges in addressing the value drives when the same organization contains various divisions and product groups. Value drivers naturally obtain special features depending on the division or product group. However there are few value drivers commonly influencing on Andritz operations and determining more generally the nature of pulp and paper industry. These value drivers are collected to the table 4 that additionally illustrates the main fields of business interface concerning the value drivers.

Table 4. Value drivers of Andritz business context

Business interface	Value Driver
Market	Cyclicality of the market Market trend changes Market competitive structure Maturity of the market
Sales	Customer-driven focus Cost control
Operational activities	Profitability Cost control
Organization	Reliability Technological competence

Mainly, value drivers are stemming from market dynamics, cost management and organizational competence. Pulp and paper industry has cyclical nature that drives business as sometimes

investments are globally frozen and capacity is decreased but sometimes trend is either to modernize or invest to new mills in order to increase capacity. Due to this cyclicality resources are difficult to allocate and direct effectively, which appears especially in sales and sales supporting technology function. Moreover, in all divisions market trends determine which processes and products are in favor and when. These trends comply with the global trends of pulp and paper products. Technical age of the equipment at the market determines the trend between the modernization projects and new projects, which affect to the profitability of the projects.

Market structure plays an important role as the value driver especially in White Liquor Plant product group and in Recovery Boilers product group where the market structure has recently changed through competitor's acquisitions having currently only two major players that control majority of the market share, therefore being a good example how changes in the market influence on business. This change has led to the aggressive pricing especially by one of the main competitor Valmet, which has further increased the importance of cost control and selectivity of bid preparation. Pricing needs to be appropriate in respect to competitors, while sales actions also need to be technologically driven and emphasize overall solutions without having the price to be the crucial factor.

Pulp and paper industry is relatively matured since the pace of strategic transformation in the industry is slow as the major shifts in trends often take years. This characteristic sets challenges to established business units e.g. Fiber Technology division or Recovery and Power division as organic growth is difficult to achieve and maintaining the market share or increasing the relative market share becomes the main target for business. For example in recovery boiler business the market is saturated, so growth has to be reached by acquiring competitors market share while Kraft Paper and Mill service division is actively seeking new markets and organic growth from new geographical areas as the business has shifted more towards economically growing countries.

Nature of sales operations is highly customer driven, which highlights the customer driven focus to be one of the most important internal value driver in all divisions. Nature of sales activities requires good customer knowledge and solution-focused approach to the customers' problems when tender inquiries are received and bidding preparations are done according to specified customer needs. However, today groups have strict protocols how to proceed with investment decisions and very little room for maneuver have left to the mills to decide their own investments. This shift in industry structure has set challenges to the sales operations as incremental investments have decreased and

new procurements are done only if necessary. Due to the nature of sales activities close and personal relationships have major impact on sales as customers appreciate reliability and quality, and thus customer relations need to be managed so that Andritz is contacted when investment decisions are made.

Especially in Fiber Technology division the value drivers are mainly determined by two major business segment that are new capital project segment and modernization segment. In terms of strategic business objectives the modernization segment is more important as modernization projects provide relatively higher gross margins; however this segment also sets challenges in terms of cost management, and thus has major implications to the profitability. Maintaining profitability is also one of the main value drivers for all divisions as the industry structure is mature and organic growth is difficult to achieve. Cost management is closely related to profitability, which emphasizes the selectivity of sales and marketing actions as tight cost control requires careful selection of which tender inquiries are relevant to lead actions. Project selectivity involves several functions since technological development and market development support selectivity of new projects as well.

Cost control applies to all sales, operational and supportive activities. In sales, the cost control affects to the selectivity of projects in terms of which bid inquiries and new projects the actual offers are targeted for and which projects are worth to take into consideration with resources at hand. Project selectivity plays an important role in many ways. By selecting carefully which projects lead to action, the efficiency of sales operations can be improved and costs can be monitored. Since pre-engineering and bid preparation binds resources and costs it should be compensated by customers. However, typically customers assume pre-engineering to be part of the product offering. Since feasibility studies and pre-engineering activities are expensive in respect to the probability of having the actual project, the risk of such activities is quite high. These unnecessary costs affect eventually to the profitability of the capital project as well.

Reliability illustrates the nature of knowledge based professional services and solutions necessary in this matured industry. This value driver relates strongly to the customer driven focus necessary to sales operations. If customers cannot trust to the quality and reliability of the solutions then new orders are difficult to receive. Reliability is the factors stemming from the organization that can add value to the customer and generate or enhance additional business opportunities as customers' experience enrich the cooperation with high technological competence. Together with reliability the technological competence is value driver generated inside the organization. This driver reflects to

the cyclicality of the market by highlighting the importance of research and development initiatives to support and enhance sales operations at the time when order intake is low or decreasing.

> *"High quality solutions and proficient employees lead to long term trust and relationship and thereby to competitive advantage." (Manager, IT systems, Kraft and Paper Mill Service division)*

Value drivers naturally affect to the business development and planning in strategic level. Business objectives that are based on effects caused by value drivers are more concrete goals that organization aims to achieve in long term. Business objectives determine the actions how organization seeks to overcome issues that the changes in the value drivers cause. Table 5 summaries the main business objectives of Andritz derived from the value drivers.

Table 5. Summary of Business objectives of Andritz operations

Value Drivers	Business objectives caused by value drivers
Cyclicality of the market Market trend changes Market competitive structure Maturity of the market	Sales activity have to be maintained in established level in order to ensure the continuity of operational activities Maintaining of market shares in established levels Effective market and customer data management aims to recognize new project opportunities Development of partnerships and networks to improve competitive position Organic market growth in selected product groups
Customer driven focus Cost control	Sales need to have readiness to identify new customer needs and provide additional solutions to improve overall effectiveness of customer Customer focus aims to recognize how to improve customers' profitability Bid/ no bid decision needs to be done fairly soon in order to avoid unnecessary sales costs
Profitability Cost control	Pre-engineering or feasibility studies have to be compensated in order to keep costs in control Clear processes when to transfer projects to the contract execution Financial objectives to improve EBITA key figure
Reliability Technological competence	Development of project management competence in different conditions in respect to project costs and schedule. Technological focus on improving customers' value through new solutions

5.4 Main business actions of Andritz

Business environment discussed above provide the context for the information needed in decision-making and planning process of necessary actions. Naturally Andritz has determined main actions how to strive towards the strategic objectives in order to capture full benefits from the value drivers identified. In order to better identify the information needs of these actions, they need to be measured since the effectiveness of the actions provide valuable insight into what kind of information is truly necessary in the business context of Andritz. Main actions can be detected to be following business interfaces. Therefore the actions are divided according to market development, sales, operational and supportive activities. Main actions are presented in table 6.

Table 6. Main business actions of Andritz

Function	Main actions
Market Development	Generation of sales potential Interpretation of market trends Market data and competitor analysis
Sales	Customer planning and segmentation New project scanning Project selectivity
Operational activities	Development of project management competence Future competence mapping Maintaining of financial profitability
Supportive functions	Focus on customer value References and pilot projects

In sales function the main actions are related to customer planning and customer segmentation, project scanning and project selectivity. Especially in Service division, where the business is very mill centralized and focused on the physical mill as a customer, the main actions are to identify each potential customer mills and create key customer plans that help sales activities to target the most potential mills. Central concept in service business is the life cycle of the mill including technical ages of equipment and processes. Mill life cycle provides an opportunity to analyze the technical condition of mill, its structure, and service potential and eventually target sales contribution to appropriate mills. Such key customer assessment additionally helps to identify new customers that would be potential to cooperate as technical ages of the installed base and thus service needs are known.

After customer segmentation and identification of key customer mills the sales actions include visits to the mills, presentations and proposals of new solutions that could help customer mills to improve their profitability. With these actions service division seeks to achieve long term trustful relationship with customer. Service business aims to be local actor and customer segmentation is done by regional management, since the best market knowledge relies locally near the customers where information of the service needs is received directly from the mills. Good relationship to the customer also breeds sales margins as new references are supplied that prove how reliable supplier Andritz is.

Well maintained customer relationships play an important role in other divisions as well. In Recover and Power division the project selectivity is one of the main actions to meet the value driver of profitability. Projects are selected and evaluated carefully based on initial data available and most importantly on the source of project information. Most reliable sources of project information are either inquires made by consultants or pre-notice notifications directly from the customer. Inquires made by consultants indicates that investment decision is close to be made since customer has already invested for consultant work. Alternatively, customer may tip off if investment plans are made and project is soon to be starting, which also indicates appropriate project. Such information however is difficult to receive if relationships with consultant agencies or customers are not maintained well. Especially in Recovery and Power division the sale activities are mainly related to customer relationship management, because of the market size and structure including only two major players. Market breeds itself which calls into question if marketing activities are necessary at all.

Other sales actions in customer interface are executions of various studies that are done in order to enhance the sales and increase the probability of winning the bidding project. Studies and pre-engineering reviews are effective way to illustrate the commitment, knowhow and solutions that Andritz is able to provide considering the project or investments. However, such studies burden the organization and generate costs so eventually tactic decision needs to be done by management whether to invest resources to the project or not and when to connect engineering and designing function to the project. Customer mapping and segmentation relates to this tactical decision-making as well since if some customers do not prefer Andritz as supplier in investment decisions but still are seeking to take advantage on pre-engineering and feasibility studies, thus careful customer segmentation and track recording prevents such activity.

Another tactical action is to increase sales potential in customer interface by assuring customers that they need new modernization or solutions. Interpretation of market trends and market data analysis are key actions in generation of sales potential since market data and trend changes provide valuable information, which customers and regions might be potential to target. Moreover competitor analysis helps to identify new areas where the relative competitive position is good respect to competitors and therefore profitable for the company.

Although the price is the starting point for bidding projects the own technological development and R&D activities relate strongly to the generation of sales potential since the development activities should focus on to prove the real perceived value of new solution and to convince why customers should invest to the new solutions. The initial R&D is done in cooperation with Tekes and universities; the further development is however done internally and focusing more on real customers' needs since hardly ever new technology is sold without any references, which requires pilot projects even in simple scaling projects that pose challenges for sales function. Additionally, technology function provides technical support for sales e.g. if more advanced energy balance calculations or capacity scaling need to be done.

From the organizational development point of view the main actions are to develop organizational project management skills and to identify future organizational needs. Project management competence refers to organization's ability to execute demanding project in difficult circumstances and locations in timely manner with low costs. Project management competence is highlighted in major new projects that are opportunities to prove Andritz's reliability as confident supplier.

Moreover HR function is actively searching for new fields of competence that will be important in the future and develop organizational knowhow by organizing training sessions and identifying organizational needs by interviewing divisional business managers. One possible future competence is the cultural understanding as geographical focus of the market shifts more and more from traditional areas to the new regions. Job rotation enables organizational development as it generates knowledge comprehensively throughout the organization and allows agile reactions for market changes in cyclical industry.

6 EXPLOITATION OF LOCATION INTELLIGENCE IN ANDRITZ

Business context of Andritz is global and geographical information has specific role in business activities as new market areas and potential customers are identified and relationships with current customers are maintained. Therefore geographically referenced data has important purpose while analyzing development of the market. In large investment projects the scope of geographical location broadens, so the actual location becomes less meaningful while the attribute information of the mill becomes more important. Then geographical information is treated in higher level e.g. regionally or in continental level.

In terms of attribute information it is important to share the installation base or reference solutions in order to illustrate current state of business. Additionally attribute information should reveal the technical equipment base and technical ages of the mills that provide valuable competitor information and market potential for service and modernization projects. Moreover it provides information of market trends and changes that affect tactic and strategic planning regionally.

Although Location Intelligence provides several fields of applications how to provide added value to the value chain the essence is to identify company specific applications and analysis tools that help organization to exploit spatial information better. Just like in any information systems, in Location Intelligence the starting point for the determination of information needs is business drivers and objectives. Previous chapters identified the business actions that aim to take advantage from the industry value drivers. Based on these actions the potential applications of Location Intelligence that provide added value to Andritz operations are reviewed.

As noted earlier, GIS provides several functions and applications how spatial information can be exploited in business and the interviews revealed that all of those applications are applicable in Andritz operations to some extent. Based on the level of information the applications can be divided into strategic, tactic and operational applications. Strategic applications aim to support strategic planning and decision-making requiring external market information while operational applications in turn require internal information and therefore naturally support planning and designing of operational activities. Table 7 presents the overview of applications how Location Intelligence could be utilized in different managerial levels in Andritz operations.

Table 7. Overview of Location Intelligence fields of application in different managerial levels

Managerial level	Location Intelligence fields of applications
Strategic	• Mid-Term planning support through visualization of divisions, market shares, regional key resources and market trends • Market development through visualization of trend shifts for regions to another, trend changes in different pulp / paper qualities • Customer planning and segmentation that support identification of modernization or service needs • Economic situation reflecting the future paper or pulp needs regionally • Development of supplier network and supply chain management
Tactic	• New project scanning and generation of sales potential • Project selectivity in terms of customers • Customer Relationship Management in group level • Regional risk management based on economic situation • Visual support for capital project reviews • Regional benchmarking in business process development
Operative	• Visualization of own installation base, CRM data, reference lists • Planning of logistic routes • Travelling plans, routes and economic information related to travelling • Visualization of seismic or climate circumstances related to engineering • Visualization of permit issues and standards • Visualization of site installation location to support project management in challenging conditions • Map based marketing material for customers • Visualization of own office locations

Strategic approach aims to support long-term planning and thus is useful in mid-term planning where business actions are designed for the upcoming years with longer perspective. In mid-term planning the GIS can be used especially to visualize market regions of divisions and product groups, their market shares and locations of key resources and major market trend changes affecting to the divisions. Market development analysis can be supported by illustrating trend shifts from regions to another or by illustrating regional shifts in specific pulp or paper quality that may have important implications to the divisions. Comparison of key resources and market shares against to the regional development of market helps to understand own competitive position in the industry.

GIS enables an effective regional customer planning and segmentation through visualization where key customers are identified according the modernization and service potential. Additionally economic cost level of the region delineates the potential of new investments as it reflects to the future paper and pulp needs in the region. For example the consumption of tissue paper in developing countries may increase while economic cost level increase and thus provide new potential investments. GIS can be used to the development of supply chain network and supply chain management if key suppliers are visualized on the map. This information combined to the general economic information form specific region helps to analyze the competitiveness of the suppliers from wider perspective, plan regional supply strategy and thus provide possibility to decrease supplier costs if supplier network is regionally designed and optimized.

New project scanning and generation of sales potential through GIS helps to identify new modernization or service needs when technical ages and capacity changes of the mills are analyzed. Technical ages determine the maturity of the mill and therefore it can be expected that the mills with matured technical ages need to be modernized or maintained with timely manner. General increase of capacity in specific pulp or paper quality regionally in turn may indicate that customers are eager to increase their capacities through modernization investments as well. Moreover analysis of geographical areas may reveal new technological possibilities to increase sales. For example, if mills are located in a region with scarce supply of wood then customer appreciate technology that increases the effectiveness in wood processing. Such technologies allow the increase of capacity that provides opportunities for additional sales.

Project selectivity is one of the main actions in order to achieve profitability in sales and capital project execution as lost projects cause additional costs without any financial benefits. Therefore regional customer behavior, hit ratio and analysis to what extent customer mills are favoring competitors are necessary applications to use GIS. As sales activities are mainly based on personal contacts and good network, some customer may favor Andritz in specific region and competitors in other region. Such behavior is important to recognize in order to decrease unnecessary sales and pre-engineering costs. Moreover GIS could be an effective tool to view customers at the group level in order to analyze sales patterns and discover geographical deviations. Then it is easier to analyze why certain group is active in specific region but the activity is low in some other region.

Visualization of regional economic situation additionally helps to determine the country specific financial risks of the projects as economic cost level indirectly reflects to the costs, gross margins and financial risks. Moreover demographic and political circumstances that can also be illustrated with GIS affect indirectly to the risks as well. Visualization of such macro-economic factors allows tactically faster review and decision-making whether it is a matter of project scanning or new sales potential. GIS can additionally be used for monthly project review where all the ongoing projects are reviewed e.g. in terms of progress and costs. GIS provides illustrative way to view all projects regionally through visualization allowing the comparison of key indicators between the different projects at the same time. Such regional comparison supports internal benchmarking that can be used to enhance business processes in various business functions.

In daily actions the main contribution of GIS could be the visualization of operational data that provides an easy way to check operational information to support decision-making. Visualization could enable the quick review of e.g. seismic and climate circumstances related to engineering, visualization of permit issues and standards, own installation base, CRM data, reference lists, own office locations and ongoing construction site locations. Seismic and climate circumstances are essential when designing and engineering technological solutions as special circumstances always require extra engineering. If such circumstances are visualized on a map it would instantly tell to the sales or engineers, which sort of additional engineering has to be done. In addition map reveals the installed base near the new site that could provide examples of how such technology has been supplied previously. Visualization of permit issues and standards share the same logic where essential standards and permit issues are easily and available across the organization and no additional energy needs to be used to find such information.

Visualization of own installation base, CRM data and reference lists help sales and marketing people to discover where the customers are and what are the solutions supplied before to them. Additionally the map helps salespeople to identify technical specifications and capacities of a mill and sales volumes of a customer regionally that reduce uncertainty in sales situations when discussing of specific mill or customer. Own office locations in respect to construction sites helps to identify the nearest office needed e.g. in case of legal entity if ad hoc issues need to be taken care of related to project management. Additionally visualization of construction site location helps to identify geographical issues related to project management under challenging conditions.

GIS would help to analyze and plan logistic routes if construction sites are located in challenging locations. Thus well done planning reduces logistic costs as shipping and freights are designed in advanced. Moreover GIS could be utilized to make travelling plans if several mills are located near to each other. Then it is easy to design where to travel and how to move from location to location. Economic cost level reveals information related to travelling as well as it reflects directly to the travelling costs and determines the level of expatriation allowance. Therefore illustration of economic level would help to identify travelling costs in specific regions in more depth.

Main operative applications are intended to internal use for organizations. However maps are visually effective ways to communicate reference solutions out of the organization as well. Thus maps could be used for marketing purposes also. Andritz marketing operations are connected to the strategic and tactic product management that determine the key solutions and equipment that marketing focus. Therefore maps could provide proactive visualization of references with success stories that can be further presented to the customers in different situations e.g. in roadshows or other customer meetings. If necessary, the maps could also be uploaded to the company website in marketing purposes as well.

7 DATA COLLECTION AND EXAMPLE MODEL CONSTRUCTION

Interviews have revealed several ways to exploit spatial information in such capital intensive business as Andritz is operating. However technology and data available limits the real ways of utilization as data need to be able to process in a way that it can be analyzed and interpreted. Therefore the real world market data is tested in order to discover how Location Intelligence software actually can enhance business decision-making and if actual benefits can be achieved.

7.1 Data collection and manipulation

Data collection process started by acquiring information form the market database of Pöyry Oy that includes information related to top paper producers, top mills, investment history and equipment technical ages, power and heat technology. Additionally it contains information related to new projects and capacity changes in the market. Pöyry (2014) describes the market database to be information and analysis portal for online competitor and market analysis, where the objectives of the online analysis is to increase efficiency in customer planning, marketing and sales. The information in the database is based on official statistics, industry conferences, technical seminars or public information sources e.g. industry magazines, press releases or annual reports, so no confidential information is included.

Frist step in determining and collecting the data used in the model is to identify the location of the mills, which was done by free mill search from Pöyry's database. Free mill search with no limits gives capacities, grades and technical facts on pulp, paper or board of all mills the database includes as results. Additionally, free mill search reports the location of the mills as longitude (x) and latitude (y) coordinates, which is later used to point the location of the mills on a map.

Secondly, the attribute data used in the model need to be identified. This model construction takes into consideration is related to pulp production, paper production and chemical recovery because these fields of market illustrate quite well the global market situation and competitive position of Andritz in its industry. Appendix 4 presents the criteria according to which the data collection was done. Paper machine search includes several paper qualities that are newsprint, printing and writing, tissue, carton board, containerboard and other uncategorized paper machines. Because of the large data sets the queries needed to be done separately region by region. Regional division included total

eleven regions that were Nordic Europe, Western Europe, Eastern Europe, North America, Latin America, China, Rest of Asia, Africa, Japan, Oceania, Rest of World. Results of this query included attribute information presented in Appendix 5.

In order to illustrate shifts in paper and board production trends other query that presents capacity changes of paper and board production needed to be done. The filter criterion of such query is presented in appendix 6 and the query results in appendix 7. The critical information is the mill number, which is a unique number referring to the specific mill in the database. This mill number is included to the results in all queries done from the database. Based on this mill number the relational database was created, which allows combining different data tables based on similar attribute. So, after enrichment process the data set included all the information from the results of the queries additionally including geographical coordinates referring the location of the mills. This data enrichment was done by using Microsoft Access program that allows creating single database that includes all collected data. After the data enrichment the table was extracted into Excel and saved as comma delimited (csv) file format so that it can be easily uploaded to the ArcGIS.

7.2 Illustration of data model examples

The actual data model examples are created by using ArcGIS software, which is a web-based geographic information system. Model construction was done by uploading data into the cloud server, which enables data processing by using the web platform. The software exploits the uploaded data in order to create information layers that are positioned on top of the topographic map layer and thus visualizes the location of the data as dots on a map and content of attribute information as a dialogue box that provides all the additional information uploaded to the software. Then, the visualization of the location and attribute data enables appropriate interpretation and analysis of the data.

Although, the basic overview display provides nothing more than the data illustrated on the map, it allows an opportunity to review single data sets in respect to each other based on different attribute information. As the empirical evidence is collected from the pulp and paper industry the examples focus on presenting pulp and paper mills. Figure 9 illustrates the basic overview of the ArcGIS platform by displaying the location of recovery boilers in Nordic countries with attribute information box. Similar maps are created by using the information presented in chapter 7.1.

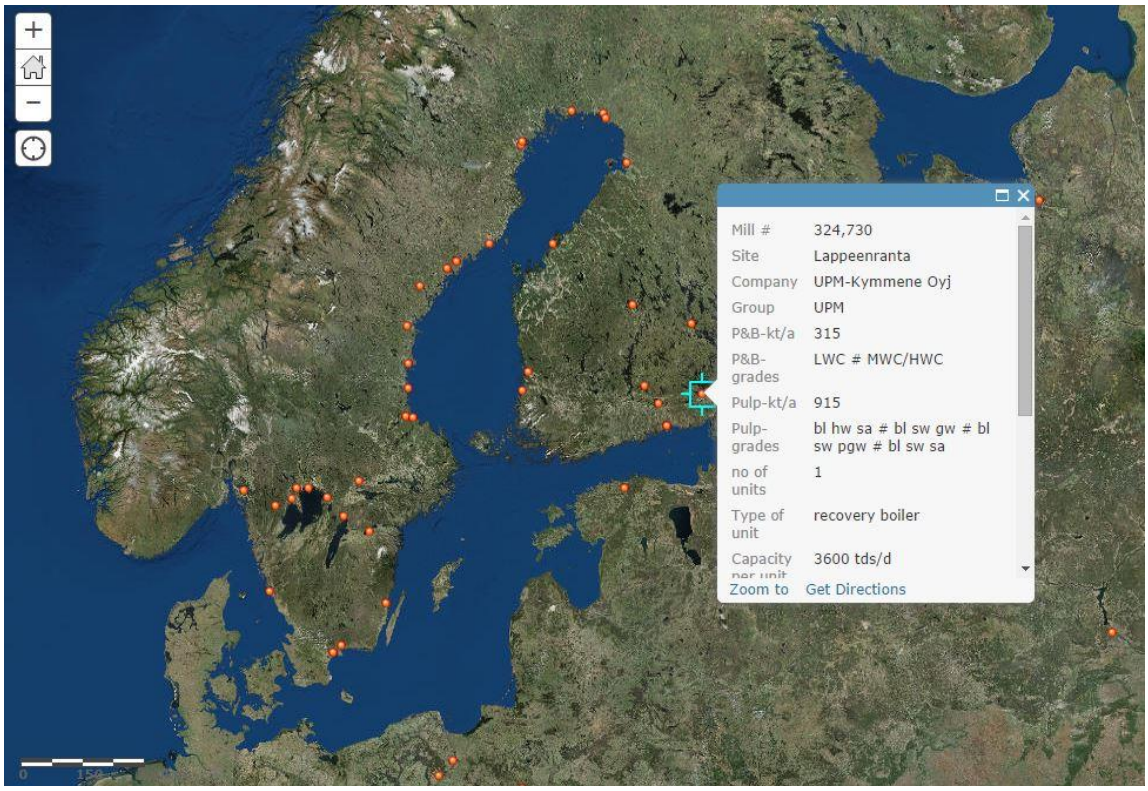


Figure 9. General overview of the ArcGIS data model

Basic overview provides general information e.g. from the market, customers, suppliers, competitors or currently ongoing projects. Together with attribute information the general overview provides rapid way to view information related to single mill or paper and board companies or groups, thus supporting managers by enabling quick access to the information visualized on a map. Only quick access to visualized information enhances business decisions as managers are able to verify assumptions based on business factors like customer mills or competitors. Basic overview is then able to answer e.g. what kind of equipment or production levels specific mills have or what kind of products specific mills are able to produce. Moreover it allows the comparison of the mills based on specific technical attribute information e.g. type of production unit or unit pressure. Dialogue box are also configurable, which allows presenting additional information related to specific mills.

The map is not only suitable to display single mill locations but also suitable to illustrate shifts and changes in attribute information, which allows more options for interpreting information. Figure 10 presents the capacity changes of paper machines in Europe, where red dots illustrate the capacity reduction and green dots in turn the increase of capacity. Size of the greed dot illustrates the number of the capacity increase; the larger dot is the bigger the increase of capacity is. This simple

illustration shows that capacity reductions have mainly been done in Western and Nordic Europe, while Eastern Europe has not suffered from major capacity reductions. The figure 10 also shows that quite much of investments have been done to the Eastern Europe.

The visualization of capacity changes illustrates the shifts in market trends but does not take into consideration the reasons behind of such development that may be caused e.g. old equipment base or simple increased demand of specific paper or boar qualities in that region. However, closer review of the attribute information reveals that the reduction of capacity is focused on paper qualities e.g. tissue or newsprint paper, while increase of capacity is in turn focused on board qualities like wrapping and packaging board or carton board.

Such illustration can give signals to the service for example to review their customer segments and make necessary changes according to regional market changes. Such trend changes can also indicate long-term shifts if temporal aspects are also studied. Capacity changes allow reviewing planned and decided new projects that could reveal the direction of market development and thus enable long-term planning of organizational resources. Such analysis could also be applied to tactic planning and decision-making as well. However, nature of business is cyclical and rapid unexpected market changes hardly happen, which emphasizes more long-term analysis in market trends.

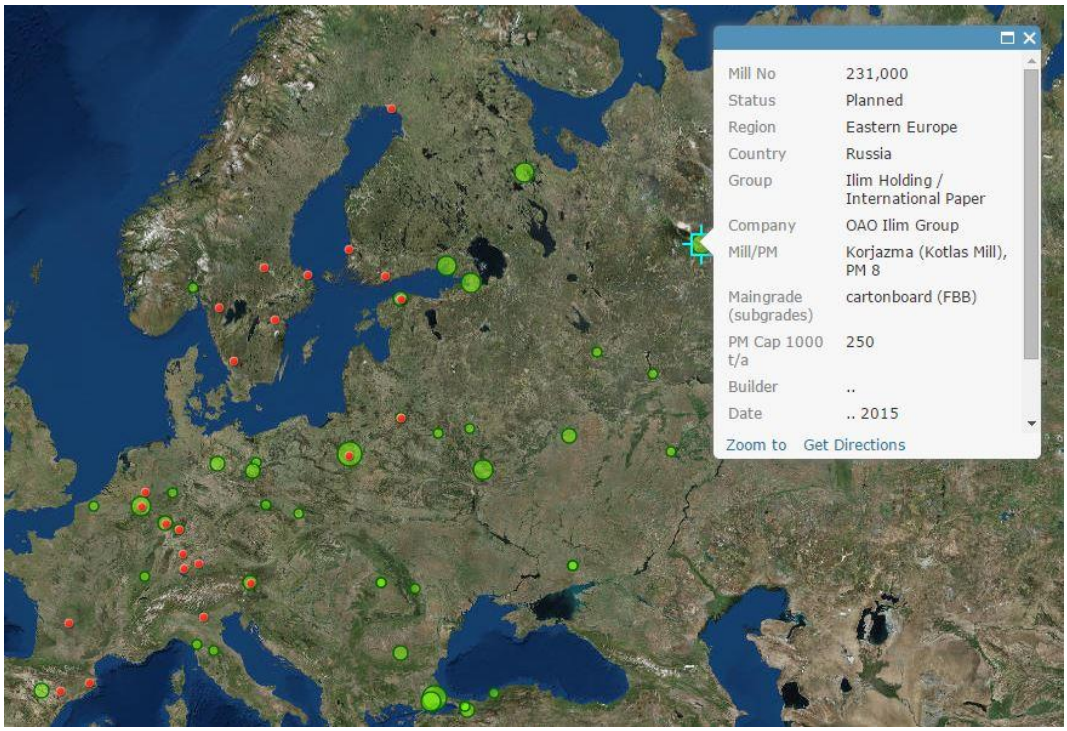


Figure 10. Capacity change of the paper and board machines in Europe

Market development and market data analysis are important to review as they provide information how company's own position in the industry is developing. The important aspect affecting to this development of market position is naturally position of competitors. Maps help to analyze what is the regional competitive position in terms of the main competitors. As the interviews revealed sales operations are based on close customer relationships. Illustration of competitors' installation base helps to address the own position in the market in relation to customers in more detail and to identify, which mills have done business with competitors. Analysis of relationships between competitors and customers help to identify how to reposition own activities to face the challenges addressed by competitors and meet the customer needs better than competitors.

Figure 11 illustrates the competitive structure presenting the evaporators supplied by Andritz and main other competitors in North America. Content on the right shows the symbols that represents the each competitor in the North American business. In this example competitors have been reviewed in group level, as the market includes several small competitors that are threat only locally, thus group level provides better understanding of global market structure. Figure 11 reveal that competitive structure in North America includes several local suppliers that have mainly supplied evaporators to the specific area of south-east coast of United States. Such an example illustrates the general overview how the competitors are geographically positioned.

Combined with attribute data, such an illustration could help in project selection if new modernization projects are generated because competitive structure may reveal if some companies favor specific suppliers, which further helps to avoid uncertain high risk tender inquiries. Additionally this kind of analysis reveal to what extent global suppliers are performing in specific region. For example figure 11 reveal that Valmet does not have major market share in North America even if it is major supplier globally in other market regions. Combination of such competitor and customer data allows more comprehensive customer segmentation and development of customer relationship management.

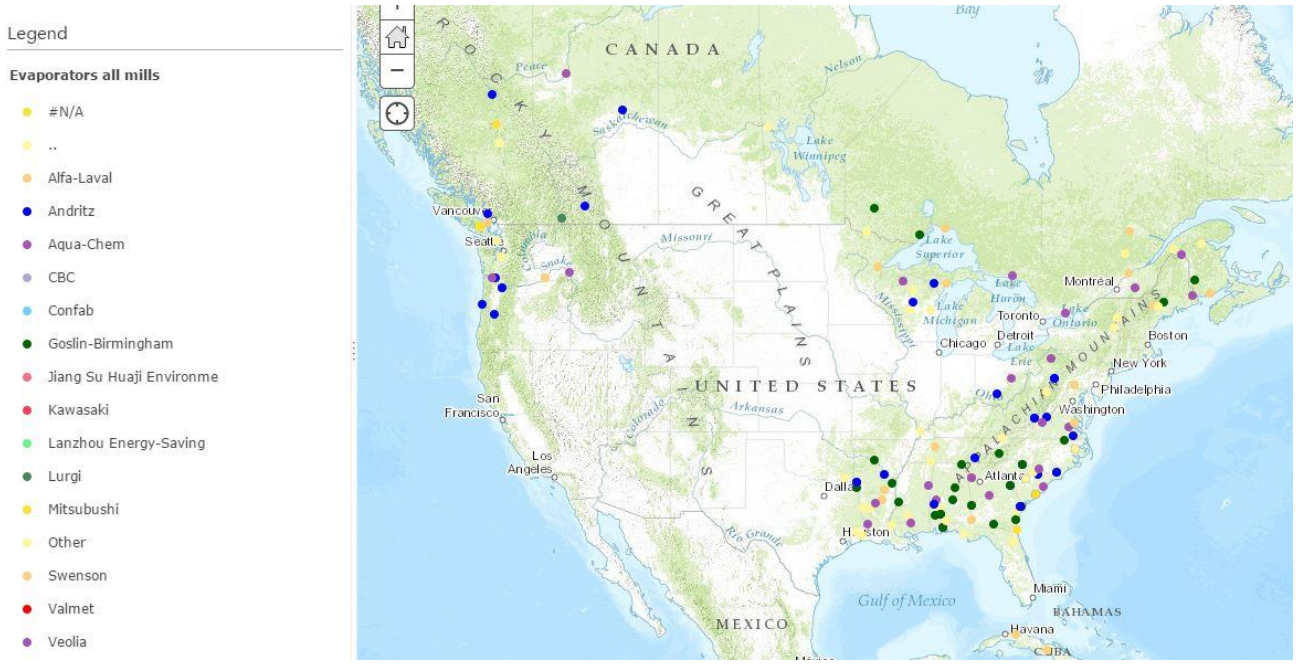


Figure 11. Competitive structure of evaporators' product group in the region of North America

Map allows the reviewing of competitive structure also in more specifically if own competitive position is necessary to be compared to some certain competitors. Figure 12 in turn, presents the comparison of single competitor in recovery boiler product group. The blue dots illustrate the supplied recovery boilers of Andritz while red dots illustrate the supplied recovery boilers of Valmet. The size of the dots illustrates the pulp production capacity of the mill, which correlates to the size of the recovery boiler providing more information about the market structure.

The figure 12 thus presents the current market situation in the regions of Nordic Europe, West Europe and Eastern Europe in terms of supplied recovery boilers. The figure shows that Valmet have absolutely more supplied recovery boilers in Nordic Europe, however Andritz has supplied recovery boilers with higher capacity, which implicates that relative market shares are fairly even. However in Western Europe Andritz has performed better than its competitor.

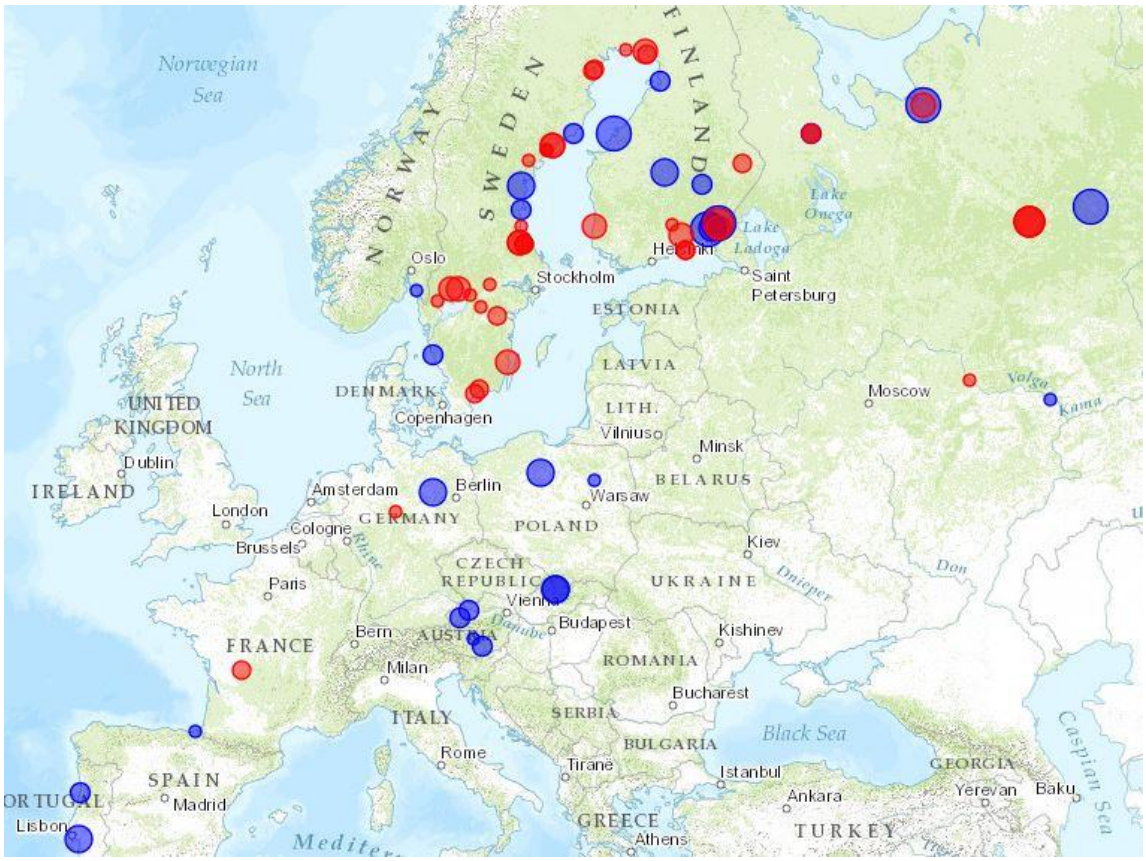


Figure 12. Single competitor analysis of recovery boilers

Such comparison in relation to single competitor reveals the regions where the specific competitor is performing strong and where the presence is relatively weaker. Historic geographical data combined to the recent activity could provide information what sort of experience and competence the competitor has or what kind of tactic and strategic intentions it may have in certain geographical regions. For example if Valmet is strongly investing in certain type of sales project without having previous experience from such projects it may implicate tactic or strategic change of actions in specific region.

Moreover spatial data allows reviewing specific competitor more closely if they are focused on acting globally or if they are focused on supplying specific equipment in specific regions in terms of pulp or paper quality, which may occur especially in China or North America with local competitors. Such analysis support similar conclusions suggested in general competitor analysis. However, this single competitor analysis takes more into consideration the global business structure and allows focusing more on the strongest competitors. For example in the product group of recovery boilers the market structure recognizes only one major competitor while other competitors act more or less locally in specific regions. Naturally such analysis provides also general

information about the current competence and performance of competitor that is essential in own long-term future competence mapping and business development.

Examples presented above are more or less based on the single map layer that present spatial and attribute data to visualize and interpret business information. However, additional feature layers and web map layers are also possible to include enriching output of map visualization. Such feature layers and web map layers are either included to the software and are based on open data collected from the databases owned by e.g. European Union, World Bank or other governmental party or analysis that are based on the data itself.

Next figure illustrates the example how open data feature layers can be used to enrich business information in order to support operational project execution. Figure 13 illustrates cooking mills in Far East including the web map layer of recent earthquakes, which illustrates the location of earthquakes in respect to cooking mills locations. Green dots show the location of cooking mills and other dots illustrate the position of earthquakes while the size of the other dots illustrates its strength of earthquakes. The map shows directly if mills are located in an area with caution of earthquake providing information through visualization.

Such visualization provides valuable information for the sales and technology as they create and review sales bids since the map shows directly if additional engineering need to be included to the bid as the attribute data reveals more specific information about the technology inside the customer mill. Moreover, engineers receive information about geographical conditions for the engineering and designing, which increase productivity since they do not have to make effort to collect necessary information from other separate sources. Similar visualization can be applied to the climate data as well that can be used to verify if weather conditions cause some additional engineering. Such visualization supports not only technology but also logistic designing if geographical circumstances have effects on transportation. Figure 13 illustrates well how enriched data can be utilized in order to provide additional information through visualization for operational actions like engineering.

Figure 13. Cooking mill locations in relation to recent earthquake areas

Together with visualization ArcGIS software allows the option to use analysis tools in order to better understand the spatial relationships of data. Figure 14 provides an example how such analysis can be utilized in reviewing current market situation as total pulp production capacity of the mills have been analyzed by using density analysis. Yellow dots present the location of the mill while the size of the dot illustrates the production capacity. The higher capacity of the mill is the larger the dot is. The feature layer in turn, illustrates the density analysis that illustrates the total pulp production capacity per square kilometer. The darker the area is the higher the pulp production is per square kilometer. Such analysis illustrates what is the number of mills in terms of actual production capacity in specific area. As the figure 14 illustrates the highest relative pulp production is in Nordic countries but it is also notable that the relative production is higher in Russia even if in absolute terms more mills are located in central Europe than in Russia.

Such analysis may reveal patterns and relationships that otherwise are difficult to identify and especially if combined with other map layers they are to some extent suitable for strategic planning as the analysis may reveal future clusters of paper or board production especially in terms of specific paper or board qualities. These notions help companies like Andritz to re-think their current competencies and resources and maybe re-establish market regions or gain new resources depending on the market development. Finding similar regional pattern in terms of product groups

or type of technology helps especially service business to create local strategies how to enter to the new regions or recreate current strategies in mature regions. For example if the main cooking technology in some region is continuous digester and batch digester is preferred in other region then the experience and technological knowhow in service business in specific region should be targeted in respect to the preferred technology.

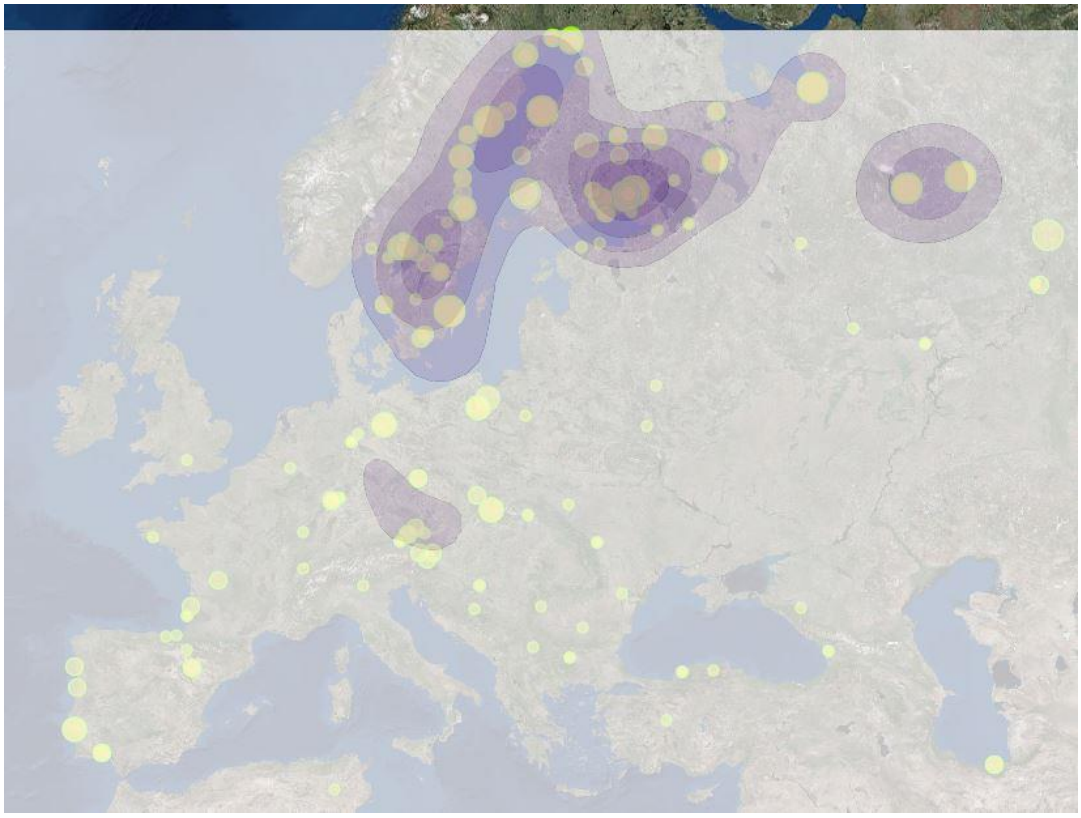


Figure 14. Density analysis of pulp capacity in Europe

Figure 15 in turn, presents the pulp capacity changes in terms of regional emphasis on total pulp production, where the size of the green dots illustrate the increase of pulp production capacity and red dots in turn presents the decrease of pulp production capacity. Darker areas however, illustrate the current pulp production density regionally. Figure 15 provides an excellent illustration about the current state and the future development of pulp production. As the figure shows, main investments have recently been made to the South America and China, while traditional markets with high production density in Japan, United States and Nordic Europe have not been recently under investment plans. Moreover number of capacity investments has been done to India as well yet statistically they are not so significant in terms of global production so it seems that new pulp production clusters are generated to just in Brazil and China.

Such development may implicate market shift from traditional areas to the new ones and eventually addressing the question what is Andritz's current market position in these areas in terms of different product groups. Overview of pulp production and capacity changes does not necessarily provide direct market information but it may raise further questions that are essential for the future e.g. what our resources in these areas are? How successful competitors are in these areas? Are we prepared for these changes well enough? Additionally, closer examination of the map reveals, which companies have been active in investments or capacity reduction thus allowing further opportunity to review customer relationships to these companies and discover potential cooperation and new projects.

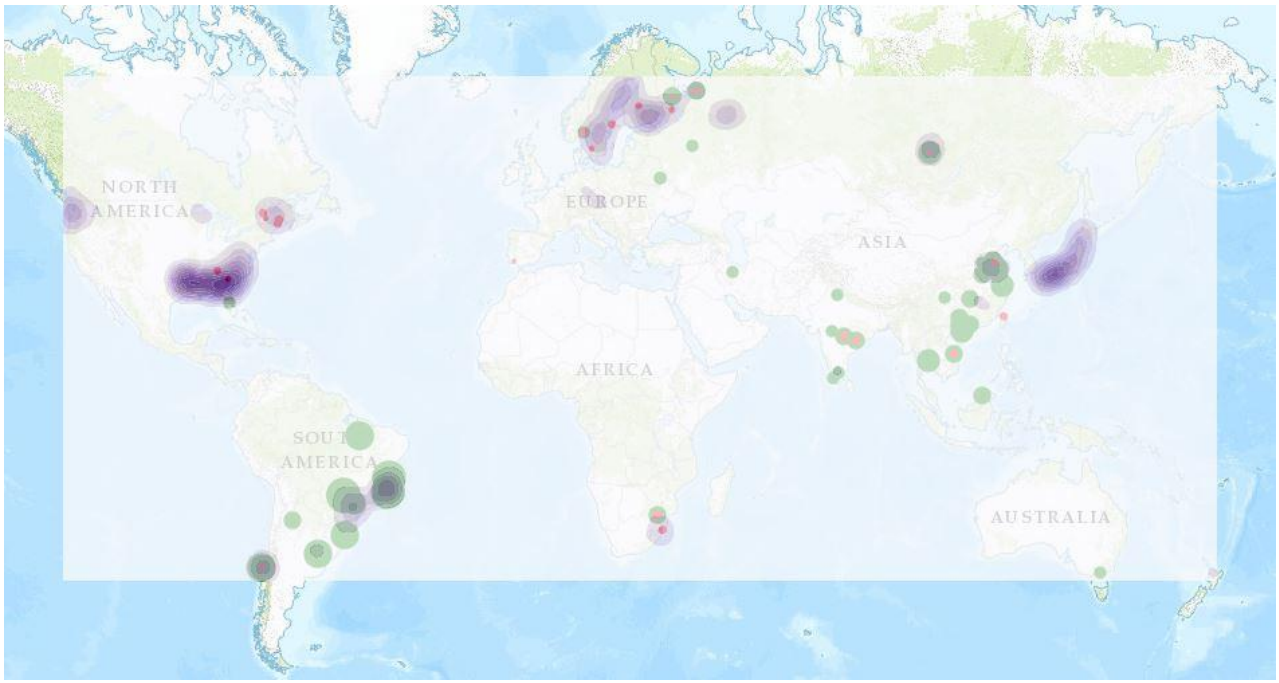


Figure 15. Global capacity changes of total pulp production.

These sorts of conclusions could also be done without visualization of structured data. However, the example illustrates how structured data supports and verifies assumptions on business issues. These changes may have several possible reasons behind that cannot be understood only via map visualization. However, analysis of attribute data in respect to current situation helps to understand reasons behind the possible changes. Some reason might be the strategic shifts of the major pulp and paper producer groups from product quality to another or changes in global pulp demand regarding the pulp quality.

Moreover the demand of paper and board products naturally affects to the investments, which may be implicated by changes in economic structures especially in developing countries like Brazil or Indonesia. Economic factors may help to identify new market opportunities and future market regions, thus supporting strategic and tactic planning together with visualization. Although conclusions of such analysis should be related to industry drivers in order to avoid incorrect conclusions. For example if market changes are results of market cyclicality but will not necessarily be permanent then the changes may not need further rapid reactions.

Examples presented here illustrate some of the ways how to use maps to visualize, interpret and analyze external business data in order to receive different outcome information that help in managerial decision-making in business. Naturally maps allow more ways for visualizing and analyzing data than just the examples presents here. However, these figures provide good general understanding of how the data is presented and what kind of analyses are possible to be performed. As the examples show, maps can be used to all different managerial approaches to support not only strategic but also tactic and operative decision-making. Additionally, attribute data has an essential role in interpreting regional differences as it provides substance for results of the analysis as the customer planning or segmentation can be done based on specific attribute requirements for example. These examples are all based on external data, which naturally emphasizes their use in tactic and strategic decision-making. However, as the figure 13 shows, external data can be utilized in operational actions as well.

8 RESULTS AND KEY FINDINGS

As in any business the main component is the customer accessibility and capital-intensive business is no exception. The study has shown that the industry value drivers are in one way or another connected to the customers as it is important to recognize customer needs, identify customer potential and select the most profitable customer projects. Moreover the operations are mainly done in cooperation with the customer, which highlights the importance of customer driven focus and customer relationship management. As the nature of business is to be globally near the customer, the location of the customers does matter in many ways.

8.1 Business benefits of Location Intelligence

Theoretical literature provided wide range of different fields of applications how Location Intelligence can be exploited. Undoubtedly these applications enhance the business as they provide additional information to support decision-making and allow interpreting business data in order to discover new relationships through visualization. However, the true business benefits of Location Intelligence are generated by those fields of applications that affect and add value to the business processes in the value chain. Therefore in order to analyze the business value of Location Intelligence the implications and further, the value adding outcome of the Location Intelligence dimension need to be identified.

Main business actions determine the information required in successful decision-making while Location Intelligence dimension illustrates the geographical approach to the business data and information. Location Intelligence has value adding benefits only if it contributes to the decisions and actions, which help organization to face the challenges addressed by industry changes and the value drivers. Therefore understanding the spatial dimensions of main business actions, which lead to the value adding outcome that this information produces enables the identification of business benefits of Location Intelligence.

Value and further the benefits of information obtained are dependent on how effectively information helps organizations to achieve business objectives. Therefore the value of spatial information depends on how useful and relevant it is to the organization and how well it helps

managers to make decisions while striving towards the business goals. Table 8 illustrates the value adding outcomes of Location Intelligence dimensions that support the business actions.

Table 8. Value adding outcomes of Location Intelligence exploitation

Main actions	Location Intelligence dimension	Value adding outcome
Generation of sales potential	Discovering regions for future paper or board production needs	Re-established market regions for product groups
Interpretation of market trends	Regional changes and shifts in market trends	Understanding the development of market structure
Market data analysis	Geographical positioning of competitors	Illustration of current competitive environment
Customer planning and segmentation	Regional segmentation of customers based on attribute data	Understanding of regional key customer base
New project scanning	Geographical illustration of new modernization projects or new technology needs	Geographical identification of new market opportunities
Project selectivity	Geographical dimension in project selection	Identification of economic and project execution risks in relation project profitability
Development of project management competence	Illustration of construction site locations in different geographical locations	Understanding of geographical challenges in project management
Future competence mapping	No identified spatial dimension	No significant outcome
Focus on customer value	Illustration of customers' installation base and geographical circumstances	Better understanding of customers' needs and requirements
Reference and pilot projects	Own reference sites and installation base	Regional sales and marketing support

As table 8 presents the value adding outcomes of Location Intelligence are quite subjective in terms of the specific business action. Therefore the added value is mainly created through managerial or organizational understanding and absorbed spatial knowledge at certain business interface. In capital-intensive business where the customer interface is rather static including companies having major capital investments the spatial knowledge has rather lower weight on business actions than in highly dynamic consumer product or retail business where the spatial focus is more on geographical behavior of the customers.

However, in global business geographical patterns could be an important source of competitive advantage if they can be utilized effectively. Naturally in generation of sales potential the technology and customer information have key role, however spatial information can reveal new

global structures by illustrating new regions with current customer needs or new customer needs in traditional regions, which may reshape the market regions of products and eventually reshape the current market structure to more favorable direction. Moreover the regional changes or shifts in market trends provide weak signals how the markets are developing in the future. It may not directly illustrate the future development but provide insight into global cycles since macroeconomic factors strongly affect to the value drivers. So, illustration of macroeconomic factors may reveal the next downturn or upswing of the industry. Market data analysis, in turn, focuses more on current market situation with shorter perspective than interpretation of market trends. Analysis of the market data helps to review the global position of competitors, not only based on market shares or other economic indicators but physically in respect to customers. Such approach provide understanding of current competitive environment and helps make tactic decisions, which are the products and regions to target in order to maintain or change current situation to more favorable direction.

In customer interface the main benefits are to understand where the customers are actually located. Especially successful service business requires thorough understanding of local customer behavior in order to meet the customer needs. Therefore regional customer planning and segmentation helps service unit to better understand the key customers and their specific needs in each geographical regions. Moreover effective regional customer planning helps to identify best practices that could be implemented to other regions as well. Comprehensive understanding of customer base makes the organization more agile and elastic to react to rapidly changing customer needs which eventually help to identify shifts in the market.

New project scanning refers strongly to the generation of sales potential and thus share similar Location Intelligence dimensions, however focusing more on to increase short-term sales volumes, while generation of sales potential is based more on long-term strategic objectives. Project selection however, is strongly related to economic factors in project execution and profitability of operational actions. Locations of project sites are affected by these conditions therefore evaluation of such factors in terms of project profitability helps to identify risks of project execution and eventually choose projects with better gross margins and higher profitability.

Internally the benefits are more based on the organizational development because the illustration of construction sites in different geographical locations improves the project management competence of the organization since the challenging conditions of previous projects are accumulated into

organizational knowledge as they are visualized in order to understand the special requirements of the site locations. Such understanding of special issues of the location streamlines the operational activities as the managers instantly acknowledge the special geographical issues that need to be taken care of in order to successfully execute the project.

Internal focus on customer value in turn, is eventually created through the better understanding of customers' needs and requirements and is tightly tied into understanding the local business environment. Visualization of customers' installation base and geographical circumstances enriched with external information provide insight into the current situation of the customers in different regions. Comparison of different regions in turn helps to better understand the possible future needs of the customers as the customers are analyzed in terms of their own competitive position in their own industry. At the same time such analysis of customers' competitive environment gives better understanding of pulp and paper industry as a whole.

These value adding outcomes are more or less generalized to illustrate the capital-intensive business since the business context of Andritz illustrates quite well characteristics of capita-intensive business. Value creating outcomes presented here, however cannot directly contribute to the competitive advantage of the organization since competitive advantage definitely requires managerial actions where the location is only one dimension. Moreover the value adding outcomes are indeed subjective and their effectiveness and eventually true benefits are dependent on the organizational ability to utilize the spatial dimensions in the managerial decision-making.

8.2 Managerial implications

Since business benefits of Location Intelligence are strongly reflecting to the organizational business processes they inevitably have implications to the managerial processes as well because new dimension of information must of necessity transforms the perspective how managers are approaching and reviewing the problems. Location Intelligence implicates to every business interface, which generates opportunities but also risks to managers. Successful coupling of spatial information and traditional business information can lead not only to new ways to approach and interpret business issues and enhance the managerial decision-making but also to develop new managerial competence to share business knowledge across the organization in order to develop organizational insight.

Undoubtedly managers have previously taken geographical issues into consideration to some extent but the focus has been more or less in traditional business issues while geographical dimension has received less attention. Therefore the major managerial implication of Location Intelligence is the transformation of spatial information into spatial knowledge, which besides allows managers to review business problems from another perspective since even more the business issues include the spatial dimension, also address the challenge of acquiring and measuring the spatial information as an additional level of business analysis. Spatial knowledge refers to the ability to combine prior professional experience and contextual information to the geographical view in order to make thoughtful decisions faster under uncertain conditions and thus gives an opportunity to interpret and conclude visualized data more accurately.

So, managerial decision-making, especially in matured industry requires at least to some extent previous knowledge and insight since all business decision cannot only be based on the spatial analysis or visualization of data. In such industry new aspects of information hardly provide direct benefits or business value for the organization. However, indirect benefits from spatial information are received if managers have prior knowledge from where they can draw deeper insight into decision-making and understand when the spatial information enriches the managerial process. Therefore, the greater value lies under the indirect effects that are driven by the change of managerial approach. Such approach and transformation should be seen as collective learning of an organization, which eventually leads to comprehensive business knowledge. Diffusion of spatial information eventually develops organization and its resource base to be more absorptive towards the spatial issues and thus enhances the organizational competence and lead to the new form of competitive advantage. Additional level of analysis increases the complexity of decision-making, however providing cross-functional integration of new information and thus generating value for the organization.

Managers need to reconsider the sources of information and determine what kind of data is relevant if new level of analysis is used. Location Intelligence inevitably broadens the information needs, as geographical locations have to be added into traditional business data. Traditional business information is a linkage between the parts of value chain and the spatial information points the position to the parts of value chain. Therefore managers should be able to see the holistic view of business that the visualization is providing instead of focusing on individual business problems. However, increasing information flow may also hamper the decision-making if important information is buried under the massive amount of information. Additionally, wide amount of

spatial information may require too much managerial focus, which distracts managers to focus on irrelevant issues. Therefore it is crucial for managers to understand when the spatial information is truly relevant and when it is not necessary in terms of decision-making.

Spatial information needs to be relevant, reliable and valid in terms of business problem at hand. The information sources of spatial decision-making however do not differ that much from traditional information sources. In spatial context both internal and external data are needed to be visualized in order to create comprehensive illustration of the business events and the operations of value chain. Spatial dimension transforms the information needs, which addresses the managerial problems if the current data is reliable and if the sources of information are relevant and valid.

If organization sees the potential and starts to develop Location Intelligence solution it should re-think its management practices and identify processes that need to be modified in order to successfully implement this new level of analysis. This requires especially determination of roles in information generation and use of spatial information. Managers need to figure out who are the key users for such information system at each level since the interpretation of information always require some broader managerial knowledge or understanding of business. Additionally, managers have to determine who produces the information for decision-making and to what extent it is available in the organization since in the case of business data visualization the Geographic Information System appears as an effective tool to share spatial information across the organization, although it is not necessary to share all information across the organization.

Finally, Location Intelligence, like any other managerial concept should trigger the evaluation of the effectiveness of current management practices in an organization. Managers have to be credibly involved in business strategy and therefore actively seek new opportunities how Location Intelligence could support business development. Like the key findings present there are spatial dimensions supporting business actions and it is managerial matter to what extent these dimensions are exploited in business since the objective of Location Intelligence is to have spatial information monitored as an active part of management processes.

9 CONCLUSIONS AND DISCUSSION

This paper studies the effective exploitation of Location Intelligence by clarifying different opportunities and solutions how geographically referenced data and technological solutions could benefit companies in capital-intensive business. As the theoretical literature and the main findings of empirical evidence suggest Location Intelligence can be exploited throughout the organization in various business functions since geographical information is a part of business at each interfaces and modern GIS technology is effective enough to be utilized in business much because of the rapid development of Information Technology. However, traditionally GIS have been mainly applied more in consumer business and not so much in capital-intensive business, therefore concrete fields of applications specifically in capital-intensive business are difficult to identify.

The GIS technology effectively supports designing and engineering, strategic planning and decision-making, transportation and logistics, market analysis, facility management and overall visualization and mapping of spatial data in business. These functions however require special designing in order to be applicable at specific industry since different industries have naturally different characteristics and priorities. Therefore requirements of the applications vary depending on the industry.

Technological applications and geographically referenced data together enable the effective utilization of Location Intelligence. Location Intelligence can be exploited by acquiring a suitable GIS solution that is able to manipulate and process company specific geographically referenced data. Such solution can be either more specific Spatial Decision Support System, SOLAP solution or more generalized GIS solution. SDSS should be used especially if the organization has specific complex spatial business issues that require further analysis and comparison between several solutions. SDSS is iterative, integrative and participative where users have active role deciding the most appropriate solution for the organization. With such SDSS organization is able to understand the problem at hand more thoroughly since it integrates expert knowledge with quantitative data and qualitative information. SOLAP instead, is more generalized data mining technology that enables rapid and easy access to the spatially referenced business data. SOLAP provides visual platform that transforms implicit spatial relationships of business events into explicit and visually evident information enhancing decision-making.

Generally GIS allows map based visualization of business data, so it can be exploited in different business functions when operating in external market interface or internal sales or project execution interfaces. Therefore Location Intelligence as concept can be exploited in all managerial levels. However, different managerial levels require different spatial data. Information needs in strategic planning are mainly external while tactic decision-making requires to some extent both external and internal information and operative actions are mainly executed based on internal information. GIS lacks the ability to produce new information as it rather modifies and enriches the existing information into new form in order to provide new managerial aspects to the business issues. Therefore business applications of GIS solutions are specifically supportive tools intended to use in managerial decision-making instead of being actively used in execution of business operations.

In strategic planning the Location Intelligence is utilized especially in determining current market situation and forecasting the future market development. Strategic planning is mainly based on the external market environment as it includes actions related to customer segmentation, competitor analysis, supplier network development and general market development. In tactic decision-making in turn, the main fields of exploitation are based on the internal sales interface in which Location Intelligence enables effective customer relationship management especially in service operations and internal business process development trough geographical benchmarking of different sales regions. In operational actions the Location Intelligence is primarily exploited through its ability visualize data since the nature of spatial information in operational actions is mainly static and informative. Operational visualization is based on the internal environment and strongly reflecting to the project execution.

Location Intelligence requires good skills in interpreting visualized information, which emphasize further Location Intelligence to be used to support especially managerial decision-making processes. Managerial information needs determine the sources and the context of spatial information utilized in Location Intelligence, thus the perceived benefits are dependent on the applicability and validity of the data available. So, if data from external sources is combined to quantitative type of information it directs the use of GIS towards the strategic direction. However, if the sources and context of information are internal then the information system operates mainly as a platform to share information across the organization without any further role of analyzing the information, still however providing spatial dimension to the business management. Results of the study support the view that sources and context of information in strategic application are external, while tactic and operative applications utilize mainly company specific information from internal

sources. The type of information however, does not have such a major role in identifying information needs since the essence in spatial information is the reference to geographical location, which does not take into consider whether the information is quantitative or qualitative.

Managerial logic and implications to managerial decision-making are strongly influencing on the benefits of Location Intelligence because nature of GIS in capital-intensive business is rather interpretative. Effective visualization of spatial data supports strategic managerial approach since it provides a holistic view of different business functions that are then easily compared. Therefore main benefits are based on further conclusions of data visualization and analyses that reveal new patterns and spatial relationships in order to enhance business development. Internal spatial information in turn, supports tactic and operative decision-making if it is exploited appropriately with GIS. As noted, these applications are specified to support certain types of business issues that require certain type of business information. Therefore the general role of Location Intelligence is mainly illustrative in operational decision-making and more analytical in strategic decision-making. Interpretation of data however requires prior managerial business knowledge that provides perspective to managers to understand the applicability of the information in respect to the business issue at hand. With better understanding of nature and utilization of the data managers are able to make better conclusions related to spatial relationships and patterns and realize the managerial level for which the data is appropriate in order to avoid decisions based on inappropriate information.

So, as it can be concluded combination of GIS technology, business information needs and managerial logic enable effective utilization of Location Intelligence. However, in order to be beneficial Location Intelligence should either provide organizational value as being an important competence of an organization or produce customer value by affecting to the company's value chain. Results of the study suggest that the benefits of Location Intelligence are difficult to determine since they are not direct but based on several organizational factors. So, the benefits of Location Intelligence are in fact the abilities to support and accelerate strategic planning, tactic decision-making and operational activities by visualizing business data efficiently.

However, these abilities are generating true business value only if they are based on real business drives of an organization. Therefore figure 16 illustrates the elements of how the perceived organizational benefits of Location Intelligence are actually generated in Andritz. Benefits of Location Intelligence thus refer to the organizational competence to exploit geographically referenced data with suitable technology where the information needs are determined appropriately

in terms of the sources of information, subject of information and type of information and where the level of analysis is determined according to appropriate managerial approach in relation to business needs.

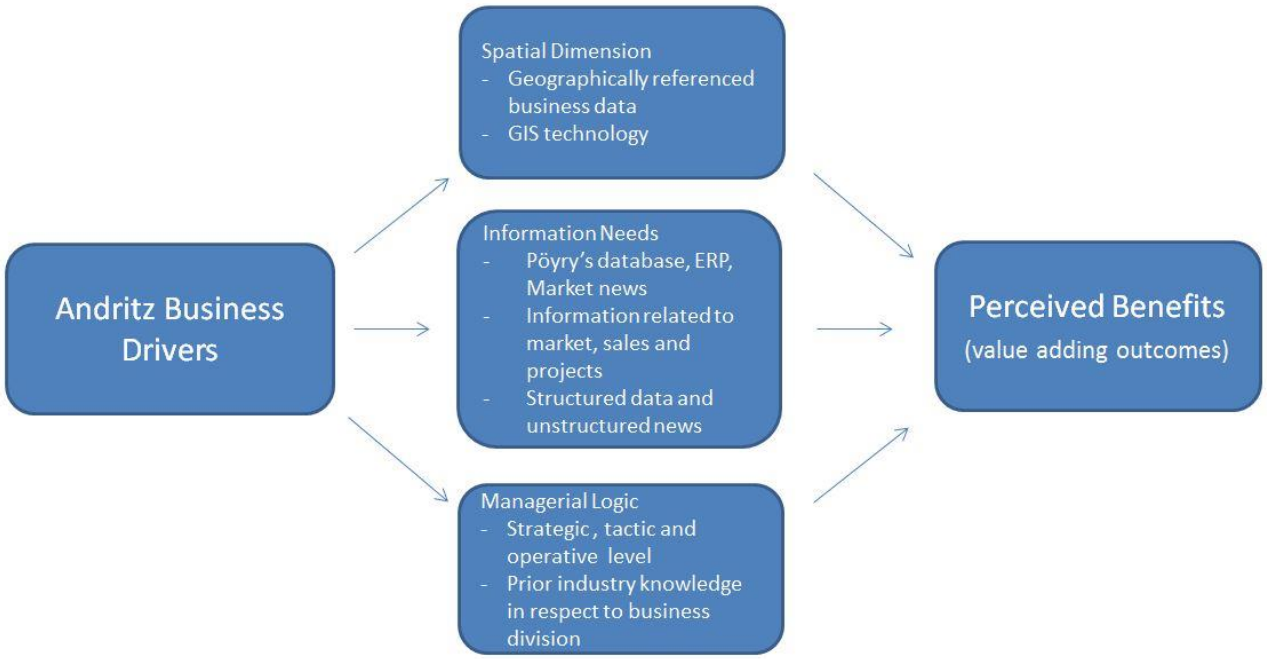


Figure 16. Elements of perceived value of Location Intelligence in Andritz

In case of Andritz the previously noted value adding outcomes are generated mainly through the geographically referenced market data, CRM data, service data and project data that are manipulated appropriately so that necessary analysis are able to be performed. Data layouts presented in chapter 7 are based on market data but internal CRM data are needed e.g. in customer planning and segmentation or in tactic business planning and optimization of business processes especially in service business. Service data and project data are needed in operation monitoring, where the map could help to illustrate broad entities. Appropriately chosen GIS tool allows the effective data manipulation, which in case of Andritz could be overall GIS solution that can be utilized in various functions widely across the organization rather than specified SDSS or SOLAP solution. The argument supporting the use of overall GIS is its wide applicability with relatively simple datasets instead of using specified solutions with complex datasets that require complex data manipulation.

The sources of information needs of Andritz in terms of GIS are mainly the market databases e.g. provided by Pöyry, own Enterprise Resource Planning (ERP) system, and news from market

information producers e.g. Intelligence Plaza or RISI databases. These sources provide comprehensive collection of both internal and external data, which can be utilized as they invariably include geographical references. The data examples of chapter 7 are based on Pöyry's data but similar visualizations are possible to be created by exploiting e.g. internal CRM data, which of course changes the context and applicability of the information. Internal ERP data in turn, allows geographically monitoring project execution or service business.

Market news in turn, provides external information that may consider Andritz or provide general market information. News are an important source to gain market knowledge that together with structured data allows managers to make notions about the development of the market, which emphasizes further the prior industry knowledge of the managers. The information is mainly used in order to generate and support sales or to analyze competitive structure of product groups that eventually provide additional information for other business interfaces like service or project execution. Therefore the context of information covers all the business interfaces from external to internal business environment.

The perceived business value and the value adding outcomes presented previously in table 8 are generated through managerial logic that determine whether the use of information is strategic, tactic or operative. Moreover the prior industry knowledge in respect to the specific business division and product groups determine the perceived value of Location Intelligence since all divisions have their special characteristics that naturally affect to the real business benefits.

The economic value of Location Intelligence however, is difficult to identify as value adding outcomes does not directly refer to any actual business operation. The value adding outcomes of Location Intelligence implicate that the business value is achieved through the interpretation and understanding of spatial relationships in the market, which refers to broad exploitation of geographically referenced information eventually highlighting the change in the whole organization. Therefore, also the economic value is eventually added through the organizational learning, which accelerates decision-making and provides additional information to the business processes. When spatial information reaches the level where it is taken into consideration in every levels and interfaces of the business, then the organization is able to utilize Location Intelligence instead of only using single GIS solutions to support business.

Effective exploitation of Location Intelligence requires well designed implementation project of GIS solution where the needs of the users are strongly taken into consideration already at the early stage of implementation project. Effective exploitation requires that organization has clear procedures to define user rights and to determine how the information is produced in order to be effectively available across the organization. At first GIS tends to answer the simple individual business issues through visualization but later when spatial issues become more complex they require more analysis and combinations of structured data and unstructured information emphasizing more managerial approach to the business. Contemporary GIS solutions are possible to be used as SaaS, which reduces development time of organizational GIS. Therefore GIS can be easily implemented to meet the needs of managerial information system and thus support managerial decision-making and produce real-time image of the business comprehensively supporting business analytics.

Although this study focuses on the benefits of Location Intelligence there are some issues, which reflect to the exploitation of Location Intelligence and Geographic Information System. In terms of Andritz operations the main issues are definitely the accuracy and validity of the data used in GIS. Like any information system, GIS does not work properly and does not provide value for the organization if the data is inaccurate, old or otherwise invalid. Especially in operative actions data should be detailed and accurate. Simple route instructions and construction site locations are good example of the detailed information that causes problems if the data is inaccurate. Therefore together with appropriate business metrics the database management has important role while implementing GIS solution in order to ensure that valid data is used. Additionally, the information used in such system may appear as trivial that seems unnecessary to some experienced users, which may cause resistance in the organization if the whole system is then seen as trivial. This emphasizes the notion that end users and user rights have to be determined carefully so that the organization as a whole is able to receive the highest possible benefits.

The study presented several fields of applications how spatial information can be exploited in Andritz and more generally in capital-intensive business. These fields of applications are to some extent examples since in the future there will become new fields of applications as the value drivers are changing and business actions of Andritz are evolving. However, these current applications do provide an excellent overview about the exploitation of Geographic Information System in business. Results of this study additionally explain the benefits that organization is able to perceive if spatial information is utilized appropriately with suitable technological solutions. The study

shows that it is not only the information available or the solutions used that matters when real benefits are determined. The results of this study can guide organization to review organizational development and help to determine whether spatial information is relevant or if it is not in terms of their business. Moreover through value adding elements the organization is able to review their current situation and review, which elements need to be developed in order to produce more added-value for the business.

9.1 Further research

This paper focused on presenting the concept of Location Intelligence and studied the conceptual business value through the potential fields of applications and its implications to managerial processes of the organization. However, the economic value of Location Intelligence has not been taken into consideration, which leaves room for further research.

When considering the further development of Geographical Information System and eventually Location Intelligence solution, Andritz has two main options. Either they acquire single GIS solution that is specifically designed to support managerial decision-making for the specifically determined business issues or they start developing a comprehensive Location Intelligence solution that shapes organizational processes according to spatial indicators by embedding the GIS functions into the existing information systems Development of comprehensive Location Intelligence solution is the desired final outcome since successful implementation emphasizes the use of existing systems as much as possible, which reduces the number of isolated modules of information systems. However, as the role of spatial information is more interpretative than productive in terms of information single GIS solution could also be beneficial to Andritz.

These two main options should be thoroughly reviewed in order to make the most suitable decision how to proceed with Location Intelligence. The following revision should include cost-benefit analysis, impact analysis and risk analysis for both of these options. Cos-benefit analysis reveals the contrast between the expected costs of the options with its predicted economic benefits while impact analysis identifies and assesses the non-cost impacts of the options including e.g. new ways of working or changes in the management processes. Risk analysis, in turn identifies the risks to success and possible countermeasures influencing on the implementation of such information system. After these analyses the final investment appraisal should be prepared in order to present

overall costs and benefits together in order to see if Location Intelligence project pays for itself and which option is more beneficial for the organization.

9.2 Reliability and validity assessment

Although the results of the study were based on interviews of professionals and exploitability tested with real-time business data examples, yet the reliability and validity of the study need to be reviewed. Interviews were executed as semi-structured, which naturally leaves some room for free discussion and brainstorming. Such method of interview enabled indeed fruitful discussions, however in some cases the role of interviewer was stronger than other cases, which inevitably influenced on the objectivity of the interview results, when more leading supportive questions were asked. Yet, it can be noted that these leading questions had no major implications to the final results since the interviewees were selected from different business units with different functional background, thus the approach to the question varied.

Testing of the data was done by using the Esri ArcGIS software. Additionally the data example testing was done in partly in cooperation with Esri, which naturally places the plausibility of the study open to questions since commercial party is involved. However, Esri is one of the leading companies for developing Location Intelligence solutions and thus supports this study by providing valuable material related to GIS applications in business. Additionally, ArcGIS software is a good generalized example of the solutions currently on the market and therefore illustrates the contemporary technological GIS solutions.

Due to the topic that is rather new and quite unfamiliar for academic community as the concept of Location Intelligence has mainly resulting of commercial GIS providers and consultants the references related to Location Intelligence are mainly from commercial sources. However, spatial information is comparable to any business information and thus considered as a subfield of Business Intelligence, which highlights the importance of general academic understanding of data-driven management that is specifically supported by commercial references. Moreover in the development of business applications the commercial references often provide the latest knowledge since the GIS technology has been already widely studied in academic journals.

REFERENCES

Amos, P. 2009. GIS and Business Applications. 1st ed. ebook. [WWW-document]. [Accessed 4.6.2014]. Available at: http://opportunityagenda.org/files/field_file/GIS%20and%20Business%20Applications%20-%20Amos_0.pdf [Accessed 4 Jun. 2014].

Andritz, 2013. Annual report 2013, ANDRITZ GROUP, Graz, 83 p.

Andritz. 2014. History - ANDRITZ GROUP. [WWW-document]. [Accessed 24.6.2014]. Available at: http://www.andritz.com/group/gr-about-us/gr-history.htm

Andritz Oy. 2014a. ANDRITZ Oy, Finland - ANDRITZ PULP & PAPER. [WWW-document]. [Accessed 24.6.2014]. Available at: http://www.andritz.com/locations/pp-andritz-oy.htm

Andritz Oy. 2014b. Andritz Oy Finland – intranet. [WWW-document]. [Accessed 14.10.2014]. Available at: http://intranet.andritz.com/ANONIDZC1EA3EF51B0495A1/finland-home

Anselin, L. 1998. GIS Research Infrastructure for Spatial Analysis of Real Estate Markets. *Journal of Housing Research*. vol. 9, no. 1, p. 113-133

Anselin, L. 1989. What is special about spatial data? Alternative perspectives on spatial data analysis. 1st ed. National Center for Geographic Information and Analysis, Santa Barbara

Bansal, V., Pal, M. 2007. Potential of geographic information systems in building cost estimation and visualization. *Automation in Construction*. Vol. 16, no. 3, p.311-322.

Barriball, L.K., While, A. 1994. Collecting data using a semi-structured interview: a discussion paper. *Journal of Advanced Nursing*. vol. 19. p. 328-335

Barney J. 1991. Firm Resources and Sustained Competitive Advantage. *Journal of Management*. Vol 17, No. 1, s. 99-120

Bartelme, N. 2012. Geographic Information Systems. In: Handbook of Geographic Information. (eds.) Kresse, W., Danko, D.M. Springer. Berlin Heidelberg. Chap. 6. p. 145-174

Bédard, Y., Merret, T., Han, J. 2001. Fundamentals of spatial data warehousing for geographic knowledge discovery. In: Geographic Data Mining and Knowledge Discovery. (eds.) Miller, H.J., Han, J. Taylor & Francis, Vol. Research Monographs in GIS. Chap. 3 p. 53-73

Bédard, Y., Proulx, M.J., Rivest, S., 2005. Enrichissement du OLAP pour l'analyse géographique: exemples de réalisation et différentes possibilités technologiques. In: Bentayeb, F., Boussaid, O., Darmont, J., Rabaseda, S. (Eds.), Entrepôts de Données et Analyse en ligne, RNTI B-1. Cépaduès, Paris, pp. 1–20.

Berends, P.A.J., Romme, A.G.L. 2001. Cyclicality of capital-intensive industries: a system dynamics simulation of the paper industry. *The International Journal of Management Science*. Omega 29. p.543-552

Bouckaert, K. 2010. The Power of Location Intelligence for Business Intelligence Users. [WWW-document]. [Accessed 27.5.2014) Available at: http://www.element61.be/e/resourc-detail.asp?ResourceId=136

Burstein, F., Holsapple, C. 2008. Handbook on Decision Support Systems. 1st ed. Berlin: Springer.

By, R. 2001. Principles of geographic information systems. 1st ed. Enschede, The Netherlands: International Institute for Aerospace Survey and Earth Sciences.

Cheng, M., Chang, G. 2001. Automating utility route design and planning through GIS. *Automation in Construction*, Vol. 10, No. 4, p. 507-516.

Crain, I. K., MacDonald, C. L. 1984. Computer Cartography's Contribution to Problem Analysis and Institutional Decision-making: From Land Inventory To Land Management the evolution of an operational GIS. Cartographica: *The International Journal for Geographic Information and Geovisualization*. Vol. 21, No.2, p.40-46.

Davenport, T.H., Harris, J.G. 2007. Analysoi ja voita: Killpailun uusi tiede. Helsinki. Talentum. 253 p.

Davenport, T.H. Prusak, L. 1998. Working knowledge: How Organization Manage What They Know. *Ubiquity. An ACM IT Magazine and Forum*. Excerpt from: 1st ed. Boston Mass: Harvard Business School Press. p.15

Densham, P.J. 1991. Spatial Decision Support Systems. In: *Geographic Information Systems: Principles and Applications, Vol. 1*, (eds) D.J. Maguire, M.F. Goodchild, and D.W. Rhind. London, Longman. p. 403-412.

Dierickx, I., Cool, K., 1989. Asset stock accumulation and sustainability of competitive advantage. *Management Science.* Vol.35, No.12, p.1504-1511.

Dodge, M. McDerby, M. Turner, M. 2008. The Power of Geographical Visualizations. In: Geographic visualization: concepts, tools and applications. (eds.) Dodge, M., McDerby, M., Turner, M. Chichester, John Wiley & Sons. p. 1-10.

Dragicevic, S. 2004. The potential of web-based GIS. *Journal of Geographic Systems*. vol 6. p. 79-81.

Edmunds, A., Morris, A. 2000. The problem of information overload in business organizations: a review of the literature. *International Journal of Information Management.* Vol. 20. p. 17-28

Eisenhardt, K.M. 1989. Building Theories from Case Study Research. *Academy of Management Review*. Vol. 14, No.4, p. 532-550

Eisenhardt, K.M., Martin, J.A., 2000. Dynamic capabilities: What are they? *Strategic Management Journal.* Vol. 21, p. 1105-1121.

Erskine, M.A., Gregg, D.G., Karimi, J., Scott, J.E. 2014. Business Decision-Making Using Geospatial Data: A Research Framework and Literature Review. *Axioms.* Vol. 3, p. 10-30.

Esri, 2006. GIS and Business Intelligence: The Geographic Advantage. White paper, New York, USA. p.11

Esri, 2012a. News Location Intelligence is more than map. [WWW-document]. [Accessed 10.6.2014] Available at: http://www.esri.com/news/arcuser/1012/location-intelligence-is-more-than-a-map.html

Esri, 2012b. Location Analytics for Business Intelligence. White Paper. Redlands, USA. p. 14.

Esri, 2012c. What is GIS? [WWW-document]. [Accessed 20.5.2014] Available at: http://www.esri.com/library/bestpractices/what-is-gis.pdf

Esri, 2014a. GIS for Facilities. [WWW-document]. [Accessed 3.6.2014] Available at: http://www.esri.com/industries/government/facilities

Esri, 2014b. GIS for logistics. [WWW-document]. [Accessed 4.6.2014] Available at: http://www.esri.com/industries/logistics

Esri. 2014c. Perform analysis—Help | ArcGIS. [WWW-document]. [Accessed 23.9.2014] Available at: http://doc.arcgis.com/en/arcgis-online/use-maps/perform-analysis.htm

Esri.com, 2014. Esri - GIS Mapping Software, Solutions, Services, Map Apps, and Data. [WWW-document]. [Accessed 16.9.2014] Available at: http://www.esri.com/

Evans, P.B., Wurster, T.S. 1997. Strategy and the new economics of information. *Harvard Business Review*. No. 9-10. p. 70-82

Fleisher, C.S. 2001. Analysis in Competitive Intelligence: Process, Progress, and Pitfalls. In: Managing Frontiers in Competitive Intelligence. (eds.) Fleisher, C.S., Blenkhorn, D.L. Quorum Books, Westport, CT, pp. 77-89

Frishammar, J. 2003. Information Use in Strategic Decision Making. *Management Decisions.* Vol. 41, No. 4, pp. 318-326

Gartner, 2013. Gartner's 2013 Hype Cycle for Emerging Technologies Maps Out Evolving Relationship Between Humans and Machines. [WWW-document]. [Accessed 16.9.2014] Available at: http://www.gartner.com/newsroom/id/2575515

Golfarelli, M., Mantovani, M., Ravaldi, F. and Rizzi, S. 2013. Data Warehousing and Knowledge Discovery. In: Data Warehousing and Knowledge Discovery. (eds.) Bellatreche, L., Mohania, M. 15th International Conference DaWaK, 1st ed. Springer, p.72-83

Goodchild, M. F. 1992. Geographical information science. *International journal of Geographical Information Systems.* Vol. 6, no. 1, p. 31-45

Grimshaw, D. 2000. Brining Geographical Information Systems into Business. 2nd ed. John Wiley & Sons. New York. p.347

Hakanen, P. 2014. Tiedolla johtaminen - Johtamisen paluu. [Blog] *It's intelligence, It's Petri's: Let new ideas bloom*. [Accessed 14.8.2014] Available at: http://www.hakanen.eu/blog/2014/07/tiedolla-johtaminen-johtamisen-paluu/

Hess, R.L., Rubin, R.S., West Jr, L.A. 2004. Geographic information systems as marketing information system technology. *Decision Support Systems*. No. 38, p. 197-212

Hovi, A., Hervonen, H., Koistinen, H. 2009. Tietovarastot ja Business Intelligence. Porvoo. Docendo. p. 196

Jankowski, P., Fraley, G. and Pebesma, E. 2014. An exploratory approach to spatial decision support. *Computers, Environment and Urban Systems*. Vol. 45, p.101-113.

Johnson, G., Scholes, K., Whittington, R. 2005. Exploring corporate strategy. 7. ed. Harlow: Prentice Hall 1033 p.

Keenan, P. 2003. Spatial Decsision Support Systems. Published in: Decision making support systems. (eds.) Mora, M., Forgionne, G. and Gupta, J. 1st ed. Hershey, PA: Idea Group Pub. p. 28-39

Keenan, P. 2005. Concepts and theories of GIS in business. In: Geographic Information Systems in Business. (eds.) Pick, J. Hershey, Idea Group Inc, p. 1-19

Keller, T., Tergan, S.O. 2005. Visualizing Knowledge and Information: An Introduction. In: Knowledge and Information Visualization. Lecture Notes in Computer Science 3426. (eds.) Keller, T., Tergan, S.O. Heidelberg, Berlin, Germany: Springer-Verlag. P. 1-23.

Kemper, H-G., Rausch, P., Baars, H. 2013. Business Intelligence and Performance Management: Introduction. In: Advanced Information and Knowledge Processing; Theory, Systems and Industrial Applications. (eds.) Rausch, P., Sheta, A.F., Ayesh, A. London, UK: Springer-Verlag. p. 3-10

Killick, J. 2014. The four imperatives of Location analytics. Esri News for Business, [WWW-document]. [Accessed 1.7.2014] Available at: http://www.esri.com/~/media/Files/Pdfs/library/newsletters/business/spring-2014.pdf

Kärri, T. 2007. Timing of Capacity Change: Models for Capital Intensive Industry. Dissertation, Lappeenranta University of Technology. p. 143

Laihonen, H. 2013. Tiedolla johtaminen tarkoittaa tiedon hyödyntämistä. Novi tietojohtaminen tutkimuskeskus. [WWW-document]. [Accessed 23.6.2014] Available at: http://www.tut.fi/novi/tiedolla-johtaminen-tarkoittaa-tiedon-hyodyntamista/

Lainiola. T., Ukkonen, J. 2014. Client meeting and hand-out material, ESRI Finland. Meeting. 3.7.2014

Luhn, H.P. 1958. A Business Intelligence System. *IBM Journal*. No. 10, p. 314-319

Maguire, D. 1991. An Overview and Definition of GIS. In: Geographical Information Systems: Principles and Applications Vol 1. (eds.) Maguire, D., Goodchild, M., Rhind, D. London, Longman. p. 9-20

Mennecke, B. E. 1997. Understanding the Role of Geographic Information Technologies in Business: Applications and Research Directions. *Journal of Geographic Information and Decision Analysis.* Vol.1, No.1, p. 44-68.

Miller, H. and Shaw, S. 2001. Geographic Information systems for Transportation: Principles and Applications. 1st ed. New York, Oxford University Press, 472 p.

Milton, S. 2011. Location Intelligence - The Future Looks Bright, Forbes. [WWW-document]. [Accessed 22.5.2014] Available at: http://www.forbes.com/sites/stevemilton/2011/10/11/location-intelligence-the-future-looks-bright/

Negash, S. 2004. Business intelligence. *The Communications of the Association for Information Systems*. Vol.13, No.1, p.177-195

Nonaka, I., Peltokorpi, V. 2006. Objectivity and Subjectivity in Knowledge Management: A review of 20 Top Articles. *Knowledge and Process*. Vol. 13, No.2, P. 73-82.

Ortiz, S. 2014. For Business Intelligence, the Trend Is Location, Location, Location | News - IEEECS. [WWW-document]. [Accessed 30.6.2014] Available at: http://www.computer.org/portal/web/computingnow/news/for-business-intelligence-the-trend-is-location-location-location

Peng, Z. and Tsou, M. (2003). Internet GIS. 1st ed. Hoboken, Wiley, 681p.

Pitney Bowes. 2006. BusinessWeek Research Services: Location intelligence: The new geography of business. White Paper, p.15

Pirttimäki, V. 2007. Business Intelligence as a managerial tool in large Finnish companies. Dissertation. Tampere University of Technology. p. 148

Porter, M., Millar, V. 1985. How information gives you competitive advantage. *Harvard Business Review*. Vol.63 No. 4, p. 149-160.

Porter, M. 1985. Competitive Advantage – Creating and Sustaining Superior Performance, Free Press, New York, NY.

Porter, M. 1991. Towards a Dynamic Theory of Strategy. *Strategic Management Journal*. Vol. 12. p. 95–117.

Prahalad, C.K., Hamel, G. 1990. The core competencies of the corporation. *Harvard Business Review*. May-June, pp. 79-91.

Pöyry, 2014. SmartTerminal market database. [WWW-document]. [Accessed 2.10.2014] Available at: https://www.jpsmartterminal.com/clients/

Rich, S., Davis, K. 2010. Geographic Information Systems for Facility Management. 1st ed. Houston, IFMA Foundation, 55 p.

Rivest, S., Bédard, Y. and Marchand, P. 2001. Toward better support for spatial decision making: defining the characteristics of spatial on-line analytical processing (SOLAP). *Geomatica.* Vol. 55, No. 4, p. 539-555.

Rivest, S., Bédard, Y., Prolux, M.J., Nadeau, M., Hubert, F., Pastor, J. 2005. SOLAP technology: Merging business intelligence with geospatial technology for interactive spatio-temporal exploration and analysis of data. *ISPRS Journal of Photogrammetry & Remote Sensing*. Vol.60, P. 17-33.

Simao, A., Densham, P. J., Haklay, M. 2009. Web-based GIS for collaborative planning and public participation: An application to the strategic planning of wind farm sites. *Journal of Environmental Management.* Vol. 90, p. 2027-2040

Sirmon, D. G., Hitt, M. A. and Irel. 2007. Managing firm resources in dynamic environments to create value: Looking inside the black box. *Academy of management review*. Vol. 32, No. 1, p. 273–292.

Smart, A. 2008. The Value of Spatial Information: The impact of modern spatial information technologies on the Australian economy. Melbourne, ACIL Tasman, 221p.

Smith, M. 2014. Technology makes a difference for Location Analytics. [Blog] *Perspectives*. [Accessed 16.9.2014] Available at: http://marksmith.ventanaresearch.com/2014/04/01/technology-makes-a-difference-for-location-analytics/

Thierauf, R. 2001. Effective Business Intelligence systems, 1st ed. Westport, CT: Quorum Books. p.373

Thill, J.C. 2000. Geographic information systems for transportation in perspective. *Transportation Research Part C*. No. 8. p. 3-12

Thompson, G., Patterson, A. 2010. Improving Smart Meter Deployment with Spatial Business Intelligence. *Powergrid international.* Vol. 10, p. 40-47

Teece, D. 1998. Capturing Value from Knowledge Assets: The new economy, markets for know-how, and intangible assets. *California Management Review*. Vol. 40, No. 3, p. 55-79

Teece, J., Pisano, G., Shuen, A. 1997. Dynamic Capabilities and Strategic Management. *Strategic Management Journal*. Vol. 18, No. 7, p. 509–533.

Toppen, F., Wapenaar, H. 1994. GIS in Business: Tools for Marketing Analysis. Hague, EGIS, p.10

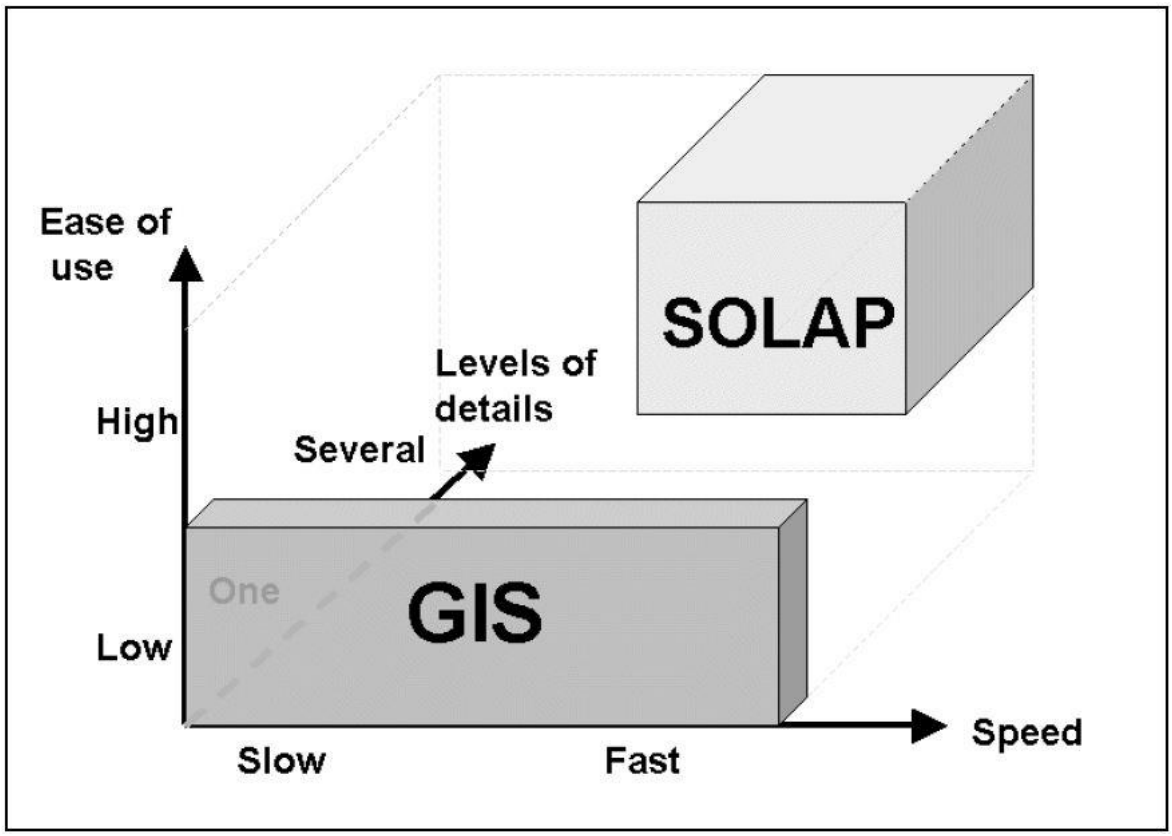
Torkkeli, M., Virolainen, V-M., Niirainen, J., Tuominen, M. 1999. Analyzing core competence and value add of small software firms in telecommunications. Working papers / Telecom Business Research Center Lappeenranta, 2. 29 p.

Winslow, J. 2007. Leveraging the Power of Location Intelligence to Enhance Business Intelligence: Enabling the Location Intelligence Enterprise. Troy NY, Pitney Bowes white paper, p. 16

Winslow, J., Jackson, K. 2010. GIS Plugs into the cloud: More dynamic applications for Location Intelligence: Drive growing preference for SaaS delivery. Troy NY, Piney Bowes white paper, p.8.

APPENDIX

Appendix 1. Position of GIS and SOLAP with regards to three axes of requirements for spatial decision-making (Rivest et al., 2001 p.543)



Appendix 2. Timetable of the interviews (Position, Unit, Date, Duration)

Division Controller, Deputy Division manager, Fiber technology division, 8.7.2014, 3h

Division Marketing Manager, Fiber Technology division, 15.7.2014, 3h

Sales Manager, Fiber technology / White Liquor Plant product group, 29.7.2014, 2h

Manager, IT systems, Kraft and Paper mill service division, 20.8.2014, 1h 45min

Research Manager, Fiber technology division, 21.8.2014, 1h

Director of Sales, Recovery and Power division, 25.8.2014, 1h 15 min

Human Resource Manager, Joint Functions unit, 28.8.2014, 1h 30min

Product Group Manager, Kraft and Paper Mill service division, 9.9.2014, 1h 30min

Vice president of Global Operations, Fiber Technology division, 7.10.2014,1h 30min

Senior vice president, regional manager, Kraft and Paper mill service division, 7.10.2014, 1h

Appendix 3. Structure of the interviews

- What are the main value drivers or business objectives for your division?
- What are the main actions to be performed in order to achieve successful business outcome?
- How these actions are measured?
- What kind of business data do you use at your current tasks?
- What are the main business problems that you face?
- How could you utilize geographical information in your current tasks?
- How your division could benefit from geographical information?
- What kind of opportunities do you see in utilization of geographical information in Andritz?

Appendix. 4. The filter criteria for attribute information query

Process	Cooking	Paper and Board Machines	Recovery Boilers	Evaporators
Detailed filters	Process limit to: All (i.e. no sub-processes); Scope: Equipment; Mill option: Operating Mills Regions: All Product: All grades including fluff, including dissolving. Company: All Product capacity: no limits Start year (section equipment): no limits Focus: Mill	PM builder: All Company: All Capacity / Speed / Wire width / start year: No limits Excluding idle/shut PM's since 2000 Machines included: Tissue, Newsprint, Containerboard, Carton board, Other, Printing &Writing	Section: Pulp mill Scope: Equipment Mill option: excluding mills idle/shut since 2000 and no limit mills idle / shut since 2000 Region: All Product: Total pulp. All grades (including fluff / dissolving) Company: All Product capacity: no limits Start year: no limits Focus: Mill	Section: Chemical recovery Limit to: Evaporators Scope: Equipment Mill option: Operating mills Region: All Product: all grades including fluff. including dissolving Company: all Product capacity: No limit Start year: No limit Focus: Mill

Appendix 5. Results of the attribute information query

Process	Cooking	Paper and board Machines	Recover Boilers	Evaporators
Query results	Region Country Company Site State Mill number Selected Grades kt/a Total pulp Grades produced No of units Type of unit Used for grades Volume m3/unit Capacity kt/a/unit Builder Started Rebuilds Second hand	Region Country Group Group 1 Group 2 G1% G2% Company Site Mill number PM number PM builder Started Last rebuild Design speed m/min Wire width mm Trim width mm Grammage min g/m2 Grammage max g/m2 Technical age years Total PM capacity kt/a Allocated grade-capacity kt/a PM main grade Main grade capacity kt/a Produced grades Known subgrades Headbox (type/started/rebuild) Forming method Forming started Forming rebuild Press type Press started Press rebuild Drying method Drying started Drying rebuild	Region Country Group Company Site Mill number P&B kt/a P&B grades Pulp kt/a Pulp grades No of units Type of unit capacity per unit Pressure bar/unit (G) Builder Builder Started Rebuilds Second hand	Region Country Company Site State Mill number Selected Grades kt/a Total pulp Grades produced No of units Type of unit Effects Used for grades Capacity per unit Builder Started Rebuilds Second hand

Appendix 6. The filter criteria for capacity changes of paper and board production

Process	Paper and board machines
Detailed filters	Region: World Product/Grade: All grades Company/Group: All Include decided projects Include planned projects Include completed projects 2014 Include completed projects 2013 Sort by: Period New Paper Machines

Appendix 7. The query results for capacity changes of paper and board production

Process	Paper and board machines
Query results	Status Region Country Group Company Mill no. Mill / PM Main grade (Subgrades) PM Capacity 1000 t/a Builder Date