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Tämä opinnäytetyö tutkii Suomen tuulivoimakonsultointimarkkinoita ja tuulivoimahankkeiden kehittäjille tarjolla olevia konsulttipalveluita. Aiheesta ei ole tehty aikaisempaa tutkimusta ja tavoitteena oli tutkimus, jossa Suomen tuulivoimakonsultointipalvelut ovat kartoitettu.

Opinnäytetyön teoria käsittelee Suomen tuulivoimasektorin nykytilaa yleisellä tasolla sekä verrattuna Euroopan unioniin, kuinka tuulivoimaa tuotetaan sekä tuulivoimaprojektien tyypillisiä osapuolia. Teoria selittää tuulivoimahankkeiden läpiviennin eri vaiheet sekä osiot, jotka tyypillisesti teetetään konsulttiyrityksillä. Konsulttitoiminnan yleiset sopimusehdot sekä suomalaisen konsulttitoiminnan nykytila käydään läpi lyhyesti.

Tutkimus toteutettiin elektronisen kyselylomakkeen avulla. Kysely lähetettiin kahdeksalle Suomessa toimivalle konsultointiyritykselle.. Kysymykset jaoteltiin kolmeen osa-alueeseen; yritysten taustatietoihin ja palveluihin, tuulimittausten toteutukseen sekä yritysten arvioihin tuulivoimakonsultoinnin kilpailutilanteesta Suomessa.

Tulokset osoittavat, että vaikka ulkomaiset konsulttiyritykset ovat suurilta osin suomalaisia konsulttiyrityksiä kokeneempia, on suomalaisten yritysten toiminta laadultaan pääosin samalla tasolla. Kotimaisten konsulttiyritysten vahvuuksia ovat paikallisten tuuliolosuhteiden, lakien ja toimintatapojen tuntemus. Vaikka Suomen tulevaisuuden tuulivoimatavoitteet ovat yhä epäselviä, uskovat vastaajat tuulivoimakonsultoinnin kysynnän jatkavan kasvuaan.

Avainsanat: Tuulivoima, tuulivoimasektori, konsulttitoiminta

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ABSTRACT

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This research paper studies the consulting market for the Finnish wind energy industry and the consulting services available for wind project developers in Finland. Since there were no previous studies conducted on the subject, there was a need for a research where the Finnish consulting services are mapped out.

The theoretical framework for this study discusses the current state of the Finnish wind energy industry in general and in comparison to the rest of the European Union, production of wind power and the key players in the market. The process of planning and implementing a wind project is explained throughout, and issues that often require expertise from external consultancies are pointed out. The theory also explains briefly what consultancies are, what they do and what guidelines they follow in their operations.

The study was conducted using a questionnaire that was sent to eight consultancy companies operating in Finland. The survey contained questions about the services that the companies provide, wind energy assessment methods as well as the competitive situation in the Finnish consulting market. The views of the respondents are reported and discussed in the analysis section of the research paper.

The results of the study show that although foreign consultancies entering the Finnish wind energy market are generally more experienced, Finnish consultancies are catching up with their foreign counterparts in terms of expertise and experience. The main strengths of the Finnish consultancies are knowledge of the local weather conditions, regulations and processes. Although the new national wind targets have not yet been set, the respondents believe that the demand for wind consulting will continue to grow.

Key words: Wind power, wind energy industry, consulting

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1 INTRODUCTION

1.1 Aim of the Study

Wind power is an energy source that is currently covering approximately 1,7% of our electricity consumption in Finland. Although it is not yet being utilized to its fullest potential, the Finnish public sees wind power as an attractive source of clean energy. The Finnish wind power association STY states that the potential for wind power production in Finland is close to 2500 MW in comparison to currently produced 627MW (2014). When the target of 2500 MW is reached, it will account for approximately 10% of Finland's energy consumption.

There are questions regarding the profitability of wind power, its competitiveness against other energy resources and the challenges related to the climate and environmental factors. The process of developing a wind farm is quite complex and it requires careful planning and expertise from many fields. Wind project developers face multiple challenges before the project will be successful, and in many cases it is useful to acquire assistance from an external source. Since wind energy consulting is still a relatively new area of business, there is a possibility to study the current market situation in Finland and compare the wind industry in Finland to the situation in the rest of the European Union, where wind power is generally utilized to a larger extent than in Finland.

1.2 The Research Problem and Perspective

This paper studies the current market situation of wind energy consultancies in Finland and the research problem is what different kinds of consulting services are available for wind project developers. The idea for this type of research came from a company, which will stay anonymous in the report. The supervisor for this thesis, Mr. Ossi Koskinen, has also a strong interest in the wind energy sector, and he had many good ideas regarding the survey. The study focuses on wind energy consultancies; the current market situation of wind energy consulting in Finland, competitive advantages against foreign competitors entering the Finnish market as well as the future demand of consulting services. The theoretical framework supports the empirical study by discussing the complex processes of establishing wind projects and pointing out the areas where consulting services are typically utilized.

1.3 Outline of the Thesis

The thesis is divided into two main parts; a theoretical framework and an empirical study. Findings and conclusions are discussed in the final chapters of the paper. The theoretical framework gives an overview of the wind energy sector as a whole, giving a foundation on which the empirical study will be based. The empirical study focuses on answering the study problem based on the information and estimations given by the respondents.

The theoretical framework in this thesis will explain the basic assumptions of wind energy and wind power projects. In order to study the consulting market for wind energy, it is necessary to know the basics of the wind energy sector, the economical aspect of the industry as well as the national and international policies that affect it. The wind energy sector and its current situation in Finland is discussed and compared to the wind power capacity in rest of the European Union. The extent to which wind power is being utilized in Finland as well as its potential as a source of energy for Finnish electricity consumption will be analysed. The key players in the wind energy field are identified, and the process of a wind power project is explained throughout. The theory also explains what consultancies are, what they do and what guidelines they follow in their operations.

The empirical study is conducted by interviewing companies with the help of a questionnaire. The respondents are companies that operate in Finland and provide consulting services for wind project developers. The case companies will be referred to with letters A-H. The names of the companies are not revealed due to competition reasons. The findings and conclusions will be presented in the final chapters of the thesis to report and analyze the results of the survey and to find out the value of the study. Possible setbacks and lacks are also analysed and suggestions for further studies will be given.

2 WIND ENERGY IN FINLAND

This chapter explains the concept of wind power in a theoretical level and gives the reader a view of the current market situation of wind power business in Finland. Wind power is not being utilized in Finland as much as in many other European countries, and the field has significant potential for growth. As the thesis focuses on the consulting services for wind power projects, the theoretical framework will explain the planning and implementation phases of a wind power project and points out the areas where consulting is typically needed.

2.1 Wind as an Energy Source in Finland

Wind has been used as an energy source for electricity production in Finland since the early 1990's. The first wind farm for industrial electricity production was set up in Korsnäs in 1991 and it was the size of 4 x 200 kW. Wind power has grown rapidly especially in recent years. At the end of 2014 the number of wind turbines in Finland was 260 (627MW) when in 2013 the number was 211 (448MW) and in 163 (288MW) in year 2012. By the middle of April 2015 there had been published wind power projects for over 11000 megawatts. The share of offshore projects was 2200 MW (STY 2015).

The market share of wind power in Finland is currently divided among twelve wind turbine manufacturers. The leading manufacturer of turbines in the year 2013 was Siemens with a 22,8%. The second largest was Vestas with a 22,3% and third WinwinD with 16,3%. Gamesa amounted to 16,1% of the market and Enercon with a 7,2%. Other manufacturers were Nordex (5,4%), Alstom(4,7%), Huyndai (2,2%), Harakosan(1,3%), Mervento (0,6%) and Sundwind (0,2%) (VTT Wind energy statistics year report, 2013). WinwinD filed for bankruptcy in October 2013 due to heavy losses. (Winwind, 2013).

The current market in Finland is liberalized and is divided into sale of energy and energy transmission. All electricity generators have access to the electricity grids, however there are agreements made on a case by case- basis that define the point of access as well as the strengthening of the lines. The electrical energy is sold to service providers for balance responsibility and the price levels are determined by Nord Pool Spot market. In addition, there are transmission tariffs set by the grid owning organizations.

The level of tariff for 12 years is 83,5€/MWh, according to the law for Feed-in Tariffs for wind energy. There is a kick off bonus of 105,30€/MWh for projects that start producing energy until 2016. The bonus is valid for three years and after that the project will receive the normal tariff for nine years. The feed-in tariff system was implemented in Finland in 2011 and its purpose is to encourage the establishment of wind power projects and to support the electricity production of renewable energy. A feed-in tariff ensures a fixed price for the electricity producer. (Motiva 2014)

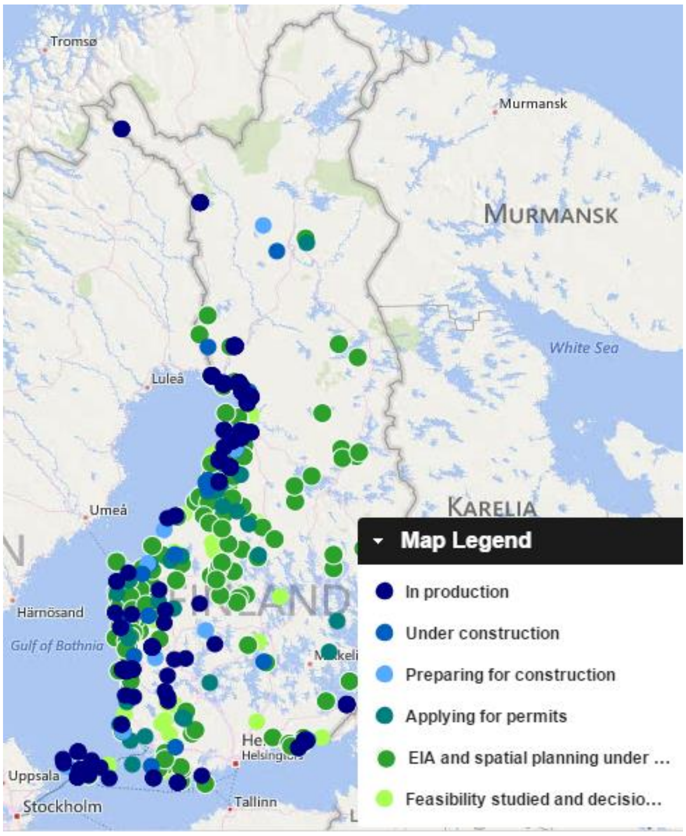


Figure 1. Onshore and Offshore Projects in Finland (STY 2015).

Figures 1 and 2 show the wind power projects in Finland, which are for most part located near the cost. The inland resources are still poorly exploited. The future of wind power in Finland looks promising as it is the energy field that has grown the fastest from the 1990's. The Finnish parliament has agreed on a climate strategy plan that comprises of national goals for renewable energy sources. The target is to increase the number of wind farms in Finland up to 2500 MW (KVA) until the year 2020, which amounts to about 1000 new wind turbines. There is further potential for development of offshore solutions as well as new inland siting.

	ONSHORE		OFFSHORE		Total	
Projects on different stages	MW	No of projects	MW	No of projects	MW	No of projects
7 Under construction	334	14	0	0	**334**	**14**
6 preparing for construction	267	13	12	2	**279**	**15**
5 Applying for permits	1004	42	240	1	**1 244**	**43**
4 EIA approved	913	10	500	4	**1 413**	**14**
4 spatial planning under process	3118	109	1140	7	**4 258**	**116**
3 EIA under process	2065	34	0	0	**2 065**	**34**
2 decision on applying EIA received	700	41	0	0	**700**	**41**
1 feasibility studied	466	10	293	4	**759**	**14**
0 project proposed	245	26	48	1	**293**	**27**
On hold	6	1	0	0	**6**	**1**
Total	**9 118**	**300**	**2 233**	**19**	**11 351**	**319**

Figure 2. Projects on Different Stages (STY 2015).

2.2 Wind Power in the European Union

According to the European Wind Energy Association the amount of installed wind energy capacity within the European Union is 128,8 GW (out of which 120,6 GW onshore and 8 GW offshore). 11791,4 MW of new wind power capacity was installed in 2014 in the EU, an 3,8% increase to the previous year. The installed 128,8 GW (at the end of year 2014) covers 10,2 % of the total electricity consumption within the EU (284 TWh). The EU power sector continues to move away from fossil fuels oil, coal and gas. Germany is the country with largest installed wind energy capacity in the EU, followed by Spain and the UK. Finland's share of the total installed capacity is 0,5%, as seen in figure 3. (EWEA 2015)

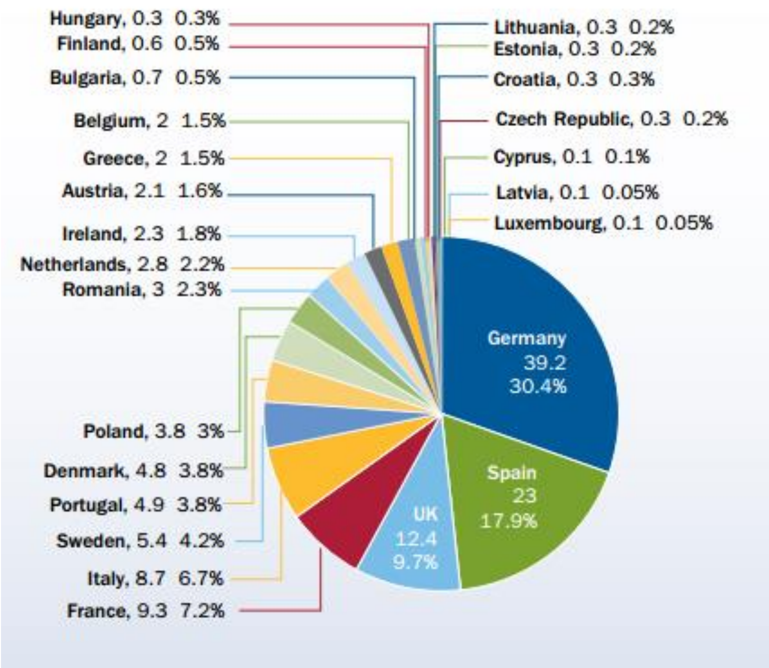


Figure 3. EU Member State Market Shares for Total Installed Capacity (GW). Total 128,8 GW (EWEA 2015).

2.3 Concept of Wind Power

Wind is one of the cleanest sources of energy. Air has a mass, and therefore the wind has a kinetic energy which can be turned into electric power, heat or mechanical work. A wind turbine does the converting of energy to power; the wind causes the turbine to rotate and the turbine turns an axis that is connected to an electrical generator.

The energy content of wind at a specific site is specified in kWh per square meter per year. This is calculated by multiplying the average hourly power per square meter by the number of hours in a year. It is important to differentiate power from energy. Power is energy in a time unit (expressed in watts or KW,MW,GW etc.) and whereas energy is power multiplied by the time the power is produced (kWh).

Electricity consumption depends on the size of a household as well as what type of a building is in question. Tore Wizelius gives the following example of average values of Swedish households in his book:

- A house with electric heating: 20 000kWh/year
- A house without electric heating: 5000kWh/year
- An apartment in apartment building: 2000kWh/year

A wind turbine of 1MW power that produces 2GWh/year can supply energy to:

- 100 houses with electric heating
- 400 houses without electric heating
- 1000 apartments in apartment buildings.

2.4 Wind Turbine Types

There are several types of wind turbines. One typical classification includes Horizontal Axis Wind Turbines (HAWT) and Vertical Axis Wind Turbines (VAWT). The three main types are VAWT Savonius, HAWT towered and VAWT Darrieus, of which the second is the most common turbine type used in Finland.

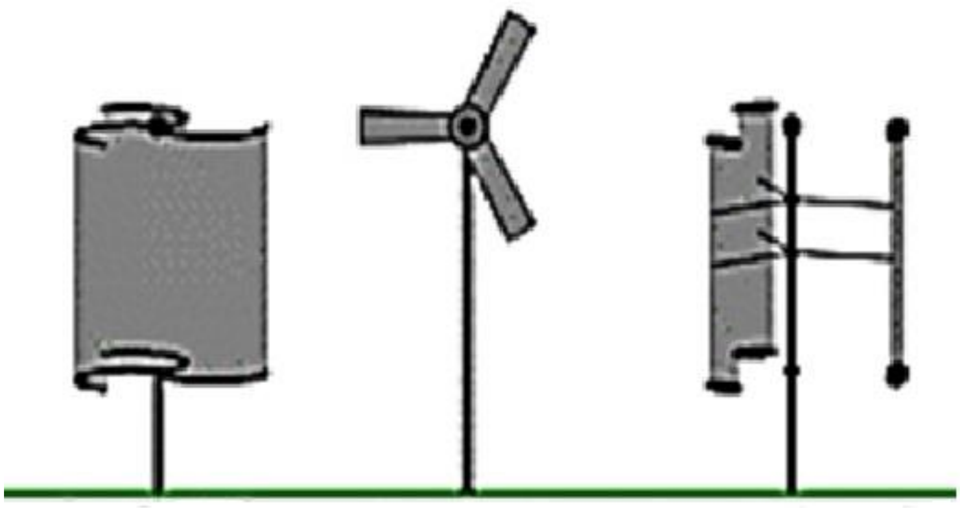


Figure 4. Savonius VAWT, Towered HAWT and Darrieus VAWT.

A typical wind turbine consists of the following main components:

- Foundation
- Tower
- Nacelle (generator, gear box, yaw motor etc.)
- Rotor
- Control system
- Transformer

A wind turbine requires a strong foundation in order for it not to move or tip over in strong winds. Depending on the ground, turbines are either mounted on foundations of reinforced concrete or solid bedrock. Large grid- connected turbines have conical steel towers that are wider at the base than at the top. Turbines can have hub heights of 40-140 meters and therefore the towers are manufactured in sections, which are attached together at site. There is a door at base level and the control system and other electric equipment are installed inside the tower. The nacelle, or the machine cabin, is the unit that is mounted at the top of a wind turbine and it is where the gearbox, generator and other components are placed. The wind turbine rotor consists of blades attached to the hub. Usually the number of blades in one turbine is three however there are turbines with two blades or only one. The market leading turbines have tip speed ratios of 5-7 times faster than wind speed, a three-bladed rotor and rotational speed of 10-30 rounds per minute. Turbine manufacturers typically offer turbine models with different heights and sizes so that they can be tailor made according to the siting. (Wizelius 2007)

2.5 Wind Turbine Siting

One of the most important phases of a project is choosing a suitable location for the wind turbine or wind farm. The process of choosing the best possible site aims at maximizing profits and minimizing overall cost of energy and negative impacts on environment and society. The scope of this process can vary according to the location, but the choosing of a physical site is usually only a small part of the development process. Things to consider include acquiring land rights and permits, power purchase agreements, public support, installation of a wind farm, to name a few.

James Manwell et al. (2009) break down the siting process into five major stages:

1) **Identification of geographic areas needing further study**. Wind atlas or similar data is used to study areas with high average wind speeds. Also the minimum required speed is for each wind turbine model under consideration is assessed.
2) **Selection of candidate sites**. The sites within the area or region of interest that have the most potential are identified. Factors such as wind speed, engineering, terrain and road access, social and cultural issues and visual and noise impacts are closely evaluated.
3) **Preliminary evaluation of candidate sites**. In this stage all the potential candidate sites are ranked according to their economic potential as well as the previously mentioned issues.
4) **Final site evaluation**. A thorough wind resource measurement is conducted for the best candidate sites. The measurements include wind shear and turbulence, speed and wind directions.
5) **Micro siting**. Micro siting means the exact siting and evaluation of energy production of the turbines after the actual site is chosen. This can be using computer programs. The more complex the terrain, the more detailed measurements are needed.

There are issues that might have a negative effect on the suitability of a site and hence need a close assessment. The main factors can be divided as follows:

- Economic issues
- Topographical issues (road access, terrain)
- Legal issues
- Permits

- Geological issues
- Environmental and social issues
- Safety
- Interconnection issues

Different costs are carefully calculated in order to find out the profitability of a project as the main goal is to produce wind power at the lowest possible cost. Costs can be divided into capex (capital expenditures) and opex (operational expenditures). For a wind turbine capex is mainly the cost of the turbine itself and other fixed expenditures whereas opex include the costs of running the site eg. variable costs (Coultate 2012). Cost calculations can also be used to compare different technologies for generation, storage and delivery of energy. A popular method for this purpose is the Levelized Cost of Energy (LCOE), where LCOE (€/MWh) is calculated by dividing total lifetime costs of a turbine by total lifetime energy production.

Difficult road access and slope of the terrain of the considered site makes transportation of manpower and large turbine parts difficult and hence might result in unnecessary costs. The distance to power lines as well as the voltage and current handling capacities of those power lines are to be considered. Legal issues (land ownership or land rental agreements, zoning issues, possible existing land contamination) as well as permits (number of permits needed restrictions and procedures) might cause problems if they are not thoroughly handled in detail. (Manwell et al. 2009)

Geological issues cover the design of the foundation used, possible erosion at the site and ground resistance for lightning protection. The environmental and social issues are mostly related to noise, visual impact and animals such as fish species and birds. Noise caused by rotating turbine blades is episodic (amplitude modulation) and can occur at low frequencies which may be regarded as disturbing. The impact of noise as well as shadows caused by wind farms are always to be assessed on case by case basis. Best thing to do is to make sure that the power plants are installed at a safe distance from populated areas which at the same time reduces safety risks. Estimating the impact of noise with help of modeling programs is a part of the planning process of a wind power project. The visual impact on the environment is equally important and often affects the public acceptance. Wind turbines are large installations which can be seen from a far distance and they might fit better in a landscape where modern man- made buildings already exists, rather than among culturally and historically important land marks.

Wind farms may have a negative impact on bird species in two ways – bird flocks can fly into the blades or building of wind farms may cause negative changes in the living environment of the bird population in a specific area (Motiva 2014). The risk of birds flying into the turbine blades is however much smaller compared to bird deaths caused for example by traffic and power lines. Building offshore wind farms can cause disturbance in the living environments of fish populations and seals.

2.6 Phases of Planning and Implementing a Wind Farm

A Finnish consulting company Pöyry made a research for Oulunkaaren kuntayhtymä in 2010 about wind energy entrepreneurship in Oulunkaari area. The report shows the different phases of a wind power project starting from planning phases to installment and implementation of the wind farm. The process includes

- Acquiring of land
- Preliminary assessment and viability assessment
- Permitting
- Wind measurements
- Land-use planning
- Soil and terrain assessments
- Technical planning of the wind farm and building of infrastructure
- Financing

- Procurement of wind turbines
- Implementation of the wind farm

The planning starts with acquiring of land, which can be bought or rented. The project developer is usually in contact with the land owner well beforehand and the agreements can be signed either in the beginning of the project or after the preliminary planning of turbine siting has been made. In a typical rental agreement of land there are two phases. The first is an agreement during which the developer investigates the suitability of the site for a wind farm. If the project developer decides to build a wind farm on the site, the agreement turns into a production phase which in other words is the actual rental agreement of the land which normally is a temporary contract of 20-50 years.

The rent for the land can be, for example, a fixed yearly fee, a sum related to the production or a part of the profit coming from the selling of electricity. A typical fixed yearly fee per power plant is around a few thousand euros, and it can be paid only to the land owners or also to the land owners of the surrounding lands, which is quite common depending on the case. The project developer is obliged to pay all costs and compensations related to the power plants. In renting of land the Finnish tenancy law (258/66)5. chapter) is applied (Finlex 2015).

The second phase, the preliminary survey (or feasibility study), is done in the beginning of a project in order to get a general overlook of the potential of a certain site. Based on the preliminary survey it is possible to make a decision whether or not to continue the project to the following phase. The content of the feasibility study includes the following details:

- Wind conditions based on data from Wind Atlas
- Initial plan for turbine siting
- An estimation of production
- Initial plan for grid connection
- Initial plan for needed construction work

- an analysis of environmental factors and related permitting
- estimation of investing- and operating costs

2.6.1 Preliminary Assessment and Viability Assessment

Based on the preliminary report it is possible to identify and assess potential risks that may prevent the building of a wind farm and also to avoid making unnecessary investments before it is certain that the project will be carried out. These kinds of preliminary reports are often conducted by consultancies, as they require experts from different fields. The viability assessment is usually done after significant wind measurements have already been made and all permitting is in order. The content of a viability assessment can vary from case to case, however normally the report includes following details:

- A detailed analysis of windiness based on measurements done on site
- A detailed plan of turbine siting
- An analysis of turbine types suitable for the conditions
- An estimation of production including an uncertainty analysis
- A detailed plan of grid connection
- A detailed plan of needed construction work
- A calculation of investment costs based on possible offers
- A calculation of operating costs based on possible offers
- Cash flow calculations
- Risk analysis

The project developer makes the investment decision based on the viability analysis when the profitability and possible risks regarding the project have been recognized. The developer can now also plan the project further on in more detail and introduce the project and its risks to the financers. A well conducted viability analysis reduces uncertainties in the eyes of financers and turbine suppliers. In this way it is possible to get cheaper financing for the project and raise the turbine suppliers' interest in it. Like the preliminary survey, a viability assessment also requires expert knowledge of many different fields and it is often done by consults. (Pöyry 2010).

2.6.2 Permitting

Dealing with different permits is an area where consulting services are especially needed as there are different laws regulating the construction of power plants and also many different institutions involved who issue the permits and whom they are delivered to. The main permits are usually

- Land permit (issued by the municipality)
- YVA consideration (environmental impact assessment conducted by ELY-centre)
- YVA- procedure if required
- Application for environmental permit if required (rarely required in wind power projects)
- Permits according to water law (offshore projects) – (issued by alue-hallintovirasto AVI
- Application for flight obstacle permit (statement issued by Finavia and reported to liikenteen turvallisuusvirasto TraFi)
- Application for construction permit

Other possibly required permits are rental agreement for land use, investigation permit for power line route assessment and a redemption permit (if the construction of power lines needs one), agreement for electric grid connection and other different grid connection permits regarding construction. (Pöyry 2010)

2.6.3 Wind Measurements

The wind conditions at a specific site can be roughly estimated using the Finnish Wind Atlas, which is a great tool for finding potential sites for wind power projects as well as a basis for zoning. It is, however, important to also conduct wind measurements at the chosen site in order to assess the wind conditions as accurately as possible, even in smaller power plants. Accurate wind assessment makes it easier for the project developer and suppliers to make right decisions regarding the viability of the whole project, turbine types and the hub heights.

The wind measurements can be done using anemometers installed in the met mast or with SODAR (Sonic Detection and Ranging) or LIDAR (Light Detection and Ranging) remote sensing technology systems designed to measure wind using sound and light (Lang & McKeogh, 2011). Wind measurements should contain the wind speed at least in three different heights, wind direction, temperature, air pressure and air humidity. The wind speed should preferably be measured at the planned hub height of the turbines and the measurements should last for a minimum of one year so that the seasonal effect on the wind conditions will be minimized (winter season typically being more windy than summer in Finland). If the wind measurements last longer than a year, the yearly deviations can also be minimized. Planning and arrangements for wind measurements are usually made by consultants. The costs related to wind measurements include planning and arranging of the measurements as well as procurement or renting of equipment. The costs may vary depending on the case.

2.6.4 Land- Use Planning

The siting of turbines requires land-use planning and taking into consideration other uses of the area. Assessing the effects on the area and environment is part of the planning process and the land-use planning is usually done simultaneously with the YVA assessment using the same reports and analyses. If the site is located in an area where the land is used also for other purposes (for example houses, ports or industrial areas), the land-use plan has to address issues such as health, safety and landscape aesthetics of that area. The preliminary plan for land use typically takes 6-12 months and final plan 12-24 months. The plan is approved by the municipal council. (Ympäristöministeriö 2012)

2.6.5 Soil and Terrain Assessment

The purpose of assessing the soil and terrain of the site is to gather adequate knowledge for the basis of planning electric stations and roads as well as making cost analyses. General maps of soil and bedrock are used in the programming phase of the researches and the research methods depend on the conditions of the soil in the area. The research is usually done in two phases; researches are conducted in the preliminary planning of the project as well as in the implementing phase.

In the first phase the placement of turbines, fields and roads is planned according to the map and its rough height estimations. The ground conditions of the turbine sites are initially investigated (quality of the soil and bedrock, ground water level) so that the exact turbine sites can be optimized so that they are cheaper to build. Soft areas, such as swamps and other special features that require special actions in order to construct roads, are also mapped out.

In the second phase the specific locations of turbines, roads and fields are planned in more detail with appropriate techniques. With these investigations the ground conditions, especially where the turbine foundations will be built, are assured. Details may be added to the plans for road and field construction.

2.6.6 Technical Planning of a Wind Farm and Building of Infrastructure

Technical planning of a wind farm includes the electric grid and roads as well as foundations and installing areas. All of these are roughly planned in the beginning of the project, and details are added to the plan as the project moves ahead. The phases of technical planning are divided into

- Preliminary planning
- Procurement planning
- Implementation planning

The preliminary planning is done in order to be sure of the profitability of the whole project and for permitting and land-use planning purposes. Choosing the type of grid connection and its costs as well as a list of components that are needed for construction are essential in this phase. In the second phase tenders and specific descriptions and graphs are made based on the preliminary material and some details may be added to the plans. The implementation planning consists of detailed drawings and documents for the foundations for turbines and related buildings. After the implementation planning the overall plans should be ready and clear so that the construction of the wind farm and its infrastructure can begin.

2.6.7 Financing and Key Players in a Wind Power Project

Wind power projects are typically long term projects that require multiple contracts in order to get financing. The projects are also capital intensive and the developer bears the risks and therefore planning is crucial in order for the project to be successful. Some of the prerequisites for a wind power project include a good support system (like a feed-in tariff), a grid connection which is not too expensive and adequate wind resources which make the project financially profitable.

There are several players usually involved in a wind power project besides the developer. These are mainly investors (if there are other sponsors in addition to the developer), banks, contractors, sub-contractors, suppliers, maintenance, states, municipalities and buyers. The bigger the project, the more complex the process gets and it is important to pay attention to details in each stage. Various things affect the financing of wind power projects. The investors require detailed plans on how the project will be carried out, that all documents and permits are in order, an experienced developer in terms of wind power projects, track records of the suppliers etc. (Pöyry 2010)

2.6.8 Public Acceptance and Implementation of the Power Plant

Before the actual building of the wind turbines can start, there is a phase where the surrounding communities and their inhabitants or municipalities may raise an appeal against the decision made by authorities. In these cases the developer may have to wait in worst cases for several years or even end the project completely. Therefore it is important to have the public's support (Wizelius 2007). The public acceptance can be helped by openly communicating with the locals. Before the announcement of the project it can be useful to start discussions with local authorities and land owners. Usually the processes include public announcement and discussion events. After the decision has become unappealable, the implementation of the wind farm starts (STY 2014).

Once the construction is finished and turbines have been installed, there is a final testing phase before they can be connected to the electricity grid. This phase is done in order to know the limits of each turbine in terms of safety and that the turbines operate according to the plan. This final testing normally takes 2-5 days and includes several tests defined by turbine suppliers and standards. When the tests have been done and the turbines are connected to the grid, the wind farm is ready to start its production.

Phases of planning and implementing a wind farm	Examples of tasks carried out by consultants
Acquiring of land	
Preliminary assessment and viability assessment	Feasibility studies
permitting	Applying for permits, managing the permitting process
wind measurements	Wind resource assessment, analysing data, AEP calculations
land-use planning	carrying out a land-use plan
soil and terrain assessments	Assessing ground conditions, optimizing turbine sites, cost calculations
Technical planning and building of turbines and infrastructure	Choosing turbines and grid, planning roads
Financing	
Procurement of wind turbines	Managing the procurement process
Public acceptance	Communicating with the public
Implementation of the wind farm	

Table 2. Phases of Implementing a Wind Farm and Possibilities for Consulting.

3 CONSULTING SERVICES

3.1 Consulting Services in Finland

The Finnish Association of Consulting Firms (SKOL) states in their yearly invoicing statistics from 2013 that the consulting for energy sector amounts to 88,9 MEUR. The whole consulting industry (members of SKOL) amounted to 1500 MEUR of which 1200 MEUR came from domestic and 300 MEUR from foreign operations. SKOL states that their member companies represent two thirds of the whole consulting engineering capacity in Finland. The number of consulting firms in the association is 200 and they employ about 15500 people in Finland. The number of people working abroad for subsidiaries of Finnish-owned firms is around 7000.

The largest consulting company operating in Finland in 2013 according to SKOL was Pöyry Finland with a total invoicing of 152 MEUR. The second largest consultancy was Swecon and FMC Group with 150 MEUR and the third largest was Ramboll Finland with invoicing worth of 118 MEUR. The following market leading companies were Neste Jacobs, Etteplan, Elomatic, Citec, FCG Finnish Consulting Group, Sito and Granlund. The total invoicing of SKOL's member companies in 2013 was 1200 MEUR. (SKOL 2013)

SKOL's economic outlook from the first quarter of the year 2015 shows continuing growth in the consulting field in Finland, both for the domestic market as well as for exporting. Total growth for bookings in the consulting engineering industry compared to the previous quarter was 7% and 18% compared to the same quarter the previous year. Within industrial consulting the number of domestic orders grew by 80% from the previous quarter and 6% from the same quarter last year. The number of export orders in industrial consulting grew by 40% from previous quarter and 17% from the same quarter last year. (SKOL 2015)

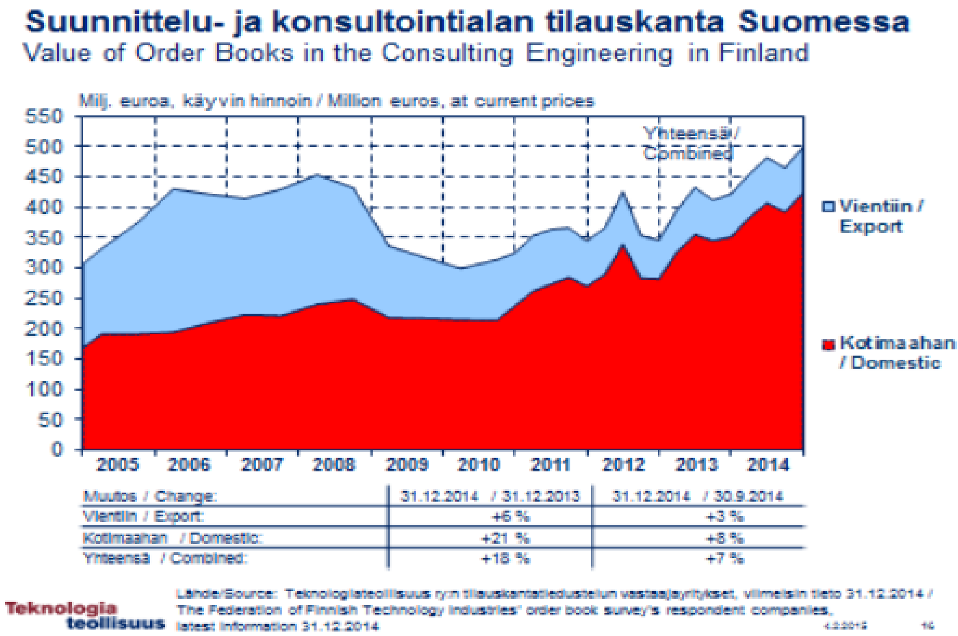


Figure 5. Value of Order Books in the Consulting Engineering in Finland (SKOL 2013).

3.2 General Conditions for Consulting

In a contract between a consultancy and a client the general conditions for consulting (KSE 2013) are applied. The conditions define the obligations and liabilities of both parties, basis for charging, materials and schedules. It also defines how to proceed in case of a dispute, delay and termination of contract. Rights of the parties, validity of documents and governing laws are also stated in the general conditions. These conditions are applied to all assignments between a consultant and a client that include for instance design, product development work, construction, production activities, research, planning, construction and monitoring duties.

3.2.1 Contract

The contract itself should always be as thorough and detailed as possible in order to prevent any disputes. According to the general conditions the contract between a consultant and a client must include at least the object, nature and scope of the assignment as well as the basis for charging, purpose of the object planned and the consultant's status in the performance organization. A written agreement is required in the general conditions. An entry in the confirmed minutes of planning or site meetings is also considered to constitute a written document. A consultant must always inform the client immediately if there are additional researches or changes to be made that has not been specified in the original contract. The client is the only party whom the consultant is allowed to turn to regarding instructions for the assignment.

The contract is always governed by the laws of Finland. All of the documents included in the contract complement each other, however, if there should be any contradictions, the documents have a validity order:

1) Contract
2) Annexes specified in the contract
3) General Conditions for Consulting
4) Task specifications approved by the organizations involved
5) The validity order specified in the contract applies to all other documents

Disputes are solved firstly through negotiations between the client and the consultant. If this does not lead to a solution, the parties may include a third party who will give their expert opinion on the matter. The third option is that the dispute will be solved through arbitration, and finally court of jurisdiction.

The client has a right to terminate the agreement if the project is cancelled, if the consultant closes down his business or if the consultant goes bankrupt. Also if there is a fault such as the consultant failing to complete the assignment within the time frame, if he is incapable of performing the assignment or if he violates the agreement and cannot correct the fault within reasonable time despite a written notice. Respectively the consultant has a right to terminate the contract if the client goes bankrupt or if there are unexpected factors that change the consultant's work, which he could not have anticipated at the signing of the agreement. Also if the client fails to meet his duties defined in the contract such as payment, client neglects his duties or violates the contract or if the client requires the consultant to perform his duties against good technical or professional practice, the consultant may terminate the contract. The General Conditions for Consulting also define rules for compensations for the different above mentioned cases.

3.1.2 Client's Obligations and Liabilities

The client is responsible for providing the consultant the proper documents needed for the fulfilment of the assignment. These include maps, drawings and other basic documentation that is needed. These documents must also be delivered on time and free of charge. The client is liable of managing the project from beginning to end and is entitled to supervise how the assignment is carried out. The client must perform all duties by order of authorities and maintain official contact with outside authorities, institutions and landowners and do it so that it does not cause any delays in the tasks. The consultant is responsible for the above mentioned duties only when agreed in the contract. If the client wants to include additional consultants to perform certain tasks, the consultant has the right to influence their selection.

The client is liable for compensating to the consultant any damage caused by the client's error or negligence. He is also liable for any unavoidable damage that can occur during research and has to inform the consultant immediately if he notices any kind of damages. The client is liable for all instructions that he gives to the consultant and for ensuring that all data is reliable.

3.1.3 Consultant's Obligations and Liabilities

The consultant acts as an expert and therefore he must perform the task that has been agreed upon in a professional manner. Quality, objectivity and good technical practices have to be ensured by the consultant as well as seeing to it that their employees working on the tasks are qualified. The consultant must not be economically or otherwise dependent on any factors that may affect his objectivity. Suppliers, manufacturers or other such factors shall be informed about to the client. The consultant has to co-operate with other consultants that the client has included in the contract, but the consultant cannot use any sub- consultants without the client's permission.

Consultant's responsibility is to make sure that the assignment is done according to the contract and all laws and regulations. If there are any errors, the consultant has the right and obligation to correct them. If the consultant does not do so, the client has the right to hire somebody else to do it at the consultant's expense. Also the consultant compensates for any damage that has resulted from his error or negligence. The consultant is not liable for damages that result from decrease in sales or production or other damages that are difficult to predict. In case of damages to third parties the consultant is liable according to the requirements of enforced laws. Like the client, the consultant also has to inform the other party of any damage that they notice.

The consultant's liabilities last for two years from the delivery of the object or materials. In assignments where the plan is not implemented immediately, the consultant's liabilities expire after five years at latest after the delivery of the materials. However if the performance of the consultant seems to be incomplete or gross negligence occur the consultant is liable for the damages even after five years. The consultant is released from all liabilities after ten years. The client has to demand for compensations without delay and within one year. There are some exceptions stated in the general conditions where the consultant is released from the liabilities, such as if the consultant somehow cannot affect the circumstances. Liability insurances are always separately agreed upon.

3.1.4 Conditions for Charging

Pricing for consultancy services is also defined in the General Conditions for Consulting. The fee paid to the consultant is either remuneration-based or price-based. In other words the fee can be calculated adding together remuneration, special compensations and for example travel expenses, or there can be a fixed sum where all of these are included. There are different remuneration systems that can be used (also a combination of these):

- Lump-sum remuneration which is agreed upon in advance
- Unit-based remuneration, calculated for different units of work
- Time-work remuneration by group of persons, calculated according to hourly or other time-based billing system
- Time-work remuneration based on consultants own costs
- Objective-based remuneration or
- Other specified remuneration, such as listed prices or percent- based remuneration

The remuneration system(s) used, travel costs and any special expenses should always be agreed upon in the contract beforehand. The conditions also contain terms for payments and invoicing.

4 EMPIRICAL STUDY

The aim of the empirical study is to gain an overview of the wind consultancy service branch operating in Finland; how big the market is and what the competitive situation looks like. The services that are offered to the wind project developers as well as the strengths and weaknesses of both Finnish and foreign consultancies are mapped out. The empirical study is based on the views and estimations of the consultancies that took part in the survey.

4.1 Research Methodology

The thesis research about wind energy consultancies in Finland started in the beginning of October 2014. There were no previous studies made on the same subject, so the project started with gathering of related literature, reading of articles and watching of documentaries to get an understanding of the current situation of the wind energy field in Finland. As the data on wind energy is rapidly changing, it was important to get as valid and updated information as possible for the theoretical part of the paper so that it would support the findings of the empirical research.

The empirical study was conducted by interviewing the companies through an online questionnaire. The consultancy companies were first contacted via telephone about the research project, after which the questionnaire was sent to the participants via e-mail. The questionnaire was sent to 11 respondents (out of which 8 companies took part in the survey) in the middle of February 2015. The respondents are Finnish companies or Finnish daughter companies providing consulting services to wind power project developers in Finland.

4.2 Survey Design

The online questionnaire consisted of 17 questions including questions regarding company information. Most of the questions were multiple choice questions with additional comment sections and two open questions that could be answered in

Finnish, Swedish or English. The design of the questionnaire was divided into three parts, the first one dealing with the competitive situation in the Finnish consultancy market, the second with wind resource assessment and the final part with background information about the respective companies.

The questions and the order of the questions were discussed and it was decided that putting the most interesting questions first could have a positive effect on the willingness of the respondents to take part in the survey. Another carrot was to offer all the respondents the possibility to get a summary of the report once finished. The third important thing was to communicate that the anonymity of the companies would be ensured in the report, as the consultancy field in Finland is still quite small. After refining the questions, the final survey form was developed with SurveyMonkey.

4.3 Validity and Reliability

Validity of a research means how accurate and reliable a report is. In a qualitative research validity is measured by the degree to which the findings are interpreted in a correct way and how the researcher has stayed objective in the research. In descriptive research internal validity cannot be evaluated, however what can be evaluated is how well the research design matches the research problem, how the candidates were selected, how the questions were designed and how the data was collected and analysed. It is also possible to analyse the external validity of the research, i.e. how well the study can be generalized to other similar situations outside the study. (Lautamäki 2014.)

The aim of this research paper is to explore the Finnish wind energy consultancy market; to find out what the current market situation looks like and what different kinds of wind energy consulting services there are available for wind energy developers in Finland. The strengths and weaknesses of the domestic consultancies in comparison to their foreign competitors are also discussed. The number of respondents (8/11) can be regarded as good and big enough a sample to give an adequate view of the market in Finland, which is quite small. The research could quite easily be generalized to other industries and companies as there are, for instance, consultancies providing services to branches other than wind energy.

A research is considered reliable if the results can be judged to be the same regardless of who does the research and who the respondents are. For instance, a research cannot be regarded as reliable if the respondent is believed to be giving only answers that their superior would appreciate. In qualitative research, reliability can be best ensured when the researcher writes notes about everything (time and place observations etc.). It is also useful to have another researcher analyse the results and compare their findings with your own. (Lautamäki 2014.)

In this research reliability was ensured by keeping an objective mind and writing down all the answers that the respondents gave in detail and not changing anything. The survey was done through a questionnaire which was sent through e-mail. A face-to-face interview could possibly have given more detailed and thorough answers which would have given more to the research, as the answers that the questionnaire generated were mostly short. A questionnaire, on the other hand, was more likely to give more answers as it is less time consuming and easier for the respondents to respond to. The respondents' names were promised to be kept anonymous throughout the research which hopefully resulted in honest answers from the respondents and thus in a reliable analysis.

5 RESULTS AND ANALYSIS OF THE EMPIRICAL STUDY

This chapter discusses the estimations and views of the responding companies regarding the wind energy consulting field. The chapter is divided into three sections. Background information describes the size of the companies as well as the scope of the services that they offer. The second chapter discusses the views of the respondents regarding the current market situation of wind energy consulting in Finland, and the third chapter focuses on the wind resource assessment and what procedures and technologies are being used.

5.1 Background Information

The background information section includes five questions aiming to map out the size of the company, how many years they have been providing consulting services to wind energy project developers, to what extent they provide services for the developers and what they believe is their approximate share of the current wind energy consulting market in Finland. The questions in the survey were multiple choice questions with a possibility to mark several alternatives or to skip a question. There is very little correlation between the number of years the companies have been in the business, how many people are involved with wind energy in the company and if the companies are doing business solely within the wind energy sector or within several branches. The companies' estimations about their own market share in the wind energy consulting field, however, correlate with the amount of experience in years and the number of people involved in wind energy consulting.

To the first background question "Which of the following statements describes your company the best?" Two companies who chose alternative a) "Our company is only doing business within the wind industry". Three companies chose alternative b) which was "Our company is providing services to many branches and wind consulting is just one sector of our activities" and other three companies chose the alternative c) "Our company focuses mostly on wind industry, but we provide services to other branches to some extent”. Most companies were, thus, involved with several branches including wind energy.

All of the respondents have several years of experience of wind energy consulting, as four companies answered over seven years and three companies answered 4-6 years. One company marked the alternative “less than one year”, however this question does not show the fact that the company in question has only recently started doing business in the Finnish market and has in fact had operations abroad for several years. To the question 15: “How many people in your company are currently involved with wind energy consulting?” three companies marked alternative a) 1-4 persons, two marked alternative b) 5-10 persons and two companies marked alternative d) over 20 persons.

The respondents’ own estimations on their market share within wind energy consulting services in Finland were all 30% or less of the total market. Two companies estimated their market share to be between 20%-30% of the whole market, two estimated their market share to be at 10-20% and three companies marked the option “less than 10%”. One of the respondents chose to skip the question. What can be noted from this question is that the two respondents who had the highest estimation on their share of the current market (20%-30% of total) were the ones with the highest number of persons involved (over 20 persons) with wind energy consulting in their company.

This part of the study shows that the market is still young and that the companies do not have comprehensive knowledge of the market. Almost all companies estimated their share of business to be higher than the actual percentage, which can be seen both from the total percentage and the rough estimations of the size of the market as a whole. Also differences in company sizes and scope of service portfolios indicate that the companies are not observing the market and the competitors.

5.2 Services

The scope of the services provided to wind energy developers by the responding consultancies varied quite a lot. Approximately half of the respondents had an extensive list of services available for the customer whereas the other half focused on 2-5 selected services. The following list and table map out the different services that each of the respondents specializes in. The companies are referred to in letters A-H.

Company A:

- Feasibility studies
- Implementing the permitting process
- Managing and speeding up the permitting process
- Applying for permits
- Wind resource assessment services

Company B:

- Feasibility studies
- Wind resource assessment services

Company C:

- Feasibility studies
- Implementing the permitting process
- Managing and speeding up the permitting process
- Applying for permits
- Financial analysis
- Bankability analysis
- Procurement services
- Planning grid connection
- Assisting with sale of electricity

- Wind resource assessment services

Company D:

- Feasibility studies
- Implementing the permitting process
- Applying for permits
- Financial analysis
- Procurement services
- Planning grid connection
- Applying for feed-in tariff
- Wind resource assessment services

Company E:

- Feasibility studies
- Implementing the permitting process
- Bankability analysis
- Wind resource assessment services

Company F:

- Financial analysis
- Bankability analysis
- Applying for feed-in tariff
- Wind resource assessment services

Company G:

- Feasibility studies
- Managing and speeding up the permitting process
- Applying for permits
- Financial analysis

- Bankability analysis
- Procurement services
- Applying for feed-in tariff
- Wind resource assessment services

Company H:

- Feasibility studies
- Implementing the permitting process
- Managing and speeding up the permitting process
- Applying for permits
- Bankability analysis
- Procurement services
- Planning grid connection
- Assisting with the sale of electricity
- Applying for feed-in tariff

Type of service	A	B	C	D	E	F	G	H	**Total**
Feasibility studies	X	X	X	X	X		X	X	**7**
Implementing the permitting process	X		X	X	X			X	**5**
Managing and speeding up the permitting process	X		X				X	X	**4**
Applying for permits	X		X	X			X	X	**5**
Financial analysis			X	X		X	X		**4**
Bankability analysis			X		X	X	X	X	**5**
Procurement services			X	X			X	X	**4**
Planning grid connection			X	X				X	**3**
Assisting with sale of electricity			X					X	**2**
Applying for feed-in tariff				X		X	X	X	**4**
Wind resource assessment services	X	X	X	X	X	X	X		**7**
Other									
Total	**4**	**2**	**10**	**8**	**4**	**4**	**8**	**9**	

Table 2. Companies A-H and Types of Services Provided by the Respondents.

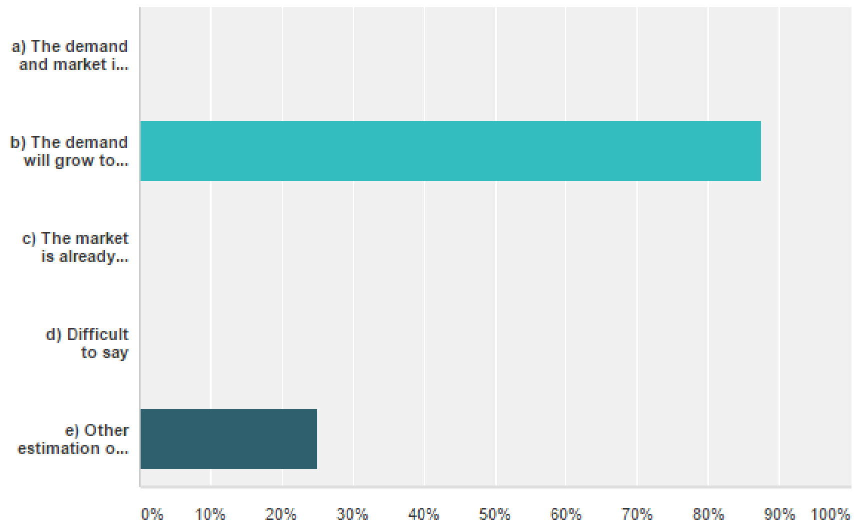
Table 1 shows all the service options listed in the questionnaire and the responding companies from A to H. The respondents were asked to mark all the options that represent the types of services that their company is providing to wind project developers. As seen from the table almost all companies are providing feasibility studies (7/8) and wind resource assessment services (7/8). Implementing and managing the permitting process as well as the application of permits were also commonly provided services amongst the respondents. Grid connection planning (3/8) and assisting with the sale of electricity (2/8) were not that commonly offered by the respondents. No additional services were mentioned apart from the alternatives mentioned on the list. The scope of services provided also differs between the companies, company C offering ten different services and company B only two.

5.3 Competitive Situation in the Finnish Wind Consulting Market

In this part of the study it is important to note that the estimations about the whole wind energy market, including the consulting companies, is concentrated on the time period from here on to the year 2020, which is the deadline for the wind energy targets set by the Finnish government. What happens after that is much dependent upon political will and what goals are set for the time that follows the year 2020. There has been political criticism in Finland concerning the viability of wind power against other energy forms, even though the LCOE calculations show that wind power is a competitive form of energy technology.

The approximate yearly turnover of the Finnish consultancy market for wind energy was one of the questions where the companies' estimations varied a lot from one another. The answers ranged from 2 MEUR/y to 50 MEUR/y. One respondent gave an estimation of 2-4 MEUR/y, three companies assumed the turnover to be 10-15 MEUR/y and two companies gave an estimation of 30-50 MEUR/y. It can be seen from the answers is that the yearly turnover is not well defined and known by the market. A couple of the respondents clarified that the turnover is very hard to define and that their answer was a rough estimation. Two respondents chose not to answer the question.

The companies were unanimous about what the future demand for consulting services for wind energy is going to be. The demand is seen as growing to some extent, however, it is much likely to decline after a few years. Some of the respondents mentioned the uncertainty of what targets will be set for the time after 2020 as a reason and that the development of the whole wind energy industry in Finland is highly dependent on the political will of the Finnish government.



Vastausvaihtoehdot		Vastaukset	
a) The demand and market is growing consistently and no decline is in sight		0,00%	0
b) The demand will grow to some extent, but will decline after a couple of years		87,50%	7
c) The market is already quite saturated and will therefore decline in near future		0,00%	0
d) Difficult to say		0,00%	0
e) Other estimation of development	Vastaukset	25,00%	2
Vastaajat yhteensä: 8			

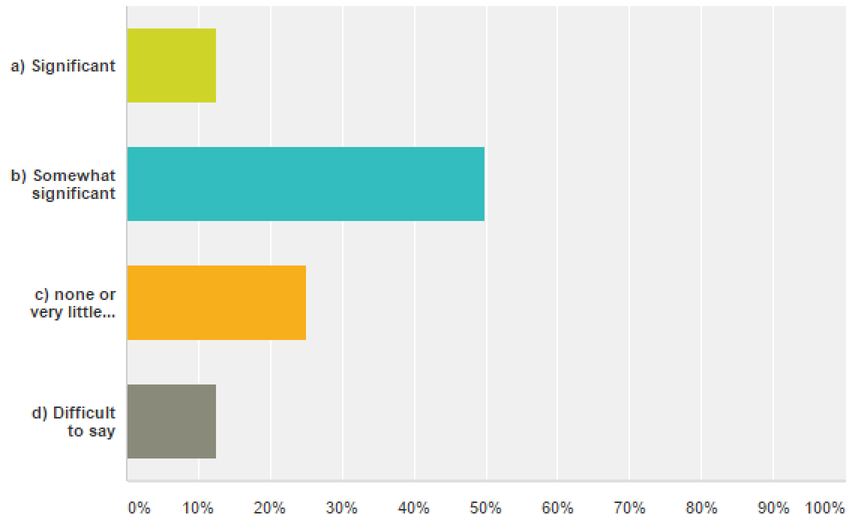
Figure 6. Demand for Consulting Within the Wind Industry.

Price level of consultancy services was estimated to remain on the same level or possibly decrease in the future. None of the respondents believed that the prices would increase. To the question about whether or not the respondents see any difference in the current price levels between the domestic and foreign consultancy services the answers were also quite consistent. Four companies were of the opinion that the price levels are approximately on the same level with some shifts to both sides. Three companies believed that the foreign consultancy providers are more expensive compared to the domestic ones. One company added that the foreign services are generally more expensive but that there are some pricing differences between services.

The companies were also asked how much and in what way they believe that foreign consultancies will influence the current wind energy consultancy market in Finland. Most of the respondents believed the foreign consultancies entering the Finnish market to have at least some impact. One company believed that the impact on the market will be significant and four companies somewhat significant. Company A added that for now the domestic consultancies hold a better market position in Finland compared to the foreign ones, however there are foreign organizations that finance and build projects but have Finnish companies to do the zoning and measuring for them. Also, international companies tend to have their own companies operating and managing the projects in Finland. Two companies estimated that the foreign consultancies will have no or very little impact on the market. One respondent answered that the impact is difficult to estimate.

When it comes to differences between the domestic service providers and their foreign counterparts the key issue was not so much quality but experience. According to the respondents' opinions foreign consultancies in general have more experience and longer reference lists than the Finnish ones, which is no surprise as the wind industry as a whole is significantly younger compared to the rest of Europe. One respondent mentioned that banks often require a certain foreign brand even though there is no actual difference in quality.

Some challenges the domestic consultancy firms face are the lack of experience compared to foreign consultancies, narrow knowledge in the foreign markets and thus difficulties in expanding their businesses abroad. Low profits were mentioned by many respondents in their answers. Most of the companies agreed that because the wind industry is still young in Finland and the Finnish consultancies have relatively short experience in the field it can be difficult for them to compete with foreign service providers. The foreign consultancies often have longer reference lists and deeper knowledge of the field.



Vastausvaihtoehdot	Vastaukset	
a) Significant	12,50%	1
b) Somewhat significant	50,00%	4
c) none or very little impact on the market	25,00%	2
d) Difficult to say	12,50%	1
Vastaajat yhteensä: 8		

Figure 7. The Impact of Foreign Consultancies in the Finnish Market.

Entering foreign markets was seen as a challenge for the Finnish consultancies. One of the companies mentioned that knowledge about the international financing sector and quality standards is important which at the moment the Finnish companies mostly still lack. Overall knowledge on the wind industry abroad could also be more enhanced since the knowledge seems to be limited to local market only. It can be assumed that price is the key competitive advantage that the domestic consultancies have at the moment however some of the respondents saw price both as strength and a weakness. A few respondents were still positive about the

Finnish consultancies catching up with their foreign competitors in terms of experience and expertise.

In addition to price, know-how was said to be strength of the Finnish consultancies. Finland is well known internationally for producing top quality products and services in many branches, and this can be seen as a good marketing point in wind energy consulting as well. When talking about the Finnish wind energy market, many of the respondents stated that the Finnish consultancies have more profound idea of the local conditions than the foreign companies.

Knowing the environmental factors, local legislation and the local ways of doing projects are vital for a company to succeed in the Finnish market according to the respondents. One company specified that knowing the local conditions is especially important as we live and operate in a country where the weather conditions vary quite a lot. Weather conditions have a huge impact on the power plant operations especially in winter conditions. Knowing the local customers and their needs as well as having good networks was also one competitive advantage that the Finnish consultancies often have when competing against foreign ones. Also the Finnish language, which was mentioned by many of the respondents, plays a big role in reaching customers.

5.4 Wind Resource Assessment

There were three questions limited to the wind resource assessment services that the consultancies provide for wind project developers. The questions were intended for figuring out with what methods the wind measurements are done, how the measurement data is analysed and what kind of reference data are utilized for the annual energy production calculations. One company skipped these questions as they do not provide wind resource assessment services.

Company A answered that they usually use either mast measurements only, or both mast and Sodar measurements on the same site. Normally the financing parties in the projects define the level of wind measurements that is needed. Sometimes Sodar measurements are enough if the wind energy project is certainly viable. The wind data that is measured is analysed mostly by using the WAsP software, which is a standard PC-software for bankable wind resource assessment and siting of wind turbines and wind farms. The respondent mentioned that they also use other linear model software however they did not specify which. For the energy production calculations they use materials that are suitable for each case and depending on the customer’s choice.

Company B uses either mast and Sodar measurements or mast and Lidar measurements on the same site. In analysing the wind measurement data the company uses WAsP and WindPRO (a wind energy software to model wind farms). The company also uses a CFD (Computational Fluid Dynamics) modelling software called Meteodyn. The annual energy production calculations are done using both true measurements and satellite data or by using NASA climate observation system MERRA (Modern Era Retrospective-Analysis for Research and Applications).

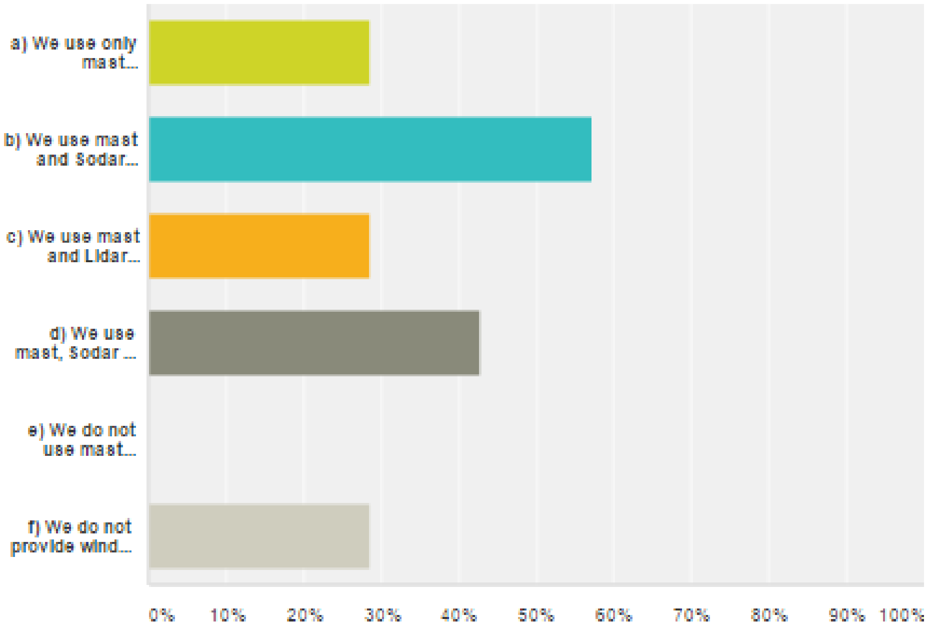
Company C also stated that their wind measurement techniques and tools are always case specific. Sometimes only mast measurement is enough to assess the wind. Other times the company can use both mast and Sodar measurements, mast and Lidar, or all three on the same site. For the measurement data analysis WasP and WindPRO are often used, as well as WindSim, which is a CFD utilizing software concentrated on wind farm design and wind resource and energy assessment. For the annual energy production calculations the company only uses true measurements of nearby locations; reference databases that are approved and well known by the international banks and investors.

Company D does wind measurements by using mast and Sodar measurements on the same site. WAsP software is used for analysing the measurement data, and satellite data from databases is used for annual energy production calculations. The respondent did not specify the database(s) that they use for the calculations.

Company E stated that they do not provide wind measurement services, but that the client commissions the wind measurements from somewhere else and then provides the data to company E. Company E does the analysis based on the data provided by the client by using their own CFD software. The reference data that the company uses for AEP calculations is Vortex.

Company F uses mast, Sodar and Lidar measurements on the sites. They also have their own, Microsoft Excel- based analysing model for analysing the wind measurement data. The company calculates the annual energy production of the project by utilizing the coast windmills data as their reference wind data.

Company G also uses mast, Sodar and Lidar measurements on the same site. WAsP and WindPRO systems are used for analysing the data, as well as another linear model called AWS Openwind which is also a software for wind developers that helps in designing, analysing and optimizing wind power projects. Company G uses both true measurements and satellite data for the annual energy production calculations.



Vastausvaihtoehdot	Vastaukset	
a) We use only mast measurements	28,57%	2
b) We use mast and Sodar measurements on the same site	57,14%	4
c) We use mast and Lidar measurements on the same site	28,57%	2
d) We use mast, Sodar and Lidar measurements on the same site	42,86%	3
e) We do not use mast measurement at all and rely totally on Sodar and/or Lidar	0,00%	0
f) We do not provide wind resource assessment services	28,57%	2
Vastaajat yhteensä: 7		

Figure 8. Technologies Used in Wind Measurements.

6 CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

The aim of this research paper was to study wind energy consulting in Finland and to find out what kind of different services are provided for wind project developers and what the current market situation looks like. The focus of the theory was wind energy projects and the process of how they are established and implemented, the procedures and technologies that are used in planning a wind farm. The theory also explains the consultancy industry in Finland and rules and regulations that govern it. The empirical study was done by sending a questionnaire to Finnish consultancies that provide wind consulting.

The wind energy is a growing industry in Finland however as both the theory and the answers from the respondents suggest that a lot is tied to the political will of the Finnish government and what goals are set after the year 2020. Most of the companies had also other branches that they offer services to in addition to wind power project developers. The respondents were asked how they perceive foreign competitors that are entering the Finnish consultancy market and what are the strengths and weaknesses of the domestic consultancies in comparison to their foreign counterparts. The common opinions were that the foreign consultancies generally are more experienced and have longer reference lists than the Finnish consultancies however the Finnish companies have stronger knowledge concerning the local weather conditions, legislation and customers.

The Finnish language is a factor that the respondents believe to play an important part in doing business in Finland. Another difference was that the price level of the Finnish wind energy consultancy services appears to be lower compared to the foreign consultancies with some exceptions. This can be assumed to relate to the foreign consultancies having more experience in the field and a competitive advantage for the Finnish companies in a bidding situation. The respondents did not see much difference between domestic and foreign consultancies in terms of competence and know-how however the lack of experience in some cases shows in inconsistent processes.

The study shows that the Finnish consulting market is still young and that the companies do not have extensive knowledge of the market. Almost all companies estimated their share of business to be higher than the actual percentage, which can be seen both from the total percentage and the rough estimations of the size of the market as a whole. Also differences in company sizes and scope of service portfolios indicate that the companies are not observing the market and the competitors as much as they should.

The questionnaire was sent out to 11 consultancies out of which 8 responded to the questions. The number of respondents was thus good enough to give a reliable overlook on wind energy consulting in Finland. Overall the questionnaire can be regarded as successful as it gave comprehensive answers. However, one respondent mentioned that there survey could have been longer. In some parts it is clear that there could have been additional questions that could have given longer answers and helped to open up the subject more.

Regarding the future demand for wind consulting services the common estimation was that the demand will continue to grow to some extent but possibly decline after a couple of years. Also, the price level of the services was estimated to remain on the same level. Some of the questions and estimations on future development were tied to the wind power objectives set for the year 2020 as it is difficult to know what will happen after new objectives have been set. Therefore, it is possible to get an estimation of future development only for the near future. Conducting a similar survey in a few years could possibly give totally different answers. The overall attitudes regarding the future prospects of the market sound positive.

There many are ways to study this subject further. For example the pricing levers in the consulting field, how the companies value their services and which remuneration systems they use could be an interesting subject. Also the service processes could be compared to European consultancies which in general are more experienced and in that way point out areas of improvement in the Finnish consulting services. Finally, mapping out the challenges and opportunities of entering foreign markets might be useful for Finnish companies as it may be a relevant question in the near future.

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ONLINE QUESTIONNAIRE

Wind Energy Consultancies in Finland

Competitive Situation in the Finnish Consultancy Market

1. How much do you believe is the approximate yearly turnover of the whole wind energy consultancy market in Finland?

2. How do you see the future demand of consulting services?

a) The demand and market is growing consistently and no decline is in sight

b) The demand will grow to some extent, but will decline after a couple of years

c) The market is already quite saturated and will therefore decline in near future

d) Difficult to say

e) Other estimation of development:

3. How do you see that foreign companies are going to influence the current market of wind energy consultancies in Finland?

The influence of foreign companies will be

a) Significant

b) Somewhat significant

c) no or very little impact on the market

d) Difficult to say

Additional comments:

4. How do you see that the price level of consultancy services will develop in the future?

a) The prices will increase

b) The prices will remain on the same level

c) The prices will decrease

d) Difficult to say

5. Do you see any difference in current price levels between the Finnish and foreign consultancy services?

a) The foreign consultancy providers are more expensive compared to the domestic ones

b) The prices are approximately on the same level

c) The prices of Finnish consultancy services are higher than foreign ones

d) Difficult to say

Additional comments:

6. What kind of differences do you see between the Finnish and foreign providers of wind consultancy services?

7. If you compare Finnish consultancy companies with foreign ones, what do you consider to be the strengths of the Finnish consultancy companies?

8. If you compare Finnish consultancy companies with foreign ones, what do you consider to be the weaknesses of the Finnish consultancy companies?

Wind Resource Assessment

9. If you provide wind resource assessment services, how do you measure the wind?

a) We use only mast measurements

b) We use mast and Sodar measurements on the same site

c) We use mast and Lidar measurements on the same site

d) We use mast, Sodar and Lidar measurements on the same site

e) We do not use mast measurement at all and rely totally on Sodar and/or Lidar

f) We do not provide wind resource assessment services

Other (please specify)

10. How do you analyse the measurement data? (several alternatives can be marked)

a) We use WAsP

b) We use WAsP and Wind Pro

c) We use a linear model other than WAsP (please specify in the comment section below)

d) We use CFD modelling (please specify the software in the comment section below)

Additional comments:

11. What kind of reference wind data do you use for the annual energy production calculations?

a) We use only true measurements of a nearby location (airports etc.)

b) We use only satellite data from databases (please specify the database in the comment section below)

c) We use both true measurements and satellite data

d) Other (please specify in the comment section below)

Additional comments:

Background Information about Your Company

12. Which of the following statements describes your company the best?

a) Our company is doing business only within the wind industry

b) Our company is providing services to many branches and wind consultancies are just one sector of our activities

c) Our company focuses mostly on wind industry, but we provide services to other branches to some extent

Additional comments:

13. How many people in your company are currently involved with wind energy consulting?

a) 1-4 persons

b) 5 -10 persons

c) 10 – 20 persons

d) Over 20 persons

Additional comments:

14. For how long has your company provided consulting for wind project developers?

a) Less than one year

b) 1-3 years

c) 4 -6 years

d) Over 7 years

15. Which of the following services do you provide to the developer concerning planning the project? (Several alternatives can be marked)

a) Feasibility studies

b) Implementing the permitting process

c) Managing and speeding-up the permitting process

d) Applying for permits

e) Financial analysis

f) Bankability analysis

g) Procurement services

h) Planning grid connection

i) Assisting with the sale of electricity

j) Applying for Feed in- tariff

k) Wind resource assessment services

Other (please specify)

16. How large do you believe is your approximate share of the current wind energy consultancy market in Finland?

a) less than 10%

b) 10%-20%

c) 20%-30%

d) 30%-40%

e) 40%-50%

f) 50%-60%

g) 60%-70%

h) More than 70%

i) Difficult to say

17. Additional comments/feedback related to the survey questions:

18. The e-mail address where a summary of the report can be delivered: