WIND, A STRATEGIC DIRECTION FOR XANTREX

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ABSTRACT

Xantrex Technology Inc has grown in sales by acquiring complementary firms in power electronics. A key market focus for the firm is distributed power. Wind generation is an important segment of the distributed power market, and suppliers must compete in this segment to be considered seriously. The wind turbine market has gone through many boom and bust cycles over the last twenty years. Due to this cyclic demand, strategies must be continually reviewed to ensure they address the needs of the market. Xantrex needs to determine the effectiveness of its current strategic plan in the wind converter business as a supplier to the wind turbine market.

This project is an analysis of the wind converter business at Xantrex and a determination of what strategy will be effective. The external analysis methodology consists of a review of the forecasted market trends, and a Porter Five Forces Industry Analysis, which determines the market attractiveness and challenges. An internal analysis of Xantrex is performed utilizing a generic "Fit" model analysis of the firm's fit with cost vs. differentiation generic strategies, followed by a value chain assessment, which is summarized into competencies and challenges facing Xantrex. Xantrex's current strategy along with the internal and external environments is synthesized through a fulcrum analysis and strategic alternatives for Xantrex are generated.

The results of the internal and external strategic analysis indicate that the wind business will be attractive in the long term but that the current strategy will not bring the penetration and profits Xantrex seeks in this market. A change in strategy is needed to turn around Xantrex's competitive position in the market. The analysis recommends that Xantrex should forward integrate into the value chain, which entails providing an integrated drive train solution for the wind turbine generator manufacturers. This can be achieved by strategic acquisitions of firms in the drives and generator businesses. These can be integrated into a new business unit at Xantrex in the next 6 to 12 months, to align with the current development cycles of next generation wind turbine generators.

DEDICATION

I would like to dedicate this work to my wife Sharon, without her support, I would not have been able to complete this program; and I would also dedicate this work to my son Grayson and daughter Natalie who have allowed me to give up some family time to complete this project.

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1.1 Project Background

1.1.1 Rationale for the Analysis

Xantrex Technology Inc. is a publicly owned company that develops, manufactures, and markets leading advanced power electronic and control products for distributed, mobile, and programmable power markets. Xantrex products in the renewable and distributed power market are used in solutions such as solar systems, wind turbines generators, micro turbines and fuel cells; backup power for homes, small businesses, and traffic lights during electric grid disruptions. In the mobile power market, the products provide auxiliary electricity in boats, recreational vehicles, heavy-duty trucks, cars, and portable power products. In the programmable power market, the products are used to develop and test electronic equipment and power precision equipment such as semi-conductor manufacturing and medical equipment. Over the last five years, Xantrex has increased its revenue from $15M (US) to $134M US.

In 2001, Xantrex revisited its strategic plan to ensure the direction and plan used to expand its markets and business was still valid. A focus as an outcome of the planning process was to change from a component supplier to a systems solution provider. Xantrex believed this would be a key differentiator and value driver to set it apart in the markets in which it competes. Xantrex's proven technological capability and system solution strategic position it to realize this opportunity in the wind business.

A major growth area for Xantrex in 2003 was the wind converter business, which grew to $19.8M US in Xantrex sales principally through a partnership with General Electric (GE) Wind. This market has been a strategic growth market as Xantrex has key wind converter technology, with over 1800 wind converters deployed and 20 years experience in the market. The global wind generation market has grown from a hand-full of units in 1983 to 40,000 megawatts (MW) units in 2003, with high growth starting in 1995. A driver to this growth has been the continual

reduction of the cost of generation along with government subsidies to make wind generation a competitive substitute to thermal and hydroelectric electricity generation.[1]

1.1.2 Issue At Hand

Xantrex has not made any strategic investments in the wind converter business over the last three years. This market has high growth and margin potential and is forecast to have double-digit growth on average over the next five years.[2] The market has been changing by the consolidation of wind turbine manufacturers, larger wind turbines being developed and the variability of government incentives. In order to increase penetration in this market, a strategy to utilize its technological capacity as a systems solution provider may need to be developed. The goal of this paper is to provide an assessment of the current strategy's ability to continue to address this market or to develop an alternate strategy to increase Xantrex's position in the market over the next three to five years. Xantrex has the capabilities to succeed in this market but needs the right strategy.

1.1.3 Strategic Issues

A strategic analysis of the wind generation market coupled with a detailed internal analysis will provide a framework to develop a clear strategy to increase market penetration. The specific strategic issues are:

1. **Should Xantrex continue its business in wind converters?** It must be determined whether Xantrex can be successful in the wind converter business. With the industry consolidation of wind turbine generator manufacturers, the majority of market in Europe and the continued threat of the captive market increasing, one wonders whether there will be enough space in the merchant market for four competitors.

2. **Should Xantrex continue to partner with other drive train component suppliers to increase penetration?** Xantrex is currently providing control technology with Winergy and Loher Energy to provide wind turbine drive trains, as well as provides printed circuit control

[1] Comparative Cost of Wind and Other Energy Sources, American Wind Energy Association. Retrieved May 10, 2004, from http://www.awea.org/newsroom
[2] BTM Consult ApS, World Market Update 2003, Preface

cards for the Loher wind converters. Xantrex needs to determine if there are long term benefits to being a sub-supplier.

3. **Can Xantrex afford to subsidize this business during valleys of demand?** The wind converter business has been very cyclic in nature due to reliance on government subsidies, which enable electricity producers a guaranteed return for the investment in generation investments. There are years where demand has been virtually zero and as high as 500 units. Xantrex needs to determine if the product can support high margins and enable Xantrex to have working capital to sustain the business during low cycles of demand.

1.2 Strategy Development Process

This strategic analysis paper is to focus on an analysis of Xantrex capabilities and potential to penetrate the market, analyze the growth and market attractiveness, and deliver a recommended strategy to pursue. This process is done in the follow steps:

Section 2, "Analysis of Wind Converter Market", contains a detailed discussion of the market by segment, geography, and growth potential. As part of the market analysis the impacts of intellectual property (IP), Grid interconnect regulations, and wind converter size segmentation is discussed. The chapter concludes with a summary of market challenges the industry faces.

Section 3, "Industry Attractiveness", develops a Porter Five Forces Model. Research for the analysis was through trade magazines, the Internet, industry associations, and company knowledge. The conclusion of the chapter is the "why" Xantrex feels this is an attractive market they should continue to pursue.

Section 4, "Analysis of Xantrex Capabilities to Address the Wind Converter Market", consists of the current wind converter strategy. A strategic fit assessment is conducted to see how suitable Xantrex organization "fits" to its differentiation strategy.

Section 5 " Xantrex Value Chain" develops a value chain analysis of Xantrex is developed, with a description of the Xantrex value chain. Gaps in the value chain are discussed and recommendations are detailed.

Section 6 "Organizational Structure and Culture" consists of a review of the current Xantrex culture and contrasts it with the desired Xantrex culture.

Section 7 "Financial Analysis", presents and analyzes a model for the project income statement, cash flow, and balance sheet.

Section 8 "Core Competencies and Competitive Advantages" consists of a list of Xantrex competencies and advantages is developed based on the internal analysis. The end of the chapter summarizes challenges facing Xantrex as it moves forward.

Section 9, "Wind Strategy Assessment" discusses and analyzes the status quo using a fulcrum analysis. Three alternatives to the status quo are presented and supported. A strategy is selected and an implementation plan with implementation concerns developed.

Section 10, "Recommendations and Summary" answers the strategic questions in **Section 1,** and a summary of the analysis and recommendations.

1.3 Company History

Xantrex Technology Inc. was formed in 1983 with a focus on providing power electronic equipment to the test and measurement market. As Xantrex business grew, the company developed a reputation for providing technically advanced, high quality, reliable products. In late 1998 and early 1999, Xantrex developed a strategy for growth focusing on its core competence in advanced power electronics technology. Xantrex chose to concentrate on the rapidly growing markets for distributed, mobile and programmable power and to focus on power levels less than one megawatt. Xantrex chose this specific focus on markets and power levels to create a strong, defendable market position for the company. The company planned to implement its strategy initially by acquiring businesses that clearly fit the criteria in terms of technology, products, and market leadership until Xantrex had the critical mass to grow internally. To finance the acquisitions and to invest in the growth strategy, Xantrex raised over $110 million Canadian in equity between October 1999 and June 2001, mainly from institutional investors in Canada, the United States, and Europe. In late 1999 and early 2000, Xantrex acquired Statpower Technologies Corporation, Trace Holdings, LLC and its two operating divisions, Trace Engineering and Trace Technologies, Heart Interface Corporation and Cruising Equipment Company, each of which was

well established and had leading technology, products and positions in markets that corresponded to the target markets. Since completing these acquisitions, Xantrex has successfully integrated all of these businesses into Xantrex, establishing itself as a market leader and creating the critical mass that enables it to grow its business internally. The integration included developing a strategic plan for operations and restructuring the organization and management team to create a single business focused on its customers and markets. Xantrex also rationalized product lines and brands and implemented new operating processes and systems to support the growth strategy.

1.4 Xantrex Mission

"Xantrex creates leading advanced power electronic products by combining proven technology with unparalleled market understanding to bring you electricity anytime, anywhere."

1.5 Products and Markets

In order to get a complete picture of Xantrex and its market scope, the products Xantrex designs and produces, as well as the markets it chooses to compete in are described in this section. This will provide context to some of the challenges and opportunities Xantrex faces.

1.5.1 Products

Xantrex develops and markets products tailored to each market segment in which it competes. In the mobile market, Xantrex sells inverters, inverter chargers, battery integrated products, chargers, and power instrumentation. In the distributed market, Xantrex sells inverters, inverter chargers, charge controllers, and system products (known as "balance of systems"). In the programmable market, Xantrex sells bench top power supplies, rack mount power supplies and data communication inverter systems. The various products vary in power output from 50 watts to 2.5 MW. The primary purpose of the products is to convert direct current (DC) power to alternating current (AC) power (inverter) or AC power to DC power (power supply or charger). These product families are developed on proprietary electronic and software platforms, giving Xantrex a competitive advantage in the market. The products are known for their reliability, features, and service support. Xantrex has created many market categories, mainly in the consumer market where the handheld and battery integrated products were introduced and

marketed. Xantrex has been able to achieve an average gross margin of 35% (See **Table 1**) on its products, and operate in the number one or two positions in each market with the exception of the wind converter business. Since the acquisitions of Trace, Statpower and Heart Interface, Xantrex has been consolidating and refreshing its product offering in each market category.

Table 1 Xantrex 2003 Product Mix By Quantity and Revenue.

Product Category	Number of Products	QTY /Year	Revenue	Gross Margin	GM %
Charger	12	24,485	$ 3,585,751	$ 1,864,512	52%
Converter	2	449	$ 13,892,054	$ 2,817,020	20%
Battery Product	25	285,746	$ 17,762,390	$ 4,149,843	23%
Integrated System	59	1,556	$ 2,231,718	$ 779,667	35%
MSW Inverter Charger	149	47,113	$ 24,962,155	$ 10,202,359	41%
MSW Inverter	128	928,054	$ 24,737,703	$ 7,571,384	31%
Power Supply	618	16,985	$ 17,933,879	$ 7,455,419	42%
Service Part	8	19	$ 487	$ 11	2%
SW Inverter Charger	63	11,054	$ 12,715,785	$ 5,618,382	44%
SW Inverter	71	8,822	$ 9,647,788	$ 4,914,372	51%
System Components	164	85,845	$ 5,461,938	$ 1,916,065	35%
MISC	20	1,379	$ 188,876	$ 88,514	47%
Refurbished Product	152	4,431	$ 936,204	$ 50,792	5%
Grand Total	**1,471**	**1,415,938**	**$ 134,056,727**	**$ 47,428,339**	**35%**

1.5.2 Markets

Xantrex competes in three primary market segments; mobile, distributed, and programmable. The mobile market consist of six sub-segments: automotive, heavy-duty truck, recreation vehicle, marine, fleet/emergency and portable. The distributed market consists of six sub segments; wind generation, photo voltaic (PV) generation, industrial backup, residential grid tie, residential non grid tie and commercial. The programmable market consists of three major sub segments; test and measurement, original equipment manufacturer (OEM), and data communications.

As described in **Table 2**, Xantrex has an available market of $2.9B and has achieved total revenue of $135M US in 2003. Currently, the majority of revenue is derived from the mobile market but the largest growth opportunity is the distributed power market. In the mobile market, Xantrex has a dominant position in the segments it competes. The distributed market is twice as large as the mobile market and larger forecasted growth (See **Table 2**). This presents an excellent opportunity for Xantrex.

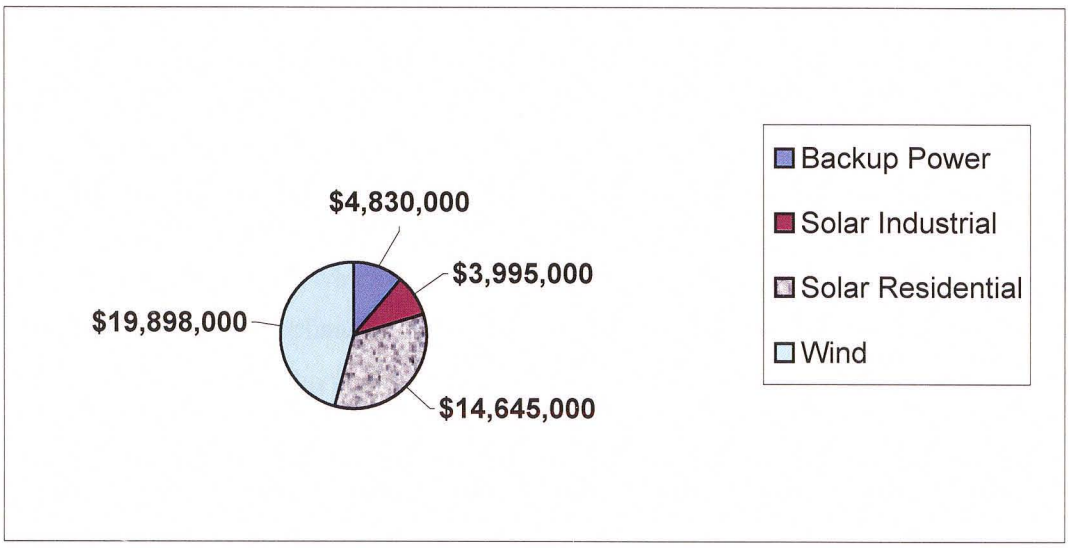
Table 2 Market Size and Revenue

Market	Market Size	Xantrex Market Penetration	Revenue Growth	Xantrex Revenue	Revenue Percentage
Distributed Power	$ 1,700,000,000	57%	21%	$ 46,000,000	34%
Mobile	$ 960,000,000	32%	11%	$ 72,000,000	53%
Programmable	$ 325,000,000	11%	14%	$ 17,000,000	13%
Total	$ 2,985,000,000	100%		$ 135,000,000	100%

1.5.2.1 Distributed Power Market

The distributed power market focuses on renewable energy for commercial or residential applications. This consists mainly of PV and wind converters products and systems. Another segment of this market is residential and commercial backup power. This segment uses an energy source (batteries) coupled with an inverter to provide back up power when there is an interruption of power supplied from the electrical grid. **Figure 1** details sales by segment for 2003.

Figure 1 Xantrex Distributed Power Market Revenue by Sub-Segment, 2003



The renewable energy product converts energy from wind generator or solar panels to electricity. This electricity is either consumed by the customer's loads or is sold back to the utility grid (grid tie). Commercial customers are typically independent energy producers who own a wind farm or

large scale PV installation and sell energy to electric utilities. This customer uses larger inverters in the rage of 10 kilowatts (kW) up to 2.5 MW.

In the residential application, consumers install PV or small wind turbines and produce electricity for off-grid homes or they sell back excess electricity to the power utility by turning the electricity meter on the house backwards. These applications use an inverter, which are in the two to five kW power level. In the off grid market, systems can be hybrid, by having solar, wind and generators creating electricity.

The backup power product converts DC power from an energy source to AC power and transfers this to residential or commercial loads. The DC power comes from batteries or a generator. In commercial applications, buildings are backed up in case of a power failure. Residential applications have the same purpose but on a smaller scale.

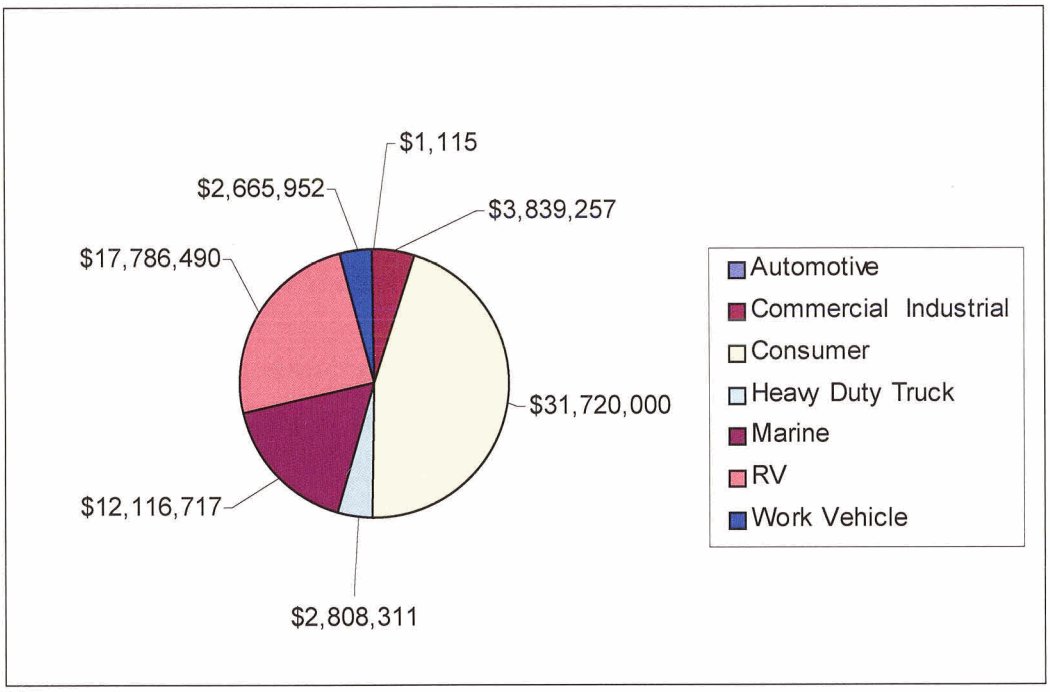
1.5.2.2 Mobile Market

The products in the mobile market convert DC power into AC power. The mobile market focuses on providing auxiliary power to operate various AC appliances on board boats, class 8 heavy trucks, emergency vehicles and recreational vehicles. The mobile market also focuses on portable power used outside the home and on the road, which operates electrical appliances through the use of hand held or battery-integrated products. **Figure 2** shows the 2003 revenue by sub-segment.

In the recreational market, which consists of marine and recreation vehicles (RV), the devices are used to power kitchen appliances, lighting, entertainment systems, and air conditioners. The devices also are used to charge the battery systems on board the vehicle and maintain the charge on those batteries. The products range in size from 400 watts to 4 kilowatts. These products are sold through OEMs such as Monaco or specialty retailers such as West Marine. Xantrex has an approximate market share of 60%.[3]

[3] Discussions with Director of Sales, Recreation Market, May 15th, 2004

Figure 2 Xantrex Mobile Market Revenue by Sub-Segment, 2003



In the heavy-duty truck market, the devices are used to power appliances and entertainment systems in the sleeper cabs. The devices are connected to the starter battery bank and are usually used in conjunction with a DC disconnects which disconnect the battery due to low voltage, to ensure the truck driver can start his truck. The products are sold directly to the OEM or through truck stops. The product range is 300 watts to 1750 watts. A limit to the penetration in this market is the electrification of truck stops, which is the truck stop providing parking stalls with a shore power connection. Xantrex has a 100% market share of the OEMs and approximately 50% of the retail market.[4]

The fleet utility market consists of emergency vehicles, work vehicles, and fleet vehicles. The devices used in this market provide AC power for electrical tools, lights, and safety equipment or charge the batteries in the vehicle. The products are sold through truck up fitters, OEMs, or fleets directly. Products range from 150 watts to 4 kilowatts in size. Xantrex holds approximately 15%, market share.[5]

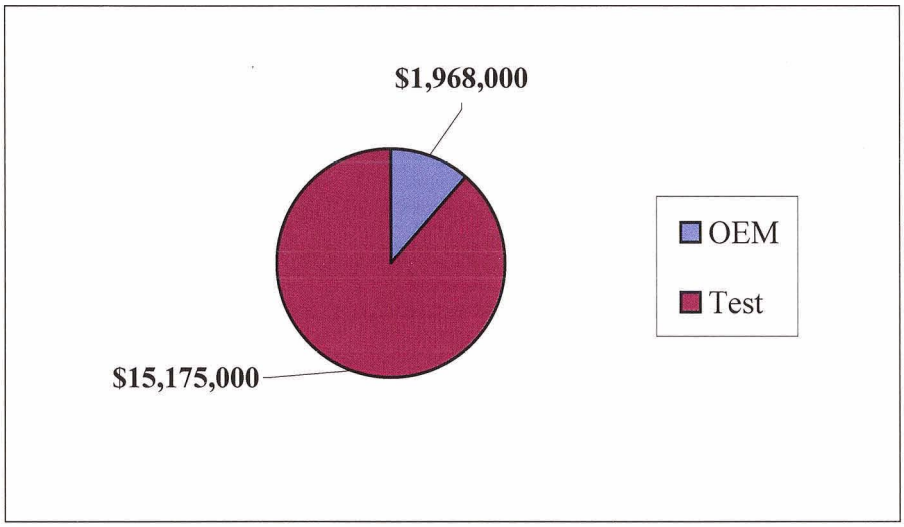
[4] Discussions with Product Management Team, May 10, 2004
[5] Discussions with Product Management Team, May 10, 2004

The portable power market products provide AC and DC power through inverters connected to batteries or battery integrated products. The products are used to provide power outside the home. The power ranges from 75 watts to 1500 watts. These products are sold through mass-market retailers like Sears, QVC, and Canadian Tire. Xantrex holds a significant market share in Canada and a small market share in the USA.

1.5.2.3 Programmable Market

The programmable market is characterized as selling precision computer control DC power supplies to the OEM, and to Test and Measurement. The product range is from 100 watts to 18 kilowatts in power and 6V to 600V DC output voltage.

Figure 3 Xantrex Programmable Market Revenue by Sub- Segment, 2003



The test and measurement market has two segments, design and development and manufacturing test. The design and development market is research and development (R&D), institutional and product development labs. These are bench top and rack mount supplies used to test and validate products and assemblies. The manufacturing test segment provides power supplies used for production testing, burn in, and service. Xantrex holds a small share in this market but is leading in market growth as seen with the 2003 Frost and Sullivan Award for market growth.

In the OEM market, power supplies are integrated into larger equipment, which requires precision power to operate the equipment. The power range for this market is 1 kW to 40 kW. A typical application would be the semiconductor manufacturing where ion implanters require precision power to fabricate silicon wafers.

1.6 Xantrex Wind Energy Market History

The Smith Putnam wind turbine generator (WTG) was erected in Vermont in 1939. This was the most technologically advanced turbine of its day and the first MW scale erected in the continental US.[6] The second WTG was erected in Demark in 1956-57 with funds from the Marshall plan.[7] The 1980's provided the next wind boom with the US investment tax credits reaching 50% and many advances took place.[8] Once the tax credit was removed, the US market severely contracted. The European WTG market evolved in the early 1980's in Denmark and spread to Germany and other European countries. European government incentives and fixed pricing drove a boom in the '90's.[9]

Xantrex entered this market through its acquisition of Trace Technologies in 2000. Trace Technologies was previously the power converter division of Kenetech Inc., which was acquired by a management buy out. The power converter group developed wind converter technologies including the patent technology (US Patent 5083039) for variable speed turbine control. In the bankruptcy of Kenetech, Zond purchased the patent and assets of Kenetech. Enron Wind then subsequently purchased Zond. Enron Wind was acquired by GE in early 2002 and has the patent rights for the variable wind turbine controller technology. Xantrex has a license for this patented technology to be used in non-WTG applications. **Table 3** describes the history of the power electronic group of Kenetech and how it became a part of Xantrex.

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[6] Wind Energy the Facts Volume 2, Costs, Prices, and Values, European Commission, Directorate – General for Energy. Retrieved May 10, 2004, from http://www.ewea.org, p. 32
[7] ibid, p. 33
[8] ibid, p. 34
[9] Garud, Raghu, Karnoe, Peter (2003). Bricolage versus breakthrough: distributed and embedded agency in technology entrepreneurship, *Research Policy*, 32, p. 282

Table 3 Xantrex Chronological Market History[10]

Year	Events Impacting Xantrex Entry into Wind Energy Market
1990	•• Power electronics group of US wind Power Created. • First 410kw wind converter developed.
1991	•• Variable speed wind turbine Patents filed (039). These key patents drive WTG business.
1992	•• US Wind Power raises $100M capital in a private placement.
1993	•• US Wind Power has IPO and becomes Kenetech (KWND) on NASDAQ. •• Became a fully integrated supplier of wind turbines.
1996	•• Kenetech files for bankruptcy. o Cited Reasons ▪ Cyclical nature of business ▪ Build up inventory / exhausted cash ▪ Production tax credit (PTC) eliminated cause severe market down turn •• Management buyout of power electronics group. (Ray Hudson, Mike Behnke, Marv Dargatz and Bill Erdman). •• Started parallel business in PV and energy storage.
1997	•• Customers for PV and energy storage rally behind power electronics group. • Trace Engineering and Zond invest $500,000. •• Zond purchases Kenetech IP and Licenses it to power electronics group.
1998	•• Power electronics group becomes a division of Trace Holdings.
2000	•• Xantrex acquires Trace Holdings and power electronics group becomes a division of Xantrex.
2002	•• GE purchases assets of Enron Wind and forms GE Wind.

1.7 Wind Converter Products

Xantrex provides two product categories to the wind turbine manufacturing industry, wind converters, and service. The wind converter is engineered to work with each specific type of

[10] Discussions took place with the VP Engineering, Livermore California Office, April 19th, 2004

WTG due to differences in technology and requirements for each wind turbine generator manufacturing (WTGM) and installation site. The wind converter performs three basic functions; power conversion, speed control, and grid interconnect of the turbine. Xantrex provides wind converters for each class of wind turbine. Xantrex currently supplies GE Wind a 1.5 MW wind converter, and is developing wind converters for other WTGMs.

The second product category Xantrex provides is the service and upgrading of the wind converters in the field. The standard life cycle of the WTG system is 20 years and a critical component of the life cycle is uptime and maximum yield when there is wind available for generation. Typically, wind generation is only possible 30% of the time. Xantrex provides maintenance and upgrade services to the wind farm operators to keep the systems running at peak performance and also adding new features when requested. This service and value Xantrex adds is critical to the customer relationship.

1.8 Wind Converter Market

Wind energy is the fastest growing renewable energy solution worldwide.[11, 12] It is considered the most promising technology for pollution-free electricity generation in the short, medium, and long term.[13] Technical advances combined with marketing innovations, production incentives, and low interest rate financing have combined to expand worldwide capacity from about 2000 MW in 1990 to over 40,000 MW in 2003.[14] The wind generation industry uses wind turbines to generate electricity, which is then fed to the electric utility grid. The industry has defined four classes of turbines, small WTG (less than 749 kW), mainstream (750-1500 kW), Megawatt Class (MW) (1500 – 2500 kW) and Multi-MW Class (greater than 2500kW).[15] Each WTG is comprised of four main subsystems: turbine, generator, gearbox, and converter/controls.

The market is divided into two main segments, variable speed, and direct drive (The direct drive segment is fixed speed drives without a wind converter). Each of these two segments has a captive, and merchant market. The captive market is those WTGMs, which are vertically

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[11] BTM Consult ApS; World Market Update 2003, p. 3
[12] Focus on Renewable Energy, New Analysis Projects 20% Renewables by 2010, *Wind Directions*, January/February 2004, Retrieved May 10, 2004, from http://www.ewea.org, p 37
[13] Wind Energy the Facts Volume 4, The Environment, European Commission, Directorate – General for Energy. Retrieved May 10, 2004, from http://www.ewea.org, p 2
[14] BTM Consult ApS; World Market Update 2003, p. 3

integrated with the design and supply of wind converters and controls. The merchant market is the balance of the industry where turbine manufactures outsource the design and manufacture of the wind converters and controls. The estimated market size for the world wind converter business in 2003 was $230M US (weighted average cost) representing approximately 5546 units.[16] The market is forecast to grow at approximately on average 10.5% per year for the next five years.[17] The wind generation market has grown from a 1 MW in 1983 to 40,000 MW units in 2003 with high growth starting in 1995. A key driver to this growth has been the continual reduction of the cost of generation along with government subsidies to make it a competitive substitute to thermal and hydroelectric generation.

1.9 Customer Behavior

There have been key changes in customer behavior over the last 12 months. GE Wind has gained significant market share and started to vertically integrate its capability to develop wind converters and controls. Vestas and NIG Micon have merged. Gamesa has purchased Made Inc. There is a consolidation in the industry in progress, with the two largest players having a captive market. This merger may change the dynamics of the merchant market.

Another change in the market has been a move to synchronous generator machine configuration with a full rated wind converter to control, condition, and grid connect all of the power generated by the WTG. GE has made this move in their MW class WTG.[18] The double fed induction machine is still the choice of many of the WTGMs, which has a smaller parallel wind converter and performs similar functions of control and grid connect.

Xantrex has addressed this issue by bundling products through partnership with Loher (power electronics) and Winergy (gearbox), and Xantrex (control board). With this partnership, the three firms are building a drive train solution for the WTG manufactures. Xantrex believes this will add more value in the market place through an engineered system solution.

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[15] ibid; Executive Summary, p 2
[16] ibid, p. 5
[17] ibid, Preface
[18] de Vries, Eize (2004). Wind A new drive and generator solution, *Renewable Energy World*, March-April 2004, p. 5

WTG customers are moving more towards engineer, furnish and install purchasing arrangements. This will require WTG manufactures to provide all of these services. Xantrex will be required to partner directly with WTG manufactures as the WTG customers are buying complete systems and do not specify subcomponent manufacturers. The automotive industry operates in the same fashion, as a consumer does not specify the brand of stereo or brakes when purchasing a new vehicle.[19]

A key driver of the wind farm operator is to have 100% uptime when wind generation is available. Wind generation is only available 30% of the time in a typical installation. Wind farm operators measure the energy yield during the generation time and need to achieve maximum energy capture. Failure to achieve this energy capture is lost revenue opportunity, which cannot be recovered. The wind converter will need preventive maintenance capabilities to indicate when components like electrolytic capacitors and fans will fail as they have a fixed life span and wear out. The wind farm operator needs to exchange these parts when they do routine maintenance to ensure maximum uptime.[20]

[19] Discussions took place with the VP Engineering, Xantrex Technology Inc., May 6th, 2004
[20] Discussions took place with the CEO, Xantrex Technology Inc., April 21st, 2004

2 ANALYSIS OF WIND CONVERTER MARKET

2.1 Introduction

The wind generation industry uses a WTG to generate electricity, which is then fed to the electric utility grid. The market has four classes of turbines: small wind turbine generator, mainstream, MW-Class, and Multi-MW Class. Each WTG is comprised of four main subsystems: turbine, gearbox, generator, and wind converter/controls. Xantrex competes in the wind converter/controls markets and designs and manufactures wind converters for each class of wind turbine. The estimated market size for the world variable speed merchant wind converter business in 2003 was $65M US (weighted average cost) representing approximately 2946 units.[21] The market is forecast to grow at approximately on average 10.5% per year for the next five years.[22] A key driver to this growth has been the continual reduction of the cost of generation along with government subsidies to make it a competitive substitute for thermal and hydroelectric generation.

This section quantifies the market by segment, geography, wind converter size, and off shore developments. It will then discuss how government regulation, utility grid connect requirements, and intellectual property impact the market. The conclusion of the section will focus on market forecasts and challenges.

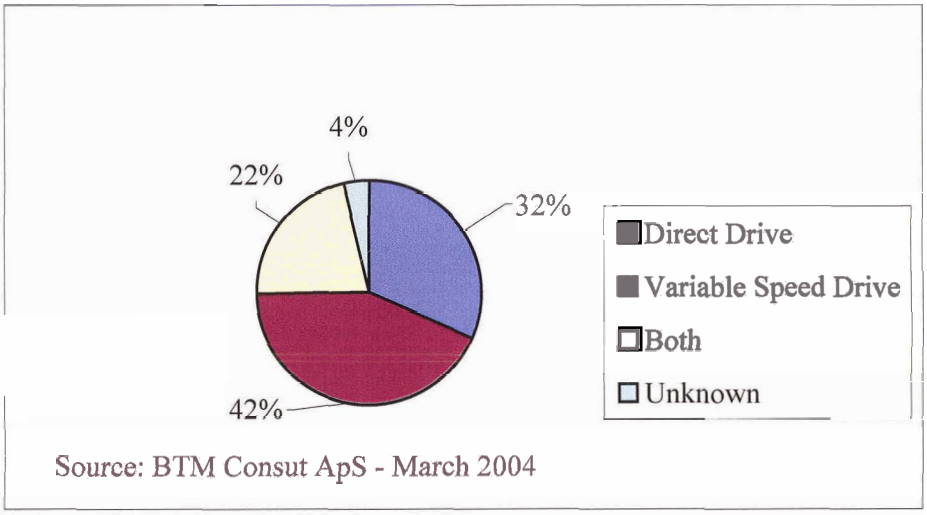
2.2 Market Segmentation

The market is divided into two main segments, direct drive (fixed speed drives without a wind converter), and variable speed drive (with a wind converter).[23] Each of these segments has two sub segments, which are captive or merchant. The captive market is those wind turbine manufactures, which are vertically integrated with the design and supply of wind converters and

[21] BTM Consult ApS; World Market Update 2003, p. 5
[22] ibid, Preface
[23] ibid, p. 12

controls. The merchant market is the balance of the industry where turbine manufactures outsource the design and manufacture of the wind converters and controls.

Figure 4 Wind Turbine Generator Market Segmentation By Drive Type



The variable speed drive segment has 42% market share (See **Figure 4**). The combined market for variable speed wind converters is approximately $100M US, with the merchant market totaling $66M US (See **Figure 5**). The combined market does not include the WTGM, which uses both direct drive, or variable speed drives as the ratio between the different drive types in not known. Therefore, the combined market for variable speed wind converters is a conservative estimate.

The top five WTGMs dominate the current market. Vestas and NEG Micon recently merged and control 32% of the market. Gamesa has increased its market share to 14%. The current trend in the market is consolidation of WTGMs. Refer to **Table 4** for a breakdown of market share by manufacturer and country. Danish manufacturers dominate the market with a 38% share, followed by German manufacturers with 21%. Spanish firms control 16% of the market. The market is dominated and concentrated in Europe. GE Wind has made inroads and has moved from 9% market share in 2002[24] to 18% in 2003 (See **Table 4**). As indicated in **Table 4**, the WTGM utilizes all sources of supply in the merchant market.

[24] BTM Consult ApS; World Market Update 2002, p. 23

Figure 5 Variable Speed Converter Market Sizes

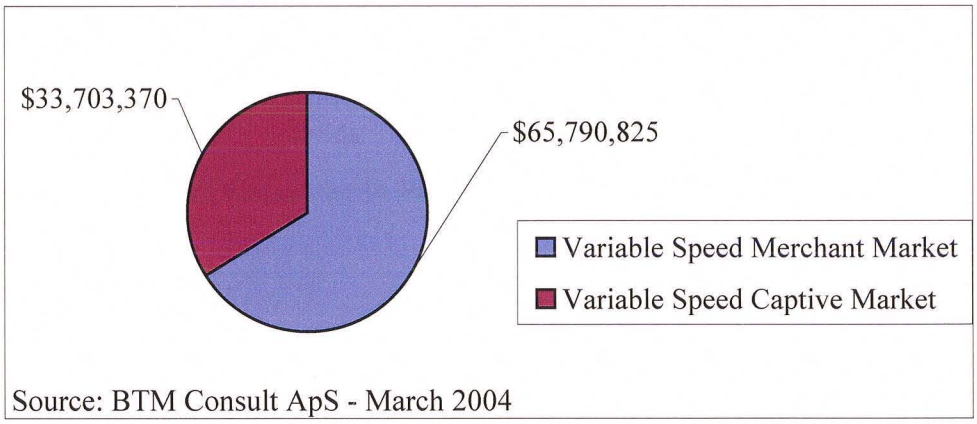


Table 4 Market Share by Manufacturer in 2003[25]

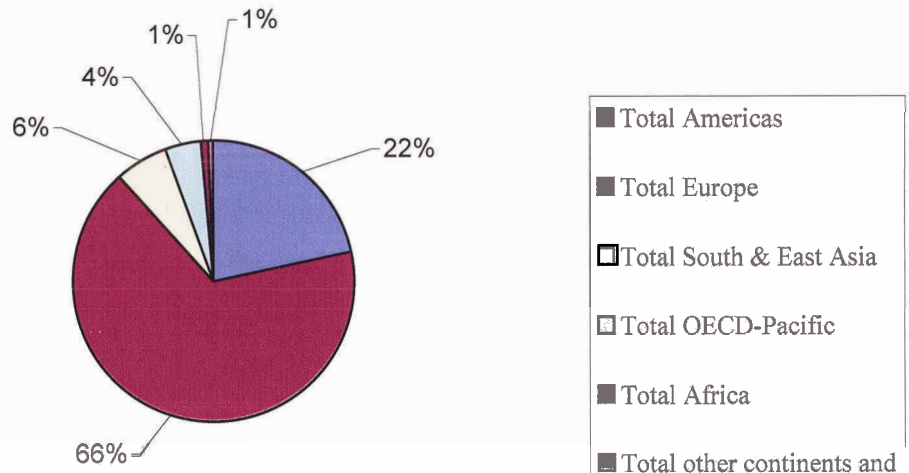
Manufacturer	Share 2003 %	System Type	Market	Technology	Converter Supplier
VESTAS (DK)	21.7%	Both	Captive	Matrix Converter	Weier Electric
GE WIND (US)	18.0%	Variable speed	Merchant	IGBT Inverter	ABB, Alstom, Xantrex, GE Industrial
ENERCON (GE)	14.6%	Variable speed	Captive		Internal supply
GAMESA (ES)	11.5%	Direct Drive	Merchant		N/A
NEG MICON (DK)	10.2%	Direct Drive	Merchant		N/A
BONUS (DK)	6.6%	Direct Drive	Merchant		N/A
REPOWER (GE)	3.5%	Variable Speed	Merchant	IGBT Inverter	SEG, ABB, Alstom
MADE (ES)	2.9%	Unknown			
NORDEX (GE)	2.9%	Variable Speed	Merchant	IGBT Inverter	SEG
MITSUBISHI (JP)	2.6%	Direct Drive	Merchant		N/A
ECOTECNIA (ES)	0.6%	Unknown			N/A
SUZLON (In)	0.8%	Direct Drive	Merchant		N/A
DEWIND (GE)	1.2%	Variable Speed	Merchant	IGBT Inverter	SEG, ABB, Alstom
FUHLANDER (GE)	0.7%	Variable Speed	Merchant	IGBT Inverter	SEG, ABB, Alstom
Others	2.2%	Variable Speed	Merchant		
Total	**100.0%**				

2.3 Geographic Segmentation

The wind converter market is geographically dispersed in five major areas, North America, Europe, South & East Asia, OECD – Pacific and Rest of World (ROW). With the geographic

concentration of installation in Europe, the majority of WTGMs are located in continental Europe, due to shipping costs. This geographic concentration also extends to the wind converter manufacturers, and Xantrex is the only wind converter supplier outside of Europe. The main competitors of Xantrex in the merchant market are ABB, Alstrom, and SEG.

Figure 6 Installed Capacities in 2003 by Region



Source: BTM Consut ApS - March 2004

As seen in **Figure 6**, Europe dominated the installation of products in 2003 with 5549 MW installed (See **Table 5**), which accounted for 66% of the world total.[26] The market is dominated by the top eight countries in Europe, which accounted for 94% of WTG installations in 2003. The European market is dominated by Germany and Spain. The balance of the European market is concentrated around six countries, Denmark, Netherlands, Austria, Italy, and Portugal as depicted in **Table 5**. Denmark has played a major role in the European market as Danish firms manufacture 39% of all wind turbines. Denmark has also been a leader in offshore wind power development as seen in **Table 7**. Denmark is the world leader in technology development.[27] As indicated in **Table 5**, there has been a decline of new onshore installed WTGs in the three leading markets in Europe. This could be the start of a trend due to a saturated onshore market?

[25] BTM Consult ApS; World Market Update 2003, p. 16
[26] BTM Consult ApS; World Market Update 2003, p. 4

In 2003, Germany had a decline in installations, no offshore development, and the major investment for WTGs came from private investors.[28] Denmark also declined in onshore installations due to a saturation of the market.[29] Currently, 20% of generation capacity[30] in Denmark comes from WTGs. There was also a change in tariff rates, which had a negative impact on demand for WTGs. In the Netherlands the installations increased over 2003 (See **Table 5**) and demand increased due to a new MEP (Dutch acronym for tariff) tariff scheme. The change in tariffs had a positive impact on demand.[31] The Spanish market on the other hand, saw sales increase but installations decrease due to lengthy installation times.[32] The Portuguese market expanded by a third due to a new tariff scheme introduced in 2003.[33] The Italian market incrementally increased due to a new tariff scheme based on green certificates. The financial community is skeptical of its effectiveness, which has had a negative impact on investment. Grid connection issues also factored in the slow growth.[34] The market in the UK exploded with 400% growth over 2002. Growth has been fueled by offshore developments like the North Hoyle wind farm.[35] Austria also saw large growth, 200%, due to new tariffs introduced in 2003.[36] The major growth market in Europe was fuelled by new tariff schemes and rates. These tariffs have a large impact on demand. (See **Appendix E** for tariff rates by country)

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[27] Garud, Raghu; Karnoe, Peter; (2003). ; Bricolage versus breakthrough: distributed and embedded agency in technology entrepreneurship, *Research Policy* 32, p.278.
[28] BTM Consult ApS; World Market Update 2003, p. 6
[29] ibid, p. 6
[30] ibid, p. 6
[31] ibid, p. 6
[32] ibid, p. 6
[33] ibid, p. 7
[34] ibid, p. 7
[35] ibid, p. 7
[36] ibid, p. 7

Table 5 Installed WTG Capacity in Europe in 2002 & 2003[37]

	Installed MW 2002	Accu. MW 2002	Installed MW 2003	Accu. MW 2003
Austria	44	130	285	415
Belgium	11	45	33	78
Denmark	530	2,880	218	3,076
Finland	4	44	9	53
France	69	183	91	274
Germany	3,247	11,968	2,674	14,612
Greece	104	462	76	538
Ireland (Rep.)	38	167	63	230
Italy	106	806	116	922
Luxembourg	1	7	5	12
Netherlands	219	727	233	938
Norway	80	97	4	101
Poland	30	54	1	55
Portugal	51	204	107	311
Spain	1,493	5,043	1,377	6,420
Sweden	55	372	56	428
Switzerland	1	6	0	6
Turkey	0	19	1	20
UK	55	570	195	759
Rest of Europe: Other East European Countries and Baltic countries	28	48.0	4.6	52.5
Total Europe	**6,163**	**23,832**	**5,549**	**29,301**

As seen in **Table 5**, the European on shore market is becoming saturated in countries like Denmark and Germany, and is creating demand for offshore WTGs.

A key factor in the development of offshore wind farms is the better wind condition offshore.[38] The wind is stronger and more consistent. Denmark is leading the market with 165 MW installed in 2003. Due to higher installation costs, WTGM are installing larger WTGs to enable lower cost of generation and driving the market into larger WTGs. Many countries are in the process of tendering offshore wind farm locations, which will drive further demand, resulting in a growth market in the future.

[37] ibid, p. 10

Table 6 Installed Capacities in the Americas in 2002 & 2003[39]

	Installed MW 2002	Accu. MW 2002	Installed MW 2003	Accu. MW 2003
Argentina	1	28	2	30
Brazil	1	24	7	31
Canada	56	270	81	351
Costa Rica	8	79	0	79
Mexico	0	3	0	3
USA	429	4,674	1,687	6,361
Other Americas	0	9	41	50
Total Americas	**494**	**5,087**	**1,818**	**6,905**

2.4 Offshore Developments

Table 7 Installed Offshore WTGs in 2002 & 2003[40]

Country	Installed MW 2002	Accu. MW 2002	Installed MW 2003	Accu. MW 2003
Denmark	183	232.9	165	397.9
Ireland	0	0	25	25
The Netherlands	0	18.8	0	18.8
Sweden	0	23.3	0	23.3
UK	0	4	60	64
Total capacity - World	183	279	250	529

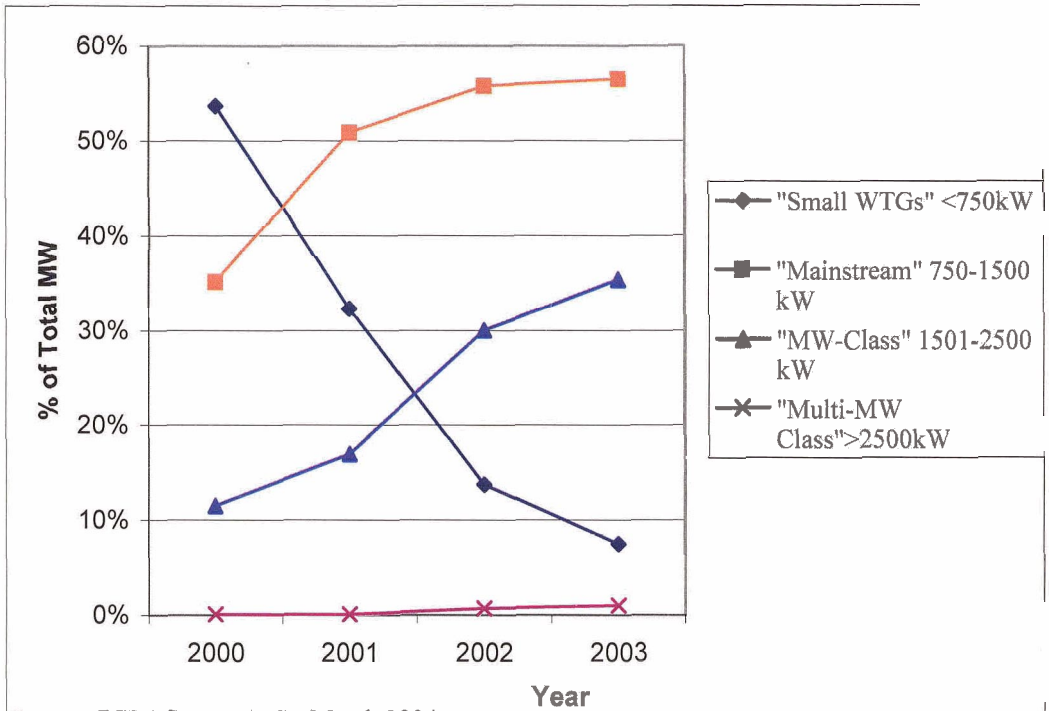
2.5 Wind Turbine Size Segmentation

The industry has four classes of turbines and the market is shifting from Mainstream WTG to MW-Class WTG, with the Multi-MW Class starting to penetrate the market (See **Figure 7**). The

[38] ibid, p. 9
[39] ibid p. 9
[40] ibid p. 11

small wind converter market has declined drastically over the last four years. The market shift has been driven by the trend of larger wind farms being commissioned which require lower cost of generation (See **Figure** 7). The lower cost of generation is being achieved by installing Mainstream and MW Class WTGs, which have a lower cost of generation. The current estimated cost for onshore installation is $1038/kW, while offshore cost is $1970/kW.[41] The energy capture of a WTG is related to the cube of the wind speed and the size of rotor's swept arc, which is the square of the radius.[42] The larger the rotor, the larger the swept area, and the more efficient the wind turbine is at capturing energy. A WTG operating at 7.15 meters per second (mps) will generate electricity at $0.048 per Kilowatt hour (kWh) while the same WTG operating at 9.32 mps generates electricity at $0.026 per KWh.[43] This efficiency in energy capture is another factor driving the market to larger wind turbines

Figure 7 Market Trend by Wind Converter Size[44]



Source: BTM Consut ApS - March 2004

[41] ibid, p. 33
[42] American Wind Energy Association, The Economics of Wind Energy, 2004, Retrieved May 10, 2004, from www.Awea.org, p. 1
[43] ibid, p. 1
[44] BTM Consult ApS; World Market Update 2003, p. 21

Another factor driving the size of larger WTG is power quality concerns. Wind power generation is irregular due to variations in wind speed and usually does not match the load on the utility grid. This causes fluctuations in the output voltage that affects power quality. The larger number of wind farms connected to an electrical grid, the higher the possible occurrence of voltage fluctuations. This is evident in Europe where there are many small wind farms. The power utilities are pushing for larger wind farms with lower operating costs, which drive the WTGM to develop larger turbines.

2.6 Methodology for Forecasting Wind Turbine Generator Size

Inigo Martija de Nicolas developed another method to forecast the ideal size of a WTG in his paper, "Wind Energy Evolution and Expectations: A typical case of Gigantism". De-Nicolas developed a Triz function of Ideality to define the ideal size of a WTG and compared it with the current market size of a WTG and market maturity using a life cycle model.

Triz provides a methodology for problem solving to get a system to an ideal state, which is when a system is performing its intended function at the most effective and efficient manner.[45] Gerich Altshuller developed this methodology by analyzing thousands of patents and developed trends and patterns to the evolution of systems and technology.[46] His hypothesis is that systems become simpler and more efficient over their lifecycle. By utilizing the levels of innovation and laws of "Ideality" a function can be derived to determine the "Ideality" of the system. This function is called "algorithm to solve an inventive problem" (ARIZ).[47]

De Nicolas developed the following TRIZ function for the Ideality of a WTG (See **Equation 1**).

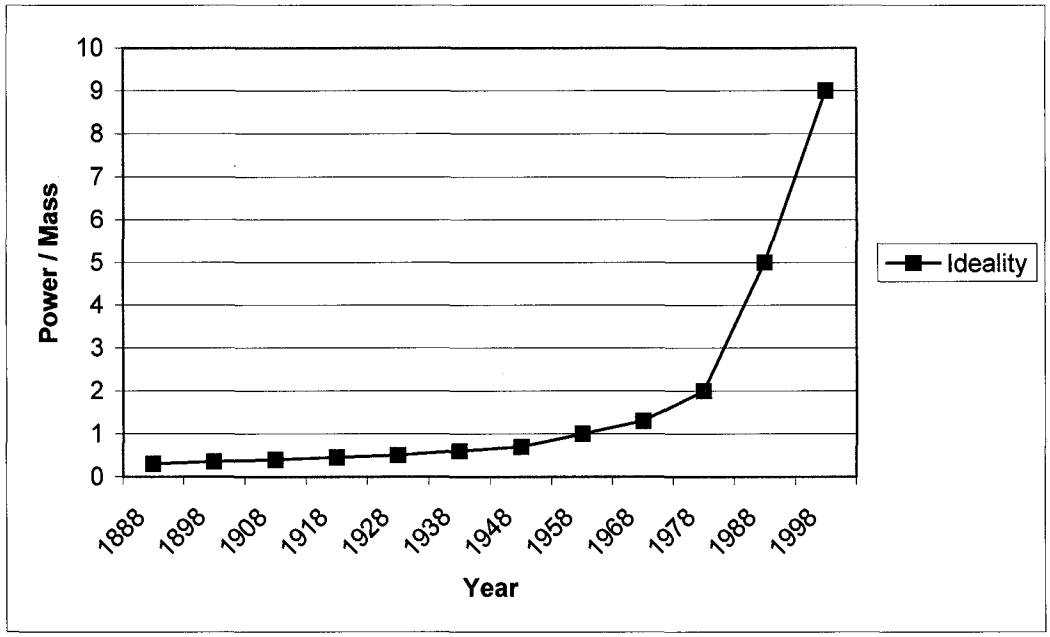
Equation 1 TRIZ Function For A WTG[48]

$$\text{Ideality} = \frac{\text{Installer Power}}{\text{Mass}} = \frac{\text{kW}}{\text{Ton}}$$

[45] Shulyak, Lev; *Introduction to TRIZ,* Retrieved June 10, 2004, from http://www.triz.org, p. 2
[46] ibid, p. 1
[47] ibid, p. 5

Inigo then compared the TRIZ function over time and compared it to the Market and WTG Life Cycle. As indicated in **Figure 9** & **Figure 10**, the wind turbine system is the beginning stage of the growth cycle. This function predicts Xantrex will be at maximum Ideality with the Multi-MW Class (greater than 2500 kW) WTG and should start optimizing the cost/efficiency. Larger size wind turbines would not be efficient or effective if this predictive model is correct. This WTG market should peak at about 2012 as seen in the market forecast and the infancy of the Multi MW class as seen in **Figure 9**. The market factors and size prediction models point to the Multi-MW Class as the most efficient size and the direction of the market. Beyond the Multi-Class size, cost reductions should be undertaken to improve the Ideality.

Figure 8 Historical Increases in Ideality in the Global Wind Power Generation Industry[49]



Note: Ideality is defined here as the ideal size of a wind power generator (See **Equation 1**).

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[48] de Nicolas, Inigo Martija; (2004), Wind Energy Evolution And Expectations : A typical case of gigantism, p. 5

[49] ibid, p. 5

Figure 9 Installed MW per year[50]

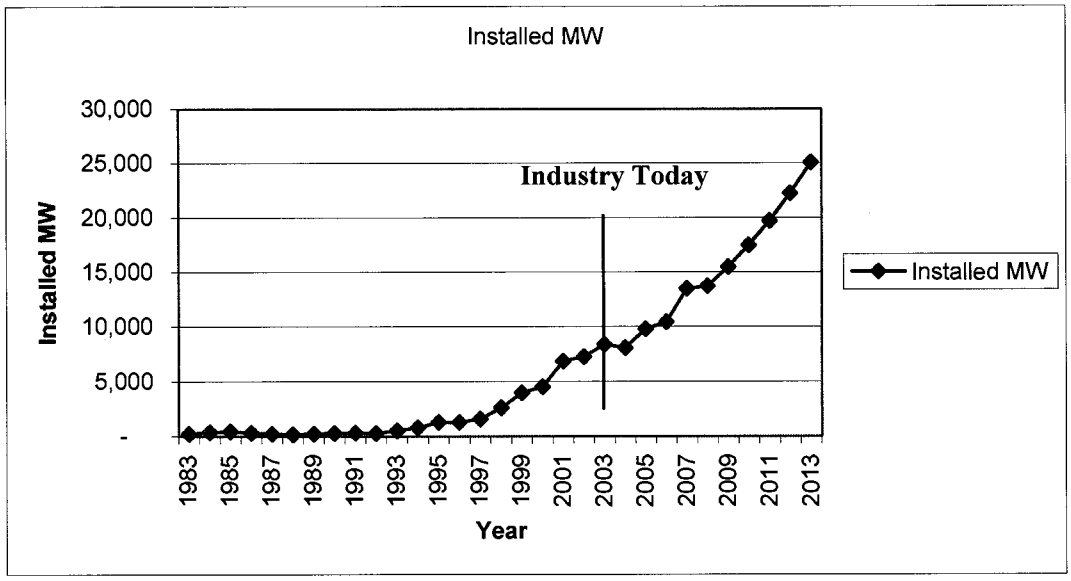
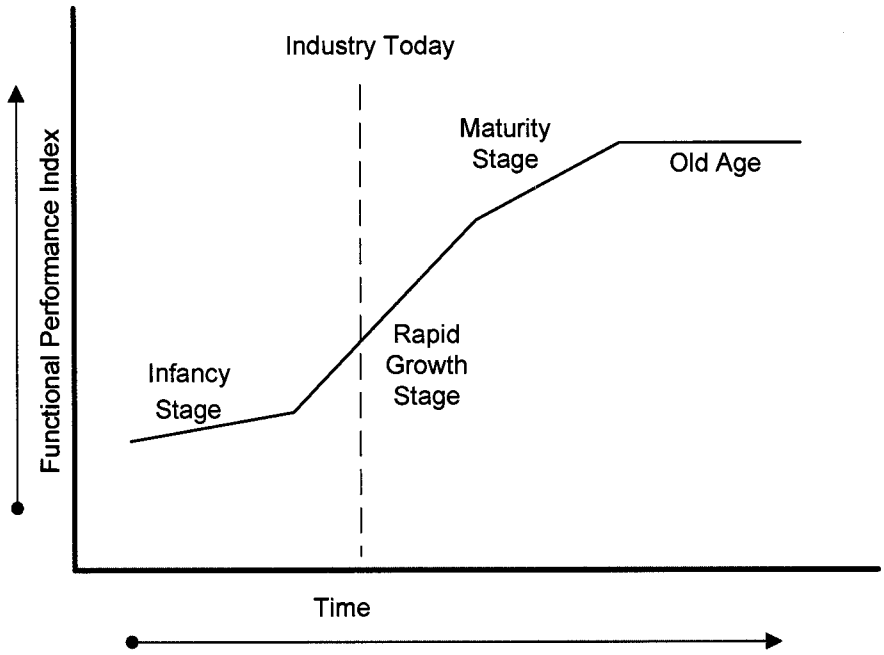


Figure 10 System Lifecycle model



[50] BTM Consult ApS; World Market Update 2003, Preface

2.7 Development Cycle

The current development cycle for wind turbine technology is 5 to 7 years, with the cost being reduced by 15% with each doubling of capacity. The cost will be reduced by 35-40% by 2006 with the introduction of the next generation of turbines.[51] Currently, most WTGMs are developing the next generation of wind turbines focusing on the MW-Class with variable speed drive trains. These manufacturers usually use an OEM model of procurements and single source wind converters for their systems. The wind converter is a highly differentiated product, built to meet the design specification of the drive train system. The OEM model usually follows an industrial marketing type process where a supplier is chosen by a buying team. Once selected, a supply agreement is negotiated for the duration of the manufacturing life cycle. Changing a supplier in the middle of a life cycle is extremely expensive and time consuming. The key to market penetration is to be "designed in" with every technology cycle of wind turbine.

2.8 Wind Tariffs

A key driver in the demand for WTG is the rate of return the independent power producers will achieve for an investment in a wind farm. Investors expect a consistent return for their investment. Tariffs supplied to the energy producers keep the economics of the playing field level with other forms of generation that are subsidized.[52] The investment communities in North America see the wind industry as an immature market with high risk.[53] This risk translates into higher cost of capital for independent producers of energy, which increases the cost of generation and lowers the return a producer can expect. The investment community is Europe sees the wind turbine generator market as less risky, as the market is mature.

In almost every jurisdiction in the world, governments provide tariffs in the form of fixed prices, production tax credits (PTC), Renewable Portfolio Standard, Investment grants, or Feed-in rates.[54] These tariffs have a dramatic effect on the demand for WTG and wind converters (See **Appendix E** for specific tariff rates). The PTC in the United States expired in 2003, and the

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[51] American Wind Association; Comparative Cost of Wind and Other Energy Sources; 2001, Retrieved May 10, 2004, from www.Awea.org, p. 2
[52] American Wind Energy Association, The Economics of Wind Energy, 2004, Retrieved May 10, 2004, from www.Awea.org, p. 4
[53] ibid, p. 4
[54] BTM Consult ApS; World Market Update 2003, p. 24

industry is expecting a dramatic down turn. **Appendix E** shows a cross section of various tariffs in different countries. The wind business is becoming more market oriented as the cost of generation declines. The market orientation will stabilize demand by reduced reliance on government subsidies.

2.9 Intellectual Property

Intellectual property (IP) rights play a large role in the wind generation market. Many European and North America organizations hold patents on wind turbine and wind converter technologies. GE Wind has acquired 17 patents with its purchase of Enron Wind. The majority of these patents originated from Kenetech. GE has vigorously defended these patents and has successfully litigated against Enercon in defending US patent 5,083,039 (039). GE has a similar patent in Europe being opposed by ten firms, of which Enercon is one. GE and Enercon have ceased litigation and have agreed to cross license the technology. The market players vigorously defend IP and will litigate. Firms in this market must be prepared to defend their IP rights, which can be costly.

Xantrex, through its acquisition of Trace Technologies, has a royalty-free license to use this patented technology (039) for use in non-wind converter markets and small wind turbine converters less than 50 kW. The patent has 131 claims for electrical design and software controls. All new designs for mainstream or larger wind converters must avoid the numerous patented IP.

2.10 Grid Interconnect

Another influence on the market and design of wind converters is the grids interconnect requirements imposed on the independent power producers by Electrical utilities that are responsible for the electrical grid. The requirements focus around the power quality which is defined by voltage quality and supply reliability. Harmonics, flicker, unbalance, and rapid changes in voltage define voltage quality.[55] Reliability is defined as the absence of interruptions, dips, sags, frequency shifts, and over/under voltage. These power quality issues have driven demand for voltage ride-through and power conditioning. In wind turbines and farms, these

power quality issues are driven by variations in wind availability and speed. Utilities are concerned about how these power quality issues affect the grid and customer loads and have developed requirements for independent power producers to minimize power quality issues at grid connect sites. These requirements differ between countries and utilities. These differences require WTGM and wind converter manufacturers to develop different model products for each jurisdiction. This reduces economies of scale and scope and increases cost of generation. An International Electrical Committee (Technical Committee 88) was set up to standardize the regulations and specifications by generating an international standard. Eleven working groups developed and released the IEC 61400 standard. Universal adoption of this standard has not been achieved. The American Wind Energy Association is currently petitioning the Federal Energy Regulatory Commission (FERC) with Docket No. RM02-1-001 to standardize the wind farm interconnects to the grid for all utilities. This docket describes the interconnect standard to be proposed and guideline for its implementation by utilities.

2.11 Market Forecast[56]

The long term market outlook will almost certainly be strong with the average growth forecasted at 10.4% through 2008 (See **Table 8**). The year 2004 marks the first time growth has decreased with a forecast of 4% less than in 2003. Europe will continue to lead the world market with 66% of demand (See **Table 9**). The European market will continue to develop with the exception of Spain and Germany, which have reached onshore saturation. The main thrust in Europe will be the development of the offshore market due to onshore market saturation. Germany will almost certainly be responsible for 25% of the demand in Europe while the Asian market may increase due to Japanese and Indian markets.

In the Americas, the United States (US) will almost certainly drive the market. PTC has traditionally driven demand in the United States. The US has the largest natural wind capability in

[55] Hansen, L.H, Helle, L., Blaabjerg, F., Ritchie, E., Munk-Nielssen, S., Bindner, H., Sorensen, P., Bak-Jensen, B., (2001). ; Conceptual survey of Generators and Power Electronics for Wind Turbines; *Riso National Laboratory*, December 2001, p.76

[56] BTM Consult ApS; World Market Update 2003, p. 37

the world[57] yet it is the largest untapped market. The balance of the Americas may play a minor role in the market.

The WTG forecast will translate into a wind converter market of $100M US in 2004 increasing to $164M US in 2008. Beyond 2008, the market in Europe will increase to 11000 MW/Yr., Americas will increase to 7000 MW/Yr., Asia will increase to 4700 MW /Yr. and ROW will increase to 2000 MW/Yr.[58] The market estimates should be achieved by 2013. These market forecasts are supported by the improved economics of wind generation in larger WTGs, global demand for energy, improvement of the economies of developing markets, security of supply concerns, lower price for energy and Kyoto ratification for CO2 reductions.[59]

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[57] American Wind Energy Association, Wind Energy: An Untapped Resource, 2004, Retrieved June 10, 2004, from www.Awea.org, p.1
[58] BTM Consult ApS; World Market Update 2003, p. 24-34
[59] ibid, p. 38

Table 8 Forecast for Global Wind Power Development 2004-2008[60]

	Cumulative installed capacity (MW) by end of in 2003	Installed capacity (MW) in 2003	Forecast 2004-2008					Cumulative installed capacity between 2004-2008	Cumulative installed capacity (MW) by the end of 2008
	2003	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**Sum**	**Accu.**
Total Americas	6905	**1818**	950	1500	1900	2550	2550	**9450**	16355
Total Europe	29301	**5549**	5560	6625	6770	880	8925	**36680**	65981
Total South & East Asia	2707	**521**	720	770	790	940	1050	**4270**	6977
Total OECD-Pacific	1077	**352**	590	650	650	875	875	**3640**	4717
Total other areas	311	**104**	215	195	285	285	285	**1265**	1576
Total MW new capacity every year:		8344	8035	9740	10395	13450	13685	55305	95606
Accu. Capacity (MW)	40301		48336	58076	68471	81921	95606		

[60]BTM Consult ApS; World Market Update 2003, p. 25

Table 9 Forecast for European Wind Power Development 2004-2008[61]

	Cumulative installed capacity (MW) by end of in 2003	Installed capacity (MW) in 2003	Forecast 2004-2008 (incl. Offshore)					Cumulative installed capacity between 2004-2008	Cumulative installed capacity (MW) by the end of 2008
	2003	**200**	**2004**	**2005**	**2006**	**2007**	**2008**	**Sum**	**Accu.**
Austria	415	**285**	200	200	200	200	300	**1100**	1515
Belguim	78	**33**	40	50	150	250	100	**590**	668
Denmark	3076	**218**	5	5	20	200	200	**430**	3506
Finland	53	[illegible]	50	100	100	100	100	**450**	503
France	274	**9**	200	200	300	600	800	**2100**	2374
Germany	14612	**267[illegible]**	2325	2525	2500	3500	2600	**13450**	28062
Greece	538	**76**	100	150	150	150	150	**700**	1238
Ireland (Rep.)	230	**63**	80	120	100	350	275	**925**	1155
Italy	922	**116**	200	300	300	300	400	**1500**	2422
Netherlands	938	**233**	200	200	150	300	300	**1150**	2088
Norway	101	**4**	150	150	250	250	250	**1050**	1151
Poland	55	**1**	40	50	100	100	150	**440**	495
Portugal	311	**107**	100	150	150	200	200	**800**	1111
Spain	6420	**1377**	1500	1400	1500	1200	1200	**6800**	13220
Sweden	428	**56**	35	285	150	150	300	**920**	1348
Switzerland	6	[illegible]	40	50	100	100	100	**390**	396
Turkey	20	**1**	5	10	50	100	100	**265**	285
UK	759	**195**	270	630	400	600	1200	**3100**	3859
Rest of Europe: Other East European and Baltic countries.	65	**10**	20	50	100	150	200	**520**	585
Total Europe	**29301**	**5549**	**5560**	**6625**	**6770**	**8800**	**8925**	**36680**	**65981**

[61] ibid, p. 26

2.12 Market Challenges

The wind converter business has a number of challenges for market participants. Some of these challenges may determine overall wind converter demand, structure of the industry and the long term stability of the market. The following is a list of challenges wind converter suppliers such as Xantrex face.

- Market is heavily reliant on subsidies to make the rate of return attractive; subsidies cause fluctuations in demand and make the market uncertain. Governments not having a long term policy or commitment to tariffs to support a stable renewable energy market.

- Cost of capital is higher than electrical generation substitutes due to maturity of market and risk. This increases the cost of capital, which affects the economics of wind generation.

- Consolidation of WTGMs, Vestas and NEG Micon merger, and Gamesa purchasing Made, consolidates the wind converter customer base and resulting in the majority of a market with four players.

- IP protection of Patent (039) has been a major barrier to US market. Plethora of patents makes product development and market entry difficult, GE/Enrecon license agreement will create market advantage for the two firms.

- Saturation of European market and development of offshore market; Offshore market may account for 50% of demand by 2008, this severe environment will force WTGMs to develop new technologies that are more reliable.

- Concentrated market, only five firms supply WTGM with wind converters. Competition may increase with consolidation.

- Fluctuating currency may affect European manufacturers' cost and sales outside of European Union.

- Threat of backward integration by WTGM, which may shrink the merchant market.

3 INDUSTRY ATTRACTIVENESS

3.1 Introduction

Strategy development requires an understanding of the competitive forces and structure of the industry in which the firm competes.[62] To analyze the structure of the global wind converter industry, a Porter Five Forces Model was developed (See **Appendix A**). The competitive forces and external environment that affect the wind turbine generator market also affect the wind converter market in the same fashion, as the wind converter market is a sub market to the wind turbine generator market. The Porter Five Forces Model describes the threat of entry, rivalry of competitors, power of suppliers and buyers, and the threat of substitute products.[63] The model shows the power the wind converter manufacturing firms have in the market and the forces that affect the success of firms in this market. Based on this analysis of the market forces, an industry attractiveness rating has been developed. This section shows that the global wind converter industry is moderately attractive in the near term and anticipated to be highly attractive in the longer term.

3.2 Bargaining Power of Suppliers (Low to Moderate)

The overall raw material supply base for wind converter manufacturers (WCM) has a moderate to low bargaining power. There are exceptions where the component supply is concentrated and the wind converter (WC) design has single-sourced these parts. The typical wind converter has 90% of its cost in purchased parts with the balance of cost being labor, overhead, freight, and duties [if exported from North America (NA)].

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[62] Porter, Michael, (1979). How Competitive Forces Shape Strategy, *Harvard Business Review*, March-April 1979, p. 3
[63] ibid, p. 6

3.2.1 Labor (+)

The labor component for the wind converter business is divided into two main groups, manufacturing and product development. Each labor group has moderate to high power in bargaining. Due to the specialized proprietary technology, the high voltages (greater than 400V ac), and complex nature of the product, the WCM invests in training the manufacturing team in the safe assembly and testing of these products. These staff members can only be replaced by investing in new people who have a ramp up time of four to six weeks. To test the final product requires additional training and a person who is a formally trained technician.

The product development teams are comprised of electrical engineers who specialize in power electronics and power system design. A typical hiring cycle for seasoned engineers is six to twelve months and they are usually hired away from competitors. They usually have a Masters or PhD degree and command a six-figure salary. In partnership with the electrical engineers are embedded software engineers. They have an extensive background in control theory and develop the embedded control software. These electrical and software engineers have high bargaining power. Mechanical engineers with thermal dynamics and electrical magnetic interference design experience are also required to create the product packaging. These mechanical engineers are less specialized for this industry but are in demand in other industries to perform product packaging. Thus, mechanical engineers have a moderate bargaining power. Companies compete for these talented individuals. It would take the WCM more than a year to regain design productivity if an employee left the organization.

3.2.2 Fabricated Custom Component (-)

Most companies competing in this market will custom design enclosures, transformers, inductors, printed circuit boards, and heat sinks. Contract assembly houses perform printed circuit card assembly. The contract manufacturers of these custom fabricated parts are less concentrated and more price competitive. The single biggest issue is the switching cost associated with changing a contract manufacturer. The cost can be substantial if the components are controlled by agency approvals such as Underwriters Laboratories (UL). In that case, the supplier has moderate bargaining power. The majority of these components can be fabricated by a wide number of sources, which reduces the contract manufacturer's bargaining power.

3.2.3 Off the Shelf Components (+, -)

The balance of components procured to assemble the wind converters is off-the-shelf parts, which fall into either concentrated supply or less concentrated supply. Many of these components are standard electrical or industrial parts such as resistors, contactors, and fuses, having many sources of supply and are commodity priced. The component manufacturers have relatively low bargaining power as they can be replaced or substituted. The balance of components such as transistors (IGBT) and CPU (DSP) are typically concentrated supply and single-sourced due to design considerations and specifications. The suppliers of single source of supply have high bargaining power, as there is no substitute or replacement without significant design changes. The switching costs for these components is extremely high and will only be undertaken once a design is in production if there is no alternative to a problem or issue. Switching is avoided at all costs. With these components, WCM have long term relationships with suppliers to guarantee price and supply.

3.3 Bargaining Power of Customer (Moderate to High)

The wind turbine generation market drives the wind converter market, with each WTG, which uses a variable speed drive train. A WTG can be designed with a variable speed or direct drive generation system. The MW-CLASS market is also segregated into a captive or merchant supply. The wind generation market for MW-CLASS turbines is project-driven by generation capacity developed in each geographic market. The largest geographic market is in Europe (See **Figure 6**). The wind WTGMs typically bid for these projects then install and commission the complete system. They have significant power over the wind converter manufacturer.

3.3.1 Concentrated Customer Base (+)

The customer base for the wind converters is concentrated with the top four wind WTGMs accounting for 70% of the wind converter market. The number one and number three players in the WTG market have merged.[64] This will concentrate the WC market even further. The top three wind converter customers control 55% of the world market and have a captive supply base. This leaves 45% of the wind converter market for merchant and direct drive competition in which

[64] BTM Consult ApS; World Market Update 2002, p. 28

there are five major customers. Typically, a WTGM single sources a wind converter to match the specification of the generation system and requires customization. This single-sourcing and generation project-based sales (cyclic demand) give the customer high bargaining power to negotiate pricing and terms.

3.3.2 Captive vs Merchant Market (+)

The primary competition for Xantrex in the merchant market is ABB, SEG, and Alstrom, all located in Europe. Xantrex is the only North American supplier of wind converters. With a concentrated supply based in the merchant market, WTGM select their wind converter supplier using an industrial marketing approach. They typically work in a single source environment and have only one wind converter supplier for each model of WTG. As the products are highly differentiated and customized to work within the system, they are designed in and specified by the WTGM. The WTGM will leverage their market position and projects to get the product designed to their specifications and negotiate terms. Since the product is customized, it cannot be sold to another WTGM without design changes. This gives the WTGM significant power over the wind converter manufacturer and requires the wind converter to be designed during the system design cycle.

The large captive market forces more competition in the merchant market as there is less market share to compete for. This also gives the merchant wind converter customer more power over wind converter suppliers, as competition is more intense.

3.3.3 Threat of Backward Integration (+)

WTGM have significant power of over wind converter suppliers by threatening to integrate backwards in the value chain and produce their own wind converters. WTGM may decide that the wind converter portion of the business is strategic and to vertically integrate it into their organization. This will reduce the size of the merchant market and increase competition. Many WTGMs are well financed and have the ability to acquire or develop the capability internally. GE Wind, Xantrex's largest customer is currently developing a wind converter to use in its next generation wind turbine. It has been unsuccessful to date and Xantrex has developed patented technology to try to deter them. It is only a matter of time for GE to succeed making it the largest threat to the merchant market. There is a trend in mature industries that firms become less

vertically integrated to focus on core competencies and outsource activities to exploit economies of scale and scope of their suppliers. As the industry reaches larger scales and matures, companies will want to specialize only in turbines and will start to outsource the wind converter business.

3.3.4 High Switching Cost (-)

The wind converter products are typically designed into the product during the design cycle of the wind turbine. Each generation of turbine changes every six years, which gives the supplier a supply cycle of approximately six years. Once the wind converter is designed and the systems are in production it is expensive for the WTGM to switch the wind converter supplier due to the integration and commissioning required in qualifying another supplier. A procurement team from the WTGM usually selects the wind converters with various functional groups represented. If the supplier is new, an extensive review process will also be conducted. It can take up to 12 months to select and commission a new supplier. This situation puts the WTGM into a better bargaining position and reduces the power of the wind converter manufacturer. Being single-sourced is a necessary due to the product being incorporated.

3.3.5 Differentiated Products (-)

The WTGMs require a customized product to integrate into the wind generation system. The wind converters are technically sophisticated units, which provide power conversion, turbine control, grid tie, and ride-through capabilities. Most wind converter suppliers have patented technology, which differentiates the product. Being a specialized and niche industry, most suppliers can extract sufficient rents to make this a profitable business. Once designed into a generation system, the turbine manufacturers must make the partnership work to have a successful business. The best chance for switching suppliers is in the next generation turbines. Typically the partnerships are long term and difficult to penetrate. This reduces the bargaining power of the WTGM.

3.3.6 Economies of Scale (+)

The top six WTGM in the merchant market control approximately 41% of the world wind turbine market.[65] This concentration gives the WTGM leverage over the wind converter manufacturers, as the company requires minimum volumes to have a competitive cost to reach minimum efficient scale. Xantrex only reached this point in 2003 with volumes in excess of 500 units, which represented approximately 10% of the world market. The WTGM can use this need for scale to increase competition in the wind converter market. This provides significant power to wind turbine manufacturers, as WCM will negotiate hard to get volume business at the cost of some profit margin.

3.3.7 Growing Market (-)

The average growth rate from 2003 to 2012 is estimated at 10.5% annually.[66] With this growth rate, all turbine generator manufacturers will see volume growth. The high growth will allow the economies of scale to develop at a number of WTGMs. The economies of scale put less pressure on the wind converter manufacturers, as their customers will be requiring higher volume of wind converters allowing the manufacturer to reach economies of scale and compete more effectively. The economies of scale may reduce their bargaining power somewhat as the wind converter manufacturer will have sufficient business with a couple of customers, but the industry is still very concentrated which will keep the balance of power with WTGMs.

3.4 Threat of Entry (Low to Moderate)

The major threat of entry into the wind converter market is firms producing products with complementary technology such as PV converters and motor drives. The market has cyclic sales due to a dependence on government incentives. The industry is also driven by differentiated products, which have moderate margins. The question competitors consider is when the market will be large and profitable enough to attract other new competitors to enter.

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[65] ibid, p. 28
[66] BTM Consult ApS; World Market Update 2003, Preface.

3.4.1 Leveraged Technology (+)

Companies with complementary technology such as motor drives pose the largest threat. It would take little investment to convert motor drives into wind converters. Motor drives are similar to wind converters in that they utilize similar hardware and software. A company like Rockwell International with a larger motor drive business could enter the market if it deemed it profitable. With the current size of $230M US, 41% of the market captive, and strong players, Rockwell will probably wait to see the wind generation market mature. With an annual growth rate of 10.5%, it will become attractive (as well as its positive political position as a green industry). Currently, this threat has not materialized.

3.4.2 Moderate Margin Business (-)

Due to the concentration of wind converter customers and cyclic sales due to power generation projects demand, WTGM have leveraged these market forces to reduce the price paid for wind converters. The WTGM bid on the generation project and require the wind converter supplier to assist in the bid process. If the project's bid is very competitive, pricing will be aggressively negotiated to ensure the success of getting the winning bid. In 2003, Xantrex had to negotiate reduced pricing to win the GE business from SEG. These reduced margins make the industry less attractive for new entrants, thus lessening threat of entry.

3.4.3 Large Capital Investment (-)

There is a significant investment required for a new entrant into the business. The investment includes capital expenditure for manufacturing capability; engineering capability and the capital required for paying operating expenses. For companies already in a complementary business, this investment would be in the order of $5 to $10 M initially and $2 to $5 M annually. This would be a significant hurdle, as sales revenue may not be seen for 12 to 18 months after the investment, due to development time and sales cycle. This would be a disincentive for entry into the market.

3.4.4 Highly Differentiated Product (-)

Wind converters are highly differentiated products with wide feature sets depending on the power level, feature, and drive train design. Typically, wind converters are designed in when a new

turbine is designed and produced during its life cycle. This requires the wind converter manufacturer to have a staff of design engineers who are able to design and modify products for each customer. This also requires a very flexible manufacturing system to make high mix products. This differentiation may be a barrier to volume manufacturers that are not adept at dealing with this type of variation. This mix of volume versus product variation creates a barrier to entry.

3.4.5 Sales Power Generation Project Driven (-)

A key driver of sales for this industry is electricity generation projects, which are driven by government subsidies. In order for wind generation to be competitive with hydro or gas driven power plants each kW/hr is subsidized. As the turbines become bigger, they have become more economical; therefore, wind generation becomes cost effective. Cyclic sales require the wind converter manufacturer to have working capital to ride through the low revenue periods. This feast or famine cycle can be a deterrent to entry for less capitalized companies. With the US government reducing subsidies in 2004, there is an expected decline in new generation capacity being added. In order for the business to become more stable, the cost of generation needs to be competitive with hydroelectric generation and government subsidies must be grandfathered out of the industry. Every jurisdiction in the world is currently subsidizing wind generation and these subsidies drive the demand and the cyclic nature of the industry. These cyclic sales reduce the attractiveness of the industry.

3.4.6 Patented Technology (-)

Another key deterrent to entry is a patent. Most wind converter manufacturers have patents on their proprietary designs. A key issue for wind converter manufacturer increasing market share is its patent portfolio. Patented technology can be a large deterrent, as Xantrex has seen with Asian competitors. They have not entered the US market due to the several patents that Xantrex holds and instead are trying to partner with Xantrex. A large portfolio of patents is a large deterrent.

3.5 Rivalry Among Existing Competitors (Moderate)

The rivalry amongst current competitors is moderate. The wind converters are typically designed in to meet the drive train specifications and are highly differentiated. Once designed in, it becomes the exclusive wind converter used for the system life cycle, which is 5 to 7 years. With the merchant market at 33% of the overall market (See **Figure 5**), competition increases close to each wind turbine design cycle.

3.5.1 High Concentration of Competitors (+)

The high concentration of wind converter manufacturers intensifies the competition during the design cycles of the wind turbine generator. Most wind converter manufacturers to the industry have strategic partners and have long term relationships. In order to gain market share, the wind converter manufacturer must displace the incumbent during a design cycle at a WTGM. This can be accomplished by developing proprietary patentable technology, which is in demand due to features needed or is regulated by the electric utilities. This high concentration of supply increases competition.

3.5.2 Differentiated Products (-)

Wind converter manufacturers develop differentiated products that are tailored to each wind turbine system. Once designed in, competitors are prevented from supplying this generation of wind turbine due to the cost of switching. Having differentiated product reduces rivalry between design cycles.

3.5.3 High Switching Costs (-)

Once a wind converter manufacturer has been selected to provide a system to the WTGM and is in production, the cost of switching prohibits competition. For a WTGM to change supplier, it will require re-integration and testing, field commissioning and validation and updating of manufacturing and servicing documentation. This changeover comes with a high price and long timeline, which could be up to 18 months. Typically, the WTGM have long term agreements in place and work with a single supplier. The high switching cost reduces rivalry.

3.5.4 Low Economies of Scale (+)

Due to the wind converter being highly differentiated, large, low volume, and technically complex, a competitor does not need a large volume to have a minimum efficient scale. A wind converter manufacturer could capture 5% of the market and have enough scale to earn adequate returns. By having a low economy of scale or scope, competition and rivalry will increase, thus producers of wind converter will compete on a cost basis.

3.5.5 High Capital Cost (+)

The capital cost for this industry is in two forms; equipment and staff. The wind converter industry requires specialized equipment to design, validate, and manufacture this type of product. The engineering functions require specialized loads, test equipment, and environmental equipment to validate the designs that can run from hundreds of thousands to millions of dollars. The manufacturing of this product requires similar equipment to assemble and test these high power products. The organization requires highly skilled engineering staff that earns high salaries to design these products. Once an organization has acquired these capabilities, it provides an exit barrier to the business. With high margin, potential, and growth, competition will increase as new entrants emerge and current competitors will not exit due to capital invested into the business.

3.5.6 Well Capitalized Competitors (+)

The industry faces a situation with all wind converter manufacturers being well financed and able to develop technology, partner with customers, and ride through the cyclic nature of sales. This capitalization enhances competition by enabling all wind converter manufacturers to bid on new design opportunities. Many of the manufacturers are in complementary businesses like PV, motor control, and generators, which provide additional sources of capital to invest in this high growth business. As the market grows, suppliers will compete more vigorously to gain market share and will partner with new WTGMs.

3.6 Threat of Substitutes (Moderate to High)

The threat of substitutes is moderate to high due to subsidies in many jurisdictions, which make wind power generation economical. Wind generation is not a mature industry with economies of

scale needed to economically generate electricity. A typical 3MW wind farm generates electricity at $.059 per kWh while a 52MW wind farm generates electricity at $0.036 per kWh. This is a 40% reduction in cost including tax credits.[67] Wind energy is capital intensive, due to equipment cost and construction of plants. The economics of wind are sensitive to interest rates, which are higher due to risk and maturity of the industry.[68] The main substitutes for generating electricity are coal/gas/biomass fuel generation plants, hydroelectric generation, and nuclear and PV generation.

3.6.1 Alternate Generation Technologies (+)

3.6.1.1 Hydro Electric (+)

The most popular substitute is hydroelectric power due to its low electricity generation cost. In today's economy, new hydroelectric projects are not being undertaken in North America due to large capital cost, environmental impact, and politics. In developing countries like India and China, hydroelectric projects are still being undertaken where sufficient water resources exist. With a lower cost of capital, mature technology, and lower generation cost, the economics and risks are certain. This increases the use of substitutes for wind generation in third world countries.

3.6.1.2 Thermal Generation (+)

Thermal generation plants, coal, gas or biomass, are under construction in North America and the developing third world. These projects give investors a predictable return by using low cost fuels and having lower cost of capital, and owning mature technology. With the Kyoto Accord being ratified and the reduction of green house gases, these power plants are losing their appeal. The economic impact of Kyoto on the generation cost is not yet solidified and it may increase generation costs. These projects are not considered green and have faced opposition in North America as witnessed with the thermal plant project in northern Washington State where many petitions and public hearings were held due to pollution issues on both sides of the border. Thermal generation is a viable substitute in the short term.

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[67] American Wind Energy Association; The Economics of Wind Energy; Retrieved May 10, 2004, from www.Awea.org, p. 2

[68] American Wind Association; Comparative Cost of Wind and Other Energy Sources; 2001; Retrieved May 10, 2004, from www.Awea.org, p. 2

3.6.1.3 Photovoltaic (-)

Another green generation technology is PV generation. This technology requires solar panels connected to a wind converter that is then tied to the electrical grid. This industry is less mature than wind generation; the cost of this generation is high due to the cost of solar panels and limited effective use in areas with large amounts of sunshine. This technology requires large areas of land for commercial PV farms and the land has a single use. Wind farms occupy large areas but can be used for other purposes such as farming. It in not uncommon in northern California to see cows grazing under the windmills. The economics of PV do not make it a viable substitute, thus reducing the threat of substitute.

3.6.2 Fixed Speed Turbines (+)

A significant substitute for the wind converter is a fixed speed direct drive turbine used by some turbine manufacturers which eliminates the need for the wind converter. Vestas, the number one supplier of wind turbines uses the technology and has a 22% market share. Direct drive technology is simpler and more reliable but does not get maximum harvest of energy. There are drawbacks to fixed speed turbines especially in gaining maximum energy harvest at different wind speeds. Variable speed drives are still the most common with the majority share of the market. They offer advantages of higher power quality and energy capture at fixed speeds. If the market leaders expand direct drive, fix speed turbines, this would have a large negative effect on the merchant market due the concentration of customers and lower volumes. This could affect minimum efficient scale and make wind converters more costly.

3.7 Attractiveness of Wind Turbine and Converter Industry

The global wind turbine and wind converter industry have a moderate attractiveness in the near term but a high attractiveness in the long term (See **Appendix A**). With the demand for clean reliable power around the globe increasing every year due to the increased dependence on electricity, the wind generation industry is on the verge of major growth over the next decade.

Energy produced from renewable sources is expected to grow from less than 1% today to over 20% by 2020[69], which will at least sustain historic growth rates far into the future.[70]

Wind power is environmentally friendly, produces no green house gases, allows land for multiple uses and its excess of 10% average growth year on year make this industry attractive[71]. Today, it is close to a nine billion dollar industry. [72] The major issues curtailing this growth are the reliance on subsidies to make this form of electrical generation economical, the current cost of wind turbine generators, and the generation cost. In the near term, the lack of consistent policies on renewable energy generation will cause uneven demand or even declining demand, such as in the USA in 2004, where the PTC was not renewed. This will cause severe down turn in the industry in North America.[73] The USA and Danish market downturns will cause a market decline of 4% in 2004 over 2003.[74]

A key factor in the cost of developing the generation capacity is the cost of capital. The US financial community finds wind power novel and risky and demands higher returns thus causing financing cost to rise. This increases the cost of generation per kWh. A study found that a 50MW wind farm could generate electricity at $0.05/ kWh, but if it used financing for a natural gas project it could generate the same electricity for $0.039 / kWh[75], a 20% reduction.

Another challenge facing the industry is the lack of standards for the generation system and how it is interfaced to the grid. In the PV industry, there are UL and CE standards for system interfaces to the grid. In the wind generation business, it is up to each utility and government jurisdiction as to the regulation pertaining to wind generation. Even though the IEC working group 88 has created a standard, it has not been universally adopted by utilities as seen with the recent petition to FERC by the American Wind Energy Association for a universal standard (Docket No. RM02-1-001). The petition is for a common grid interconnects standard. This may require each installation to have feature changes to allow it to interface to the grid. This also

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[69] European Wind Energy Association; Wind Power Targets for Europe: 75,000 MW by 2010 Briefing Retrieved May 10, 2004, from, www.ewea.org , p. 3
[70] American Wind Energy Association; Wind Power Outlook 2004, Retrieved May 24, 2004, from www.Awea.org, p. 2
[71] American Wind Energy Association; Wind Power Outlook 2004, Retrieved May 24, 2004, from www.Awea.org, p. 4
[72] BTM Consult ApS; World Market Update 2003, Preface
[73] ibid, p. 24
[74] ibid, p. 24
[75] American Wind Energy Association; The Economics of Wind Energy; Retrieved May 10, 2004, from www.Awea.org, p. 4

raises the cost of generation. Even with these cost issues, the industry is attractive due to high growth, continual reduction of generation cost with each new generation of turbine, maturing industry and low environmental impact compared to substitutes.

To be successful in the wind converter business, an organization must continually lower its cost structure to decrease the cost of generation. The industry is on the verge of being as economical as substitutes. Competitors must be able to add value through development of innovative technology, which is patentable, and give the firm a competitive edge. The wind converter manufacturers must be able to reach a larger scale to reduce cost. Consolidation is starting to happen in the industry. A wind converter manufacturer must partner with WTGMs, gearbox, and generator manufacturers to make a more integrated and reliable drive system. These partnerships will provide longer-term supply cycles. A WCM must understand government and utility regulations to ensure they can communize the wind converter for many jurisdictions. This will reduce the overall cost to the supplier.

The future of the wind energy business appears promising. Growth in wind generation will likely be driven by environmental regulation like the Kyoto Accord[76], lower generation cost, and demand for electricity. The industry growth forecast is very conservative.[77] As a clean source of power with almost endless areas where generation capacity can be installed, it is ideally suited for the 21st century. Many citizens do not want thermal generation plants in their proximity due to environmental concern of pollution and green houses gases as was seen in protests to the plant proposed in northern Washington state. Hydroelectric power is constrained by availability of water resources. The cost of electricity generation using PV technology makes it uneconomical on a large scale due to the capital costs.[78] The only thing holding back explosive growth in wind industry is the cost of generation. The industry is on the brink where this technology will be very cost competitive with its substitutes without PTCs.

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[76] Government of Canada, A discussion Paper on Canada's Contribution to Addressing Climate Change, ISBN: 0-0662-32176-6, p. 7

[77] BTM Consult ApS; World Market Update 2003, p. 37

[78] Focus on Renewable Energy, New Analysis Projects 20% Renewables by 2010, *Wind Directions*, January/February 2004, Retrieved May 10, 2004, from http://www.ewea.org, p 37

4 ANALYSIS OF XANTREX CAPABILITIES TO ADDRESS THE WIND CONVERTER MARKET

4.1 Introduction

Xantrex is a vertically integrated firm with a function-based organization structure. The organization is structured around operations, sales, marketing, engineering, customer service and IT, human resources, quality assurance and finance. The firm currently employs approximately 550 people, principally in Burnaby, British Columbia; Arlington, Washington; and Livermore, California. The majority of staff is located in Burnaby and Arlington with a small contingent of 40 in Livermore. The sales, marketing and engineering teams are organized to focus on the target markets (mobile, distributed power and programmable). The industrial scale PV and Wind business is performed in Livermore California, with sales, engineering, and customer support.

This section consists of an internal analysis of Xantrex. The analysis is based on a strategic "fit" model[79] and determines Xantrex's fit to its generic differentiation strategy. The end of the section provides an assessment of "Fit" to the strategy.

4.2 Xantrex Strategy 2002

The Xantrex corporate strategy is to reposition itself from a product-component supplier to a provider of system solutions provider. It plans to achieve this end by leveraging core product platforms into systems products to meet market needs.

The strategy for the wind converter business is to develop new products that work around the GE IP issues (patent 039), to upgrade products to meet European standards and to provide system solutions by integrating dynamic generator products with Xantrex products through the use of intelligent software. Currently, Xantrex has a partnership with Loher and Winergy to develop next generation drive trains for variable speed wind turbines. Xantrex is to supply control

hardware and software. Loher is to provide the power electronics and generators and Winergy is to provide the gearbox.

4.3 Strategic Fit Assessment

To evaluate the effectiveness of the current Xantrex strategy of providing differentiated products, a strategic fit assessment based on the generic "Fit" model will be performed. A scorecard will be developed with each criterion being rating a strategic fit out of ten points, where 10 is a perfect fit (See **Figure 11**). Strategic fit is achieved when there is fit between strategy, organizational capabilities, core competence, and markets.[80] Each score is anchored to the dominant side of the scorecard for that criterion. As depicted in **Figure 11**, the structure is rated at 4 out of 10 for a fit with a differentiation strategy. It is anchored on the cost based side of the scorecard. This score can also be thought of as 6 out of 10 for a fit with a cost based strategy.

Figure 11 Xantrex 'Fit' Score Card, 2004.[81]

	Cost Based Low Cost / Adequate Quality			**Differentiation** High Quality / Adequate Cost
		Score		
Product Strategy	Rapid Follower		**7**	Innovative
R & D Expenses	Low R & D		**6**	High R & D
Structure	Centralized	**4**		Decentralized
Decision Making	Less Autonomy	**3**		Autonomy
Manufacturing	Economies of Scale		**6**	Economies of Scope / Flexible
Labour	Mass Production		**8**	Highly Skilled / Flexible
Marketing	Comparative / Push	**5**	**5**	High Cost / Pioneering / Pull
Risk Profile	Low-Risk		**8**	High-Risk
Capital Structure	Leveraged		**10**	Conservative

Before 2002, Xantrex operated as a component (box) supplier and competed using a cost-based strategy. A strategic plan created during the last half of 2001 shifted the focus from a cost-based component supplier to a differentiated system solution supplier. This change in focus was to be achieved by: consolidating four business units into three, focusing development in current markets, penetrating the programmable original equipment manufacturer (OEM) market,

[79] Bukszar, Ed, MBA 607 lecture slide 8, SFU, January 2004
[80] Bukszar, Ed, MBA 607 lecture slide 8, SFU, January 2004
[81] Bukszar, Ed, MBA 607 lecture slide 10, SFU, January 2004

enhancing marketing capabilities and brand, developing a clear manufacturing strategy, updating skills in product development, manufacturing and service, and by aligning performance with incentive structures. In August 2002, Xantrex changed the organizational structure from decentralized business units to a centralized functional organization to improve efficiencies. The strategic focus continued as outlined in the 2002 strategic plan.

4.4 Product Strategy

Xantrex has always attempted to differentiate its products through market knowledge and product design. It is currently following an innovator strategy in developing new system products. Its challenge is the three distinct markets and 15 sub-segments in which it competes. Xantrex differentiates itself by developing complete solutions and network products. In the mobile market, Xantrex is investing $2.5 million to develop a networked power system. In the distributed residential market, Xantrex is investing $2 million to develop grid-tie and non-grid-ties systems for residential and small commercial applications. Xantrex is also investing in the development of a new line of photovoltaic inverters for the commercial market. In the consumer market, Xantrex designs differentiated products but compete on a cost-based strategy. The renewable wind business has no significant investment in new product development and the product strategy is based around removing the barrier to market by the patent GE acquired when it purchased Enron Wind. The patent (039) is licensed from GE and prevents the technology to be sold to non-GE customers. Xantrex has not created differentiated system products in this market for four to five years. The wind converter market is driven by generation projects around the world and supplied by strategic partnerships in wind turbines, power conversion, and control systems. Xantrex has a partnership with GE Wind, but GE has designed a wind converter. Xantrex has invested heavily in other markets in differentiated products resulting in the strategic fit of 7 out of 10.

4.5 R&D Expense

Xantrex has typically capped R&D (engineering) gross spending at approximately 7% of revenue prior to tax credits (SRED). This spending includes contract engineering revenue, customer non-recurring engineering costs, and any other engineering revenue. The R&D spending in 2003 was 7% of revenue and will increase to 7.8% in 2004. This degree of investment is equal to industry norms and does not coincide with a differentiation strategy. High-differentiated organizations

typically spend over 12 % of revenues on R&D and segregate product development from research. Xantrex currently spends its entire engineering budget on product development with some R&D on specific product programs. There is no specific research program at Xantrex. In order for it to stay differentiated, it must create new technology for the mobile and distributed market. Xantrex needs to be developing its next generation platform to be integrated into products being produced in the next two to three years. In order to expand its wind business, Xantrex needs to invest in new technology development in power conversion and control. The current technology is eight years old and has limited penetration due to the GE wind patent. A new platform needs to be developed to stay competitive in this market. Strategic fit 6 out of 10.

4.6 Structure

Prior to the reorganization in August 2002, Xantrex was organized into three business units, an operations unit, and a corporate unit. Each market unit consisted of Sales, Marketing, Customer Service, Engineering, Applications Engineering, and Finance. All manufacturing was done by Operations. HR and Finance supported the business units and operations. Each unit was market focused and operated independently. In August 2002, the organization was centralized into functional departments of Sales, Marketing, Engineering, Operations, Human Resources, Finance, QA, IT, Customer Service and Program Management. This centralized structure is typically implemented to support a cost base strategy rather than a differentiation strategy. This change was made to improve efficiencies but engineering, marketing, and sales are still organized around product markets. Xantrex has moved into a hybrid organization, market sub teams in a centralized structure. This type of organization has diluted the focus in some markets and created conflicts around resource allocation. As a result, some markets are not supported to the extent they should be. By competing in 15 distinct segments, Xantrex is challenged to support them at a minimum level to sustain market share and develop new products. Strategic fit 4 out of 10.

4.7 Decision Making

Since the reorganization from a decentralized to a centralized structure, decision-making has become less autonomous for the various market groups. Centralized decision-making structure supports a cost-based strategy. This strategy is effective for the consumer group but is not effective to the other market segments. Market segments with lower growth and financial returns

have a smaller voice in product investment decisions, staffing decisions and business planning. The programmable group, which sells products with a high margin and high differentiation, has a small say in product development and marketing efforts within the company. The current structure of decision making will reduce the ability of the company to maintain market share and will reduce the contribution margin supplied by these products. The programmable market represents 13% of overall revenue but has 19% of the contribution margin of the entire company. Market share loss will have a large impact on the bottom line. Strategic fit 3 out of 10.

4.8 Manufacturing

Xantrex currently manufactures products in Burnaby, Arlington, and at two subcontractors in China and one in the Dominican Republic. The strategic plan called for the development of a clear manufacturing plan. Today the manufacturing strategy is not clear and Xantrex is moving toward an outsourced manufacturing model. The outsource strategy does not support all market segments and is appropriate to a cost-base model. The manufacturing plant in Burnaby is flexible and employs highly skilled staff, which supports the programmable market. Its key strategic attribute is short lead-time and the ability to customize standard product. Thirty percent of the business is customized and 35% is in/out in the same month. If the lead-time lengthens, the in/out sales decrease. The key order winner is lead-time. The plant carries virtually no finished goods and supports the differentiation strategy.

The Arlington plant has similar characteristics of short lead-time and higher volume, low mix products and uses an MRP driven, push-manufacturing model. The plant supports products for the mobile and residential back up markets. The Livermore based products of low volume high mix has recently been transitioned to the Arlington plant. The Livermore products have the same attributes as those in the plant in Burnaby. Livermore products support commercial PV and Wind converter markets. It is unclear how this transition will support the differentiation strategy.

The Chinese subcontractors produce mid to high volume products at a low cost for the consumer and mobile markets. The sub-contractors support a cost-based strategy for the consumer market and provide economies of scale and scope for the mobile market. The main challenge of the out-sourced strategy is effectively managing the high cost of finished goods. These plants require long lead times (typically 6-8 weeks) and produce high volumes. The current manufacturing

strategy does not effectively support the current strategy as the majority of product is produced offshore in a long lead-time, less flexible plant. Strategic fit 6 out of 10.

4.9 Labor

Xantrex has the benefit of both mass market and a flexible labor force. The onshore manufacturing facilities have highly skilled production workers, which enables them to do low to moderate volume product, product customization, and engineer-to-order products. Its offshore manufacturing is mass production with a low skill set labor force focused on high volume manufacturing. The single biggest challenge is the depth of skills set in the operations management team. In the last three years, Xantrex has not focused on providing any employee, managerial or leadership development. The departure of a key staff member can send ripples through the organization (loss of tacit product and market knowledge) because a replacement person cannot be readily found with similar experience and skill. Another challenge is the high cost of flexible manufacturing. Xantrex is moving some of its moderate cost products offshore, risking the flexibility to compete with lower cost producers both onshore and off.

Xantrex also benefits from a highly skilled engineering, marketing, and sales team. Xantrex has the ability to design and market any technology or power level from 50 watts to 2 MW to meet any of the 15 market segment needs. The organization faces a two-fold challenge: the first is to simultaneously defend all markets and the second to execute the product development programs cross-functionally. Due to the breadth of markets, there are not enough resources to simultaneously develop products for all markets. The company has chosen certain markets for the current product programs and left other markets vulnerable. The execution of the product development programs has been inconsistent due to the inconsistent support from different functional groups supporting these programs. Many times programs are stalled or late due to staff shortages or skill sets not aligned with needs. Until 2004, engineering provided the program management staff to plan and manage the development programs. Of all the functional groups, only engineering had the experience or will to drive development programs. A small pool of engineering managers had to manage as many as 20 programs in development at any one time. This effort strained the engineering management team.

The Livermore team has the skills necessary to support the commercial wind, the PV, and the alternate energy markets. These skills, both technical and market, are held by a handful of staff.

Xantrex is vulnerable if these people leave, as they have been instrumental in customer relation with GE Wind, product design, and manufacturing. The staff has also been key in receiving government contracts with Sandia Labs, and the National Research Electrical Lab (NREL). Xantrex receives approximately $2 million a year in grants from these organizations and has not developed key relationships outside of the Livermore team to manage these grants.

The focus for 2004 is to align capacity and skill sets across the functional teams to improve execution in conjunction with the development of a program management office. Strategic fit 8 out 10.

4.10 Marketing

The current Xantrex marketing strategy is a push strategy. Xantrex directly markets and sells to retailers, wholesalers, distributors, dealers and OEMs. In the retail business, both in mass market (i.e. Canadian Tire) or specialty retailers (i.e. West Marine), it uses promotions, trade spending, and marketing materials to push products through the channel. With wholesalers, distributors, and dealers it provides marketing material to promote the products. With OEM customers, Xantrex sells directly to a buying team. Typically, the OEM already knows the company in the industry, and then Xantrex uses a pull strategy. By advertising in industry publications, trade shows, user associations shows (i.e. Family Motor Coach Association) and direct mailing, Xantrex provides pull for the products.

As an overall mix, Xantrex uses a higher proportion of push strategies than pull strategies. Xantrex has investigated some pull strategies such as infomercials and television advertising, but the cost was seen as high risk. A typical infomercial costs approximately $1M. Xantrex has used QVC home shopping in the United States to help with its pull strategy. It has provided free television exposure, which has increased sales in its retail channels.

Xantrex needs to develop its pull strategy in the wind converter market. Without GE wind, there would be no business penetration. To support its infrastructure costs, Xantrex needs to create a partnership with a WTGM and system integrator to create a systems solution we can market across the globe. The key to penetrating this market is a solution, which can be sold to these generation projects being installed by various power utilities. This will provide pull for Xantrex products and services in the high power markets such as commercial PV.

Xantrex is developing pioneering products in many markets but does not spend the appropriate money marketing these differentiated products and has not achieved the desired market penetration. The sales and marketing team are using a cost-based strategy to sell these differentiated products based on cost. The organization needs to change its selling strategy to achieve higher margins and market share. So far, this has not been achieved. The current market strategy marginally supports our differentiation strategy. Strategic fit 5 out 10.

4.11 Risk Profile

Xantrex has a high-risk profile in the current product programs, which supports the differentiation strategy. The company is spending approximately $6 million on four-product development programs in its transformation to a solutions company. In the mobile market, Xantrex is pioneering a new network protocol enabling all devices in a vehicle to communicate and control. Xantrex is approximately two years ahead of its competitors and will be looking for key customers to adopt this protocol. The success of this strategy will depend on the market penetration. It is the key to success in the recreation vehicle market. The company has a challenge in shifting its paradigm from cost to solution competition. In many instances, they still sell based on cost.

In the consumer channel, Xantrex is competing on cost but delivering a differentiated product. Xantrex has a low investment in development as it develops these products with offshore partners. While the investment risks are lower, the company has significant inventory risks as retail customers purchase products in large volumes. The company has had to discount some products to move stale inventory, as the lifecycle is very short in the consumer market.

The wind converter market relies on heavy investment in R&D coupled with strategic alliances in systems and wind turbines to achieve market penetration. The market is driven by generation projects across the globe. If Xantrex does not invest in both R&D and these alliances, it will be excluded from the market. Xantrex also lacks an alliance with a WTGM.

In all markets, Xantrex has a high investment risk, which supports our strategy. Strategic fit 8 out of 10.

4.12 Capital Structure

Xantrex has a 99% equity structure. Other than short-term credit, Xantrex is virtually debt free. This is a very conservative structure and highly operation-leveraged for cash flow. Xantrex is currently in a high liquidity position to fund growth and marketing activities. This structure fits with the current strategy. Strategic fit 10 out of 10.

4.13 Assessment

Xantrex has not yet made a complete transition to a differentiation strategy but is on the path towards it. As stated in the 2002 strategic plan, Xantrex wants to make a shift from component supplier to a solutions supplier, or from a strategic perspective, cost based strategy to a differentiation strategy. In some markets, like consumer, the company is competing with a cost-base strategy with differentiated products while in the programmable market it is competing with a differentiated product with a large portion of business coming from customized products. As can been seen from **Figure 11** Xantrex is currently in the middle of the road with anchors in both strategies. In order to succeed in the long term, the organization needs to align its strategy with each market segment.

The consumer market is currently competing on a cost based strategy with differentiated products. The team is developing innovative products and creating products categories but not achieving the margins expected of differentiated products. Selling these differentiated products based on cost competition does not support the risk, expense, and marketing capabilities of a differentiated strategy. The team needs to either develop cost-based products and reduce investment or change its marketing mix to extract higher margins.

The mobile market is currently a highly differentiated market with leading edge products, which extract high margins except for the RV segment. The mobile market team scores high in all capabilities except in manufacturing and marketing. The team is investing heavily in new differentiated products with high risk of return but struggles with its marketing mix. The mindset of the sales team has been cost based and it needs to develop market strategies to extract higher margins for RV OEMs to support the investment. The OEMs rely on Xantrex to provide significant design resources to assist them with integration. By becoming more of a system design

house, the company could lock out competitors and significantly increase switching costs for RV OEMs.

In manufacturing, Xantrex utilizes both economies of scale in offshore manufacturing and flexible manufacturing onshore. With the manufacturing sites in North America, Xantrex has not achieved minimum efficient scale to utilize economies of scope in any one facility. By not having a minimum efficient scale, the cost structure is high. In order to reduce the cost structure, all three manufacturing sites should be consolidated. Consolidation will reduce overhead costs and enable Xantrex to maximize economies of scope. It would also allow them more flexibility by cross training staff, and improve labor usage thus providing lower cost products. The consolidation would support the strategy significantly. The offshore manufacturing gives Xantrex economies of scale and significantly lowers cost; it does however require longer lead-time and more finished goods inventory. This does not allow Xantrex to respond to changes in demand in a responsive fashion.

The renewable energy market is split into commercial and residential. The commercial markets have two segments, wind, and PV. The PV market has highly differentiated products that extract margins to sustain the business. Xantrex is investing in updating the product line to keep the products differentiated. Xantrex has monopoly penetration in this market and sells through system integrators using a pull strategy. The current manufacturing operation supports the current strategy. The wind business relies on generation projects and strategic alliances to market and sell products. Xantrex needs to create a marketing mix and alliance to continue to penetrate this market. The company also needs to invest in new product development to create a product line, which will allow it to bypass the GE patent 039. This is a high-risk endeavor, as the company has no strategic alliance with a wind turbine generator manufacturer or system integrator. GE Wind, the current WTG partner has developed its own wind converter. To penetrate this market Xantrex needs to improve its product development and marketing strategy. The residential renewable market is mainly PV with grid-tie inverter products. Xantrex is investing heavily in differentiated products. Xantrex is following the current differentiation strategy.

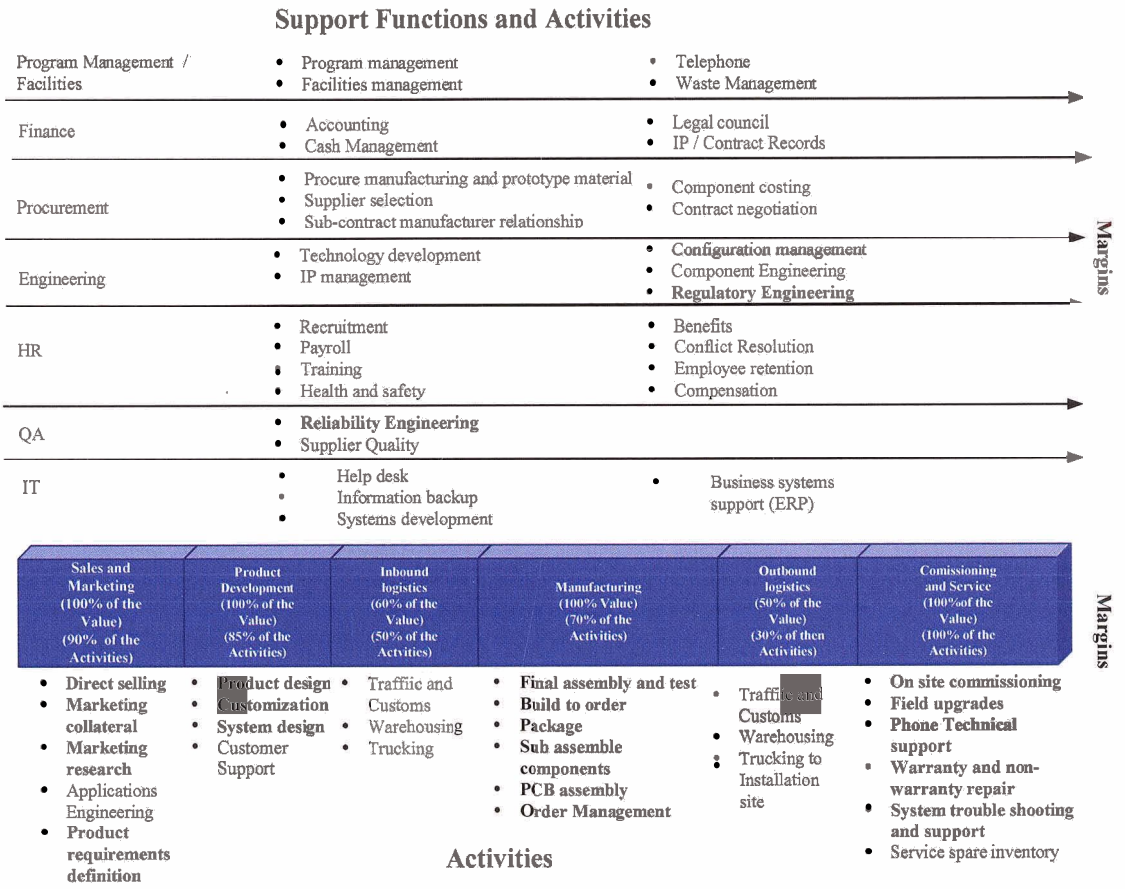
The programmable market is also differentiated and supports the strategy in all aspects except R&D. Xantrex has not invested in new product development, as this is a mature slow growth market. The company's current strategy is to brand-label other products to supplement the product line. Recently, the competition has released highly differentiated products into the market

that will decrease the company's market share. Xantrex has not kept pace with other market competitors and has given up its spot as the innovator in the market. The company has not kept minimum investment in this market to maintain its product leadership.

Overall, Xantrex needs to focus on four areas to improve its strategic fit: structure, decision-making, manufacturing, and marketing. Before the August 2002 reorganization, Xantrex had a decentralized autonomous structure, which supported the differentiation strategy. The organization has moved to a centralized structure to achieve more economies of scope and scale with less autonomous decision making from a market perspective. This organization has diluted focus such as the programmable market. Xantrex needs to decide which markets to focus on as the current structure cannot effectively support all markets. The manufacturing operations need to be consolidated in North America to lower the cost structure and increase flexibility across the various market segments. From a marketing perspective, Xantrex should align the marketing mix with the differentiation strategy and make investments in marketing programs to increase penetration and consumer awareness. If Xantrex makes these changes, it will align the differentiated strategic fit with the capabilities of the organization.

5 XANTREX VALUE CHAIN

Figure 12 Xantrex Value Chain For Wind Converter Business



5.1 Introduction

Xantrex performs many of the activities in the wind converter value chain. Figure 12 Xantrex Value Chain For Wind Converter Business depicts the Xantrex value chain footprint and the percentage of value performed within the organization for each step in the value chain. In some areas of the value chain, Xantrex performs a higher percentage of activities than a typical wind converter manufacturer due to its vertical integration. The section will describe the activities

Xantrex performs and the value associated with those activities. It will conclude with an overall assessment of core competencies and issues pertaining to its value chain.

5.2 Sales and Marketing

Wind converters are marketed using an industrial marketing approach, which requires selling to a team from the customer's organization. The customer buying team usually consists of representatives from sales, operations, engineering, marketing, and quality assurance. The wind converter is designed into the wind turbines system and it takes approximately 12 to 18 months to complete a sales cycle. A sales cycle encompasses all of the activities from initial wind turbine company contact to signing a supply agreement for a specific wind converter system. The supply agreement usually run throughout the life cycle of the wind turbine, which is three to five years. The core competencies required are relationship management, technological shrewdness, application knowledge, and ability to provide after sales service. ISO 9001 certification is a requirement for transacting business with a WTGM. Currently Xantrex performs all of the sales value chain activities, which includes direct selling, marketing collateral, product management, advertising copy, and applications engineering. It out sources market research and advertising to research firms like Frost & Sullivan. These functions represent approximately 100% of the value of sale and marketing activities in the value chain and Xantrex performs 90% of the activities. Due to the amount of customization of the wind converter, the sales applications team works with the product managers and customers to create the product requirements. This product requirement is then translated into a product design.

5.3 Product Development

Xantrex has traditionally vertically integrated all of the engineering disciplines required to design its product. These disciplines are electrical, mechanical, software engineering, technical communications, and configuration management. Xantrex has core competencies in power electronics, in mechanical and in software design. The engineering team also has deep market knowledge as the engineers work closely with customers and the service organization defining and servicing wind converters. The engineering team spends time in the field learning the customers' applications. Xantrex uses a stage gate process to manage product programs through its life cycle. The stage gate process defines how engineering designs, how cross function team

interaction and how design verification is performed. The process is divided into definition; development, launch, and post launch stages with specific activities defined in each stage.

The wind converter design team contracts out the thermal and magnetic design. All other design activities are performed in house in Livermore, which represents 100% of the value and 85 % of the engineering activities. These outsourced design activities are key competencies the wind converter team needs to develop internally. The team is vulnerable if the contractors are not able to support Xantrex in future. Due to a skilled labor shortage in Livermore, California and lack of suitable replacements elsewhere, Xantrex has not been able to hire skilled engineering staff to fill these competencies.

The wind converter design team translates the market requirements into a specification and creates a prototype for customer evaluation. Due to the modular nature of the design, a customer can get a prototype within three months for field-testing. The engineering team typically works with the customer to install, commission and test the field trial units. Xantrex adds significant value by having the ability to simulate, create, and test a prototype quickly, and provide assistance in field trials. This technical ability provides significant credibility to the Xantrex ability to deliver highly customized products. The next stage in the process is commercialization of the design.

Once the customer has validated the prototype design, the engineering team prepares the product design documentation for product launch into manufacturing. These activities include creating final version of all fabrication drawings, bill of materials (parts lists), software files, and assembly drawings. The production-engineering group in operations designs all production test equipment and manufacturing process definition.

The Livermore team is geographically split from the rest of the engineering team in the Burnaby facility. The Burnaby engineering team performs all other design activities for all the other markets. The Livermore engineering team designs products for the wind turbine market, PV market, and emerging, large scale distributed markets. The team reports to the VP of Engineering in Burnaby. The Burnaby engineering organization follows the stage gate development process (Product Creation and Support). The Livermore team, due to its distance and culture, has not adopted all of the design practices and processes followed by other project teams based in Burnaby. Currently the Burnaby and Livermore engineering teams work independently on product development project but work by common processes. The lack of discipline and process

implementation has lead to a number of design defects reaching the field, in turn causing customers to question the ability to deliver high quality products.

5.4 Inbound Logistics

Inbound logistics consists of four value added activities: procurement, customs brokerage, warehousing, and freight. The logistics team performs 50% of these activities and outsources customs brokerage and freight. The team liaises with outsourced partners who actually do the work of customs processing and freight forwarding. Inbound freight could come from any geographic location as Xantrex sources materials internationally. Xantrex currently stores (warehouses) all inbound components at each manufacturing location.

The inbound logistics function is initiated with an order from a customer. As Xantrex assembles to order, the order is placed in the materials requirements planning system (MRP), which then initiates a work order and triggers parts procurement. The procurement team uses the sales forecast to plan materials usage and pricing but places component orders only when customer orders are received and committed. The typical material lead-time is approximately 12 weeks. The logistics team then arranges freight based on the "Free on Board" (FOB) point. For North America suppliers, the FOB point is the Xantrex dock and the supplier arranges freight and brokerage. For offshore suppliers, the FOB point is the supplier's dock and Xantrex arranges freight and brokerage. Once the parts arrive at the Xantrex dock, they are received into the inventory system and stored in the components warehouse.

The logistics team is responsible for negotiating and managing shipping costs. The wind converters use large components with high shipping cost. This necessitates fabrication suppliers (2 to 3) to be in close proximity to the manufacturing plant in Arlington. It is critical for the team to make trade offs between component cost and landed costs (cost including freight) to ensure Xantrex has the most appropriate component cost. This is a key competency Xantrex should keep in house.

5.5 Manufacturing

Xantrex manufactures products in-house as well as outsourcing the manufacturing of subassemblies and fabricated parts, representing 70% of the activities and 100% of the value. The

wind converter is a low volume, high variation product, which requires an "assemble to order" manufacturing model. In the wind converter manufacturing process, printed circuit board (PCB) assembly for through-hole technology is done in the Burnaby factory. The surface mount technology PCB is outsourced to local contract assembly firms in the Arlington area. Most electronic manufacturers do not consider PCB assembly a core competency and outsource the assembly to achieve economies of scale (component purchasing) and scope (assembly overhead and equipment usage). Transformers, sheet metal fabrication, cable assembly, and label fabrication are also outsourced to local firms.

The Arlington manufacturing plant focuses on final assembly, testing, and packaging of the final product. This is accomplished through the use of assembly cells, MRP, and highly trained manufacturing personnel.

The manufacturing cycle starts with an order that drives the MRP. The order is scheduled on the production floor. Once the materials arrive, they are staged for assembly. The product is pushed through the assembly and test cells and is then packaged. The manufacturing cycle time (assembly, test and packaging) is approximately two weeks. Risk inventory is purchased for long lead and single sourced components. Risk inventory are components that have longer than 12 week lead-time or are hard to procure due to supply constraints.

The Arlington manufacturing team has started to manufacture the wind converters in Q2 2004. The production was moved to Arlington to reduce overhead in proportion to the scale of the operations. The wind converter business is driven by generation projects around the globe. The demand is cyclic with many periods of low production rates. Xantrex offsets this cyclic demand by having the same facility produce PV converters and inverters. This smoothes out demand and spreads overhead across more product lines (economies of scope).

5.6 Outbound Logistics

The finished wind converter is the size of a large refrigerator and weighs approximately 1500 lbs. It is typically shipped on a custom pallet and is boxed to prevent damage. The cost of shipping is high; therefore, the product is shipped and staged for installation based on the construction schedule of the wind turbine. The logistics function handles the warehousing of finished good, customs brokerage, and freight of product to the construction site. The team currently performs

30% of these activities, which represents 50% of the value. Xantrex out sources freight, and brokerage.

The outbound logistics group also manages the finished goods warehouse in Arlington where the product is stored for shipment. Xantrex keeps virtually no wind converter finished good inventory, and uses the warehouse to store the wind converter until the customer is ready to install. The customer provides a shipping list of dates and addresses to ship the order on the purchase order. The logistics group then uses this purchase order information to ship the wind converters to the destination site. A key function is to ensure the product arrives at the construction site on the appropriate day. This requires close contact with the customer to ensure the product not does arrive too early or late, as there are usually delays in the construction of the wind farms and penalty costs due to late deliveries.

Due to the cost of shipping, the logistics team works out yearly contracts with freight carriers to ensure Xantrex has minimized its shipping costs. Xantrex has developed a good logistics capability allowing it to reduce duties, brokerage, and shipping costs and have a 96% on time delivery. This is a key competence; which Xantrex needs to keep in house.

5.7 Commissioning and Service

Xantrex performs 100% of the activities and value to commission and service the wind converter. Once the wind converter arrives at the installation site, it is prepared for installation. This entails uncrating and wiring preparation. The customer and Xantrex personnel will install and connect the wind converter to the wind turbine and electrical grid. A systematic "bring up" and test will be performed. The wind converter is then run for a test period, which will include data logging of energy capture, efficiency, output voltage, and current. After this initial operating period the wind converter will be adjusted to match the wind turbine, switch gear and generator system to ensure maximum energy capture and efficiency. Adjusting various operating parameters in the wind converter is done through software configuration. If a larger operation issue arises, the software code in the wind converter can be modified to enhance operation. This software modification is done by one of the engineers on the design team in Livermore. Changes are then archived in the configuration management system.

Xantrex uses a combination of service technicians and engineers to perform the "bring up" and system test. This mix provides invaluable experience to the design teams and enables Xantrex to display its flexible highly skilled capabilities. The "bring up" activity also brings together the customer and Xantrex staff, thus building a strong relationship. These relationships are vital to maintaining the business, building customer confidence, and enabling long term partnerships. The major disadvantage of using engineering staff in service is the disruption of the new product design process and delivery. The engineering staff is constantly being called out on service calls and can be tied up in commissioning for weeks at a time. Many times, a significant change is done on site to bring up and start the wind generators. These disruptions delay engineering projects in process due to staff re-assignments.

An example of this problem was the commissioning of a wind farm for GE. The GE personnel had installed approximately 50 wind turbines in a new wind farm and had encountered thermal and performance issues. When the Xantrex staff arrived, they discovered that GE had substituted the equipment tower for a different configuration due to supply problems. Xantrex personnel had to make a number of design changes to enable the wind converter to work in the new towers. These changes took one month to resolve with staff on site seven days a week.

Xantrex also provides warranty and non-warranty field service, phone support, training, and product upgrades. Wind converter service is typically performed on site, as it is impractical to return the wind converter once it is installed. Xantrex provides service in a wide variety of geographic locations across North America. The service team has the capability to dial into the system and perform remote diagnostics prior to a site visit. This ability reduces customer down time and ensures the service team arrives on site with the right tools and parts to repair the wind converter. Xantrex service capability is a significant advantage as the team can work on both wind converters and complete systems. If the problem is too complex for the service personnel, an engineer is brought in to resolve the problem.

Another aspect of Xantrex service value is the training of customer personnel in the installation, operation, and maintenance of the wind turbine generator's converter. Xantrex service personnel and engineering staff train in the classroom and in the field staff. Training is an activity that reduces service costs and builds the relationship with the wind turbine manufacturing staff. The training utilizes the wind converter's user documentation in conjunction with training materials, and hands-on demonstrations.

5.8 Support Function

Xantrex has seven main functions, which support the value chain and its ability to deliver value to the market. These include program management, finance, engineering, procurement, human resources, quality assurance, and IT. These functional teams bring specific core competencies to support the value chain.

The program management office is a newly created function in the organization. It is responsible for the overall cross-functional management of product development programs. Previously, engineering was responsible for this activity in the program manager's role. Due to execution issues, a separate team was formed to handle the high-level program management and to co-ordinate activities across functional teams. This change will allow engineering to focus on product design. The goal of program management is to improve execution of new product development programs.

This program management team also has facilities management responsibilities. Facilities are responsible for building maintenance, office layout, furniture procurement, leasehold improvements, and parking.

The finance team provides two major support roles, accounting and legal council. The finance team provides support in product costing, project accounting, and financial reporting. This team develops custom reports to assist project teams in cost management. A challenge Xantrex faces is the management of product cost through the development cycle. It has not been able to execute this process effectively and needs to develop the capability. Good product cost management will allow the design teams to make tradeoffs on cost early in the design cycle. Xantrex also needs to develop forward-looking cost forecasting tools for managing project costs. Currently, project managers can only get historical project costs and cannot make good decisions on current spending. This lack of information has led to cost overruns which reduces a product's overall financial return.

A new subgroup in finance is legal council, which used to be outsourced. It provides support on negotiating contracts, drafting legal agreements, and supporting liability issues.

Engineering provides key support for the product development team with component engineering, intellectual property management, configuration management, and technology development. The

engineering team has strong capabilities in all areas but technology development. Xantrex has focused almost all of its engineering resource on developing and supporting current product development activities. For Xantrex to sustain its level of competitive advantage it needs to allocate more resources to technology development. Xantrex could see a competitor enter the market with new technology and it would take Xantrex 12 to 18 months to respond to this threat.

The procurement function at Xantrex supports the value chain by procuring prototype materials, selecting suppliers, negotiating supplier contracts, managing manufacturing subcontractors' relationships, and procuring office supplies. The process is started by a requisition request on the MRP system, which is then electronically approved by signing authority in each department. Once the requisition is approved, the purchase order is issued. Another function of the procurement team is product costing in the product development process. The buyer assigned to a project is responsible for assisting the team in negotiating product and component costing with suppliers.

The human resources team provides employee recruitment, retention, and exit support to the functional units. These activities consist of compensation, payroll, training and health and safety. A challenge for Xantrex is the recruitment of new talent. Xantrex is expanding and finding it difficult to find engineers with specific embedded software, mechanical, or electrical experience. A key focus for human resources is improvement in recruiting process and timeliness.

The quality assurance group at Xantrex is responsible for maintaining ISO 9001 certification, supplier quality, reliability engineering, and general audits of compliance for the organization. A capability development for Xantrex is reliability engineering. This team has just been created to enhance product reliability at Xantrex. Product reliability will become a core function in the value chain as the reliability of the wind generation system will become more critical as the installed base increases. Wind turbine uptime will become critical as the percentage of total electricity generation from wind increases.

IT performs the key role of developing and maintaining the information systems at Xantrex. The organization is dependant on the enterprise resource planning (ERP), e-mail and other applications the staff use to develop, market, and manufacture products. IT staff are divided into two functions, operations and information systems (IS). The IT operations team is responsible for the help desk, data back ups, IT infrastructure maintenance and procurement of computer equipment. The IS team is responsible for implementation of new applications and process

improvements to support the value chain. The team provides project leadership and implementation plans. Xantrex needs to develop an IT strategy to ensure information systems keep pace with its growth so that the company receives a maximum return on investment. Currently, the IT team is always playing catch up (for example a functional team purchasing software without IT participation) with the rest of the organization and needs a strategic direction and plan to support the value chain.

5.9 Xantrex Value Creation

Xantrex has created substantial value through the value chain by being vertically integrated. Xantrex performs all of the key activities in the wind converter value chain and has captured 10% market share. Xantrex core competencies enable it to perform industrial marketing, product design, assembly and test, logistics, and service. Xantrex has also developed a strong marketing capability, which performs product marketing, marketing communications, and branding. Marketing is a competency, which allows it to effectively market Xantrex products to consumers and industrial customers and provides a message of the one stop shop for power electronics.

Another competency is the ability to engineer to order or design stand-alone products derived from market needs. The firm has a vertically integrated engineering function, which can execute the entire design process. This enables the firm to respond quickly to market changes and design custom product for industrial customers. This is a competency Xantrex needs to nurture.

The integrated ability to assemble and test to order is vital in the wind converter business. Due to long lead times and high product variations, Xantrex has been able to develop rapid response and short lead times by buffering manufacturing with risk inventory. PCB assembly is not a key competency and should be outsourced. Xantrex needs to continually improve manufacturing execution and lead time reduction.

Logistics is another competency Xantrex needs to continually nurture. Xantrex has developed the capability to efficiently move inbound and outbound components and products from around the globe with continual cost reductions. Xantrex key focus for logistics improvement is in its procurement capability.

The final core competency is its ability to perform technical service in house and in the field. Xantrex is able to provide highly valued service to repair and upgrade its product. This capability is high regarded by customers. Xantrex need to enhance the technical sophistication of its field service personnel to improve the capability and reduce its reliance on engineering.

5.10 Improving the Value Chain

To increase its portion of the value chain and resolve some execution issues, Xantrex needs to focus on improving its manufacturing, procurement, service, and engineering competencies.

Xantrex needs to increase its engineering complement and develop thermal, packaging, and magnetics design capability in the Livermore engineering team. It must reduce its dependency on contract engineering, as these are design activities, which are not resident in Livermore. Xantrex is vulnerable if these contractors leave Xantrex. These design talents are difficult to recruit for and would hinder Xantrex ability to develop products.

A challenge the value creation team faces is the aging technology. Xantrex must also invest in new technology development, as the current platforms are ten years old. Some of the components used are becoming obsolete, and the current products have a high manufacturing cost. This is squeezing the margins of the product. The company needs to invest approximately $10M to develop new power conversion and control technology, which can be patented. Without this investment, its competitive advantage will be severely diminished.

Xantrex also needs to develop its field service capability by adding technical capability to troubleshoot and modify the wind converters. Due to the lack of technical sophistication within the field service group, the engineering team is continually called on to do commissioning and service work. This added work diminishes their ability to do product development in a timely fashion. Development programs are continually challenged to meet schedules by resource shortages. In the short term, the engineering team develops relationships with customers but diminishes the long term ability to develop products. The service team needs to increase the level of staff and technical skill of the field service team to minimize the intervention of the engineering team.

The manufacturing team needs to focus its core competency on final assembly and test. The through hole assembly should be outsourced as PCB assembly is not considered a core competency. Xantrex does not have a deep talent pool in its operations team and it needs to develop its core competency. The operations team is turning inventory four times per year and currently has $22M inventory on hand. An organization of Xantrex's maturity should be turning inventories a minimum of 12 times per year with an average inventory of approximately $9M. To reduce its overhead and cost structure, Xantrex has merged the two US manufacturing facilities. The organization is moving in the right direction by consolidating the manufacturing in the US to improve the overall cost structure by lowering overhead and maximizing economies of scope. These activities should continue.

Xantrex faces a major weakness in the procurement function. The team does not have a depth of knowledge and experience for the size of the organization. The team has been challenged to provide product costing support, purchasing support in new development programs, as well as providing appropriate supplier management. Xantrex development teams have been challenged to manage product cost during development. Xantrex margin are affected significantly by material cost. Purchased material is over 80% of the product cost. It is essential for Xantrex to manage these costs to maintain margins and provide products and services at an appropriate cost. Xantrex needs to develop procurement as a core competency of the operations group by adding talent and providing training to the current staff. This is a critical competency that will enable Xantrex to add considerable value going forward.

Xantrex needs to improve three areas in the support functions to support its value chain: IT, cost reporting, and program management.

The IT function at Xantrex needs to be developed from being reactive to being proactive to strategically support the value chain. This strategy should be developed in conjunction with the functional leads to ensure all business issues related to IT are addressed. Functionally, IT needs to be a core competency that supports the value chain.

To support the costing activity the finance team needs to develop more comprehensive cost reporting process to allow the design team to make more informed decisions. The cost reporting improvements must be in product cost as well as project costing.

Xantrex needs to continue the development of the program management office to assist in the cross functional execution of product programs. Being a newly formed team, the processes and roles have not been fully developed yet. By improving execution, new products will be launched on time and within budget, thus building credibility in the market and solid customer relationships.

6 ORGANIZATIONAL STRUCTURE AND CULTURE

Xantrex is structured in a functional organization. The company changed its structure 22 months ago from having three business units to functional departments. The company is an amalgamation of staff from former companies, Xantrex, Statpower, Trace Engineering, Trace Technologies, Heart Interface, and Cruising Equipment. These firms merged between November 1999 and April 2001. During the past four years Xantrex has changed leadership four times, and in the course of these changes only one senior executive remains from the original merged companies. This constant change has left leadership voids and cultural gaps in the organization. Xantrex has turned over staff in all functional areas, which has resulted in some loss of tacit product and company knowledge. Because of these events the culture in each office has developed independently of each other. Information was gathered through informal interviews with Xantrex staff, and the cultural analysis under taken by Kris Jernstedt in Livermore Office as part of his EMBA studies. We will discuss the different aspects of each culture and look to where Xantrex wants to take the corporate culture and finally, the challenges Xantrex faces going forward.

6.1 Culture in Livermore[82]

The team in Livermore has worked together since the Kenetech days, working through the cyclic nature of the wind business, three different owners, and the different leaders over the past four years. This has developed the Livermore team into a close-knit community, which relies on supporting and trusting each other in times of adversity. The constant change in management over the last three years has drawn the team together and reinforced their culture. They view what has worked in the past as an anchor for decision-making. The team is divided into two main groups, operations and engineering.

The operations team feels disconnected from the Canadian management team and seeks more ties to the firms' leadership team. They are focused on their job security as the products are moving to

[82] Jernstedt, Kris, (2004). Capstone Project, Xantrex Technology, A corporate Cultural Analysis, Pepperdine University EMBA-52, May 23, 2004, p. 24

the Arlington manufacturing plant. They feel betrayed and that no one is looking out for their interests. There is distrust with Canadian management due to lack of communication and follow through.

The engineering group has a positive view of Livermore today. They have been together a long time. They draw on their teammates for trust and support as they have been through great adversity and succeeded. They are wary of Canadian management. The team seeks more clear leadership signals from Canadian management and a long term commitment. The engineering group is very connected to the renewable energy market and has a strong passion for it. This work is more than a job to them, but has significant personal meaning and satisfaction.

6.2 Culture in Burnaby

The culture in the Burnaby facility is a stark contrast to the Livermore facility. The Burnaby facility houses the corporate head quarters, which influences the culture. The staff feels more connected to activities at Xantrex and have a high degree of trust in the leadership. Due to the proximity to the corporate management, staff has a lower barrier of resistance. The high rate of turn over in senior management has an effect on the direction and culture in the organization. The staff in the facility has two distinct groups, manufacturing and professionals.

The manufacturing team in mainly made up of unskilled labor whose main focus is on job security and Xantrex strategy for outsourcing. The group comes from a wide cultural background, which drives their goals and values. The team has little understanding of the products and the markets Xantrex deals in but is connected through the manufacturing process. They are a social group, and engage in many group activities together. They have a high level of trust in the management team.

The professional group is a mixture of long term employees and new employees. A large number of the senior team has been employees at Xantrex for less than one year. Most of the staff grants trust to these managers and have a "wait and see" attitude. The group values trust and integrity and provides support to each other. The amount of change that has transpired over the last three

years, make the group wary at times. Over all, the group is connected to the market, is non political and are building trusting relationships.[83]

6.3 Culture in Arlington

The culture in Arlington sits in the middle between the Burnaby facility and the Livermore facility.[84] The main focus of the facilities is operations based. The staff has a distrust and concern about the intention of the corporate management team. The office has been in flux for a number of years with no clear direction or mission. It is currently intended to become the service center and rapid response manufacturing location for high mix, low volume production. This has not been communicated effectively, thus breeding mistrust. The staff feels a high degree of uncertainty about the company commitment to the Arlington facility. The staff come from the Trace and Heart organization and has built trust and support in the team. They feel somewhat disconnected from the management team. Xantrex needs to paint a clear picture of the future for the team.

6.4 Desired Culture of Xantrex

Xantrex is starting the process of cultural change. The CEO understands the cultural diversity of the various locations and has a vision of creating one culture for Xantrex based on integrity, trust, support, truth, accountability, and forward looking. Xantrex wants its employees fully engaged in the process, working faster and smarter, and succeeding and failing together. The company has started this process with a training program called "The Leadership Challenge", which is run by the Tom Peters group. The company is training all staff, starting with the senior and line management teams. Employees see this as the first step in the culture change at Xantrex.[85]

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[83] Discussions that took place with the CEO, Xantrex Technology Inc., May 25th, 2004
[84] Discussions that took place with the CEO, Xantrex Technology Inc., May 25th, 2004
[85] Discussions that took place with the CEO, Xantrex Technology Inc., May 25th, 2004

7 FINANCIAL ANALYSIS

A key question the management team needs to understand is the Xantrex ability to fund growth in this wind converter market. **Appendixes B to D** contain projected income statement, balance sheet, statement of retained earnings, and cash flow statement for the firm with projections to 2013. Based on current growth projections and a successful initial public offering, Xantrex is well positioned to fund growth. With Xantrex current capital funding of $70M US, and retained earnings, strategic investment in the wind business is viable. Xantrex has to keep tight control of both operational costs (below the line) and cost of goods sold (COGS). Xantrex gross margin is very sensitive to changes in COGS and operational costs. Negative variation in COGS and operational costs will affect its retained earnings and ability to fund growth. Xantrex is in the enviable position of having virtually zero debt. This low financial leverage gives Xantrex access to a large line of credit, which can be used to fund growth. Xantrex has always positioned itself with a very conservative financial structure in line with its differentiation strategy.

8 CORE COMPETENCIES AND COMPETITIVE ADVANTAGE

Xantrex has developed a number of core competencies and competitive advantages in its acquisition and growth over the course of the last four years. Many of these competencies and advantages are as a result of the integration of the acquired firms and employee development.

8.1 The Core Competencies

- Electrical engineering in both embedded systems and power electronics from 50-Watts products up to multi mega watt wind converters. (See **Figure 12**, highlighted section of Product Development)

- Software engineering capabilities for embedded systems and networked products. (See **Figure 12**, highlighted section of Product Development)

- Mechanical packaging of products for both ergonomic and environmental requirements. The requirements are usually focused on thermal and EMI design. (See **Figure 12**, highlighted section of Product Development)

- Regulatory engineering capabilities to achieve UL, CSA, CE, ASTM, ABYC, DOC and FCC compliance. Xantrex participates in a large number of industry committees involved in safety and compliance regulations. The firm is seen as a leader in the industry and provides consulting service to many of its customers. (See **Figure 12**, highlighted section of Engineering)

- Product verification testing has resulted in Xantrex acquiring the ability to perform a wide variety of environmental and electrical tests. This capability includes HALT, thermal, EMI and vibration testing. (See **Figure 12**, highlighted section of Product Development and QA)

- In depth market knowledge in all of its markets it participates in. This knowledge has enabled it to develop market leading products and systems. Xantrex is the market leader in all markets in which it competes. (See **Figure 12**, highlighted section of Sales and Marketing)

- Advanced capability in high mix, low volume manufacturing processes. The capability has enabled it to reduce assemble to order lead-time to three days and has allowed Xantrex to capture significant market share in the programmable market. (See **Figure 12**, highlighted section of Manufacturing)

- Deployed a service organization for the RV and distributed markets. This critical mass allows Xantrex high service levels, which competitors cannot match. (See **Figure 12**, highlighted section of Commissioning and Service)

8.2 Competitive Advantages

8.2.1 Size.

Xantrex is larger than many of its competitors in each market, thus allows Xantrex to achieve economies of scale and scope. In addition, Xantrex also leverage its investment in new products by using base technology in more than one platform and product family.

8.2.2 Financial Structure.

Xantrex is well financed with a large war chest and virtually no debt. This positions Xantrex well and gives it the ability to ride out cycles in the market.

8.2.3 Design Capability.

Xantrex has a significant design capability from 50 watts to multi mega watt. Xantrex is vertically integrated in engineering and is called upon by customer to solve system problems.

8.2.4 Strong Service Organization.

Xantrex has both a field service and repair depot for its products. The firm is known for its service capabilities and has the size to support this capability.

8.2.5 Industry Leader in Product Quality and Reliability.

Xantrex customers consider the firm to be the leader in its markets and the gold standard. Customers have instructed potential rivals to provide a product of higher quality, or not to bother trying to sell them a product.

8.3 Challenges Facing Xantrex

Even though Xantrex exhibits admirable core competencies and competitive advantage, it also faces challenges in meeting all of its customers and stakeholders expectations. The following is a list of significant challenges the firm faces.

8.3.1 Employee Retention.

Xantrex has experienced dramatic leadership changes following the acquisition of the five firms. The firm has had four CEOs since January 2000 and a complete change of senior management with the exception of a single Vice President since January 2000. This has lead to many talented people leaving Xantrex with their tacit product and market knowledge. This can cause the organization to forget some of its competencies and reduce competitive advantage.[86]

8.3.2 Depth of Talent.

Xantrex faces the issue of talent depth in some functions. If a senior manager or line manger leaves, there is no one to quickly fill the position, thus leaving Xantrex vulnerable. There has also been a significant turn over of staff and a loss of product and market knowledge.

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[86] de Holan, Pablo Martin; Phillips, Nelson; Lawrence, Thomas B.; (2004). Managing Organizational Forgetting, *MIT Sloan Management Review*, Winter 2004, p. 46

8.3.3 Core Livermore Engineering Functions are Outsourced.

Currently the magnetic and thermal design is outsourced to a contract employee. These are key design capabilities required for mechanical packaging and system design. Xantrex is vulnerable if the contractor leaves Xantrex employment.

8.3.4 Focus.

Xantrex participates in three market areas with fifteen sub segments, thus diffusing focus and spreading resources thinly. Xantrex has challenges defending its market share in each market. Xantrex is seeing more competitors entering each market, thus requiring more focus on each segment.

8.3.5 Strategic Fit.

Xantrex current organization does not align to either the cost or differentiation strategy. The firm is in the middle ground. This is usually a place where unsuccessful firms sit. Xantrex needs to decide on its strategy to best equip it for success.

8.3.6 The Company Commitment to the Livermore Team.

Xantrex has moved the manufacturing of Livermore designed products to the Arlington facility to consolidate manufacturing operations. This has led to a feeling of distrust and lack of security for the Livermore engineering team. To effectively compete in the wind converter market, it requires the design talents of the Livermore team.

8.3.7 Strong Leadership.

The staff has felt the outcome of having a void in consistent leadership over the last four years. Xantrex needs to show strong leadership skills and build a strong team to be successful and retain staff.

8.3.8 Culture.

There are currently three cultures in Xantrex based on office location. This has affected the organization's performance and execution. Xantrex needs to build a single culture to improve moral and retain staff.

8.3.9 Operational Execution.

Xantrex has not executed well over the last four years in both operations and engineering. Leadership and staff changes, organizational structure changes and new staff being hired in has caused execution problems due to learning curve and change management effects. In order to succeed, Xantrex needs to execute flawlessly and stabilize its structure.

9 WIND STRATEGY ASSESSMENT

9.1 Introduction

Xantrex and the wind converter market face a number of challenges as described in **section 2.1** and **section 8.3**. In order to assess whether Xantrex's current strategy will be effective at addressing this attractive market a fulcrum analysis is performed. The fulcrum analysis integrates and summarizes the external and internal analysis in order to determine the effectiveness of the current strategy. If the strategy is determined to be ineffective in attaining Xantrex's goals, strategic alternatives are developed and analyzed utilizing the internal and external analysis and a multi-goal analysis (See **Appendix L**). Finally, a balanced scorecard methodology is utilized to choose the strategic alternative that is best aligned with the strategic goals and values of Xantrex.

9.2 Status Quo

Xantrex's current wind converter strategy is to develop technology to circumvent the GE patent (039) and sell Xantrex wind converters to other WTGMs. Another aspect of this business strategy is to also move from a component supplier to a system solutions supplier. Xantrex currently has a partnership with Loher and Winergy, divisions of Flender, to provide complete drive train systems to wind turbine manufacturers. The Xantrex component of this partnership is to provide Loher with control electronics and software. This partnership has yet to sell any volume of product as it is still in the development stage.

Xantrex has also supplied GE Wind with approximately 417 wind converters in 2003. GE is the largest customer in the wind generation market for Xantrex. As detailed in **Appendix K**, Xantrex has made a 200% return on the development of the of the 1.5 MW wind converter with the majority of the return in 2003. In the prior two years, Xantrex had virtually no revenue from the wind generation market. 2003 was a boon due to the production tax credit in the US. The PTC ended in 2003 and the US market has seen a dramatic down turn in business in 2004, as utilities are not investing in wind farms. The firm's current business is solely focused on the North

American market and does not have any products to address the European market. Xantrex will be in a loss position, as expenses will exceed revenue in 2004. Xantrex finds itself in the same financial predicament as in 2000, 2001, and 2002. Due to its current financial structure, Xantrex has working capital to ride out this down turn in 2004, not like the case in 2001 and 2002.

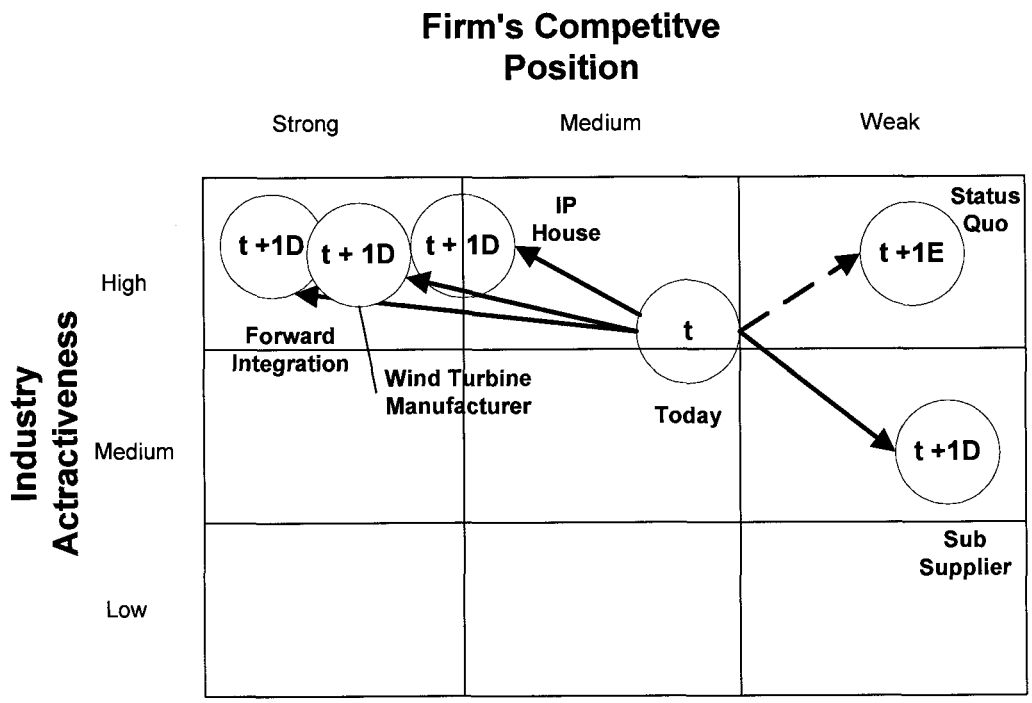
Xantrex currently produces Small and Mainstream WTC. The small WTC market is in rapid decline; the mainstream market has reached maturity (See **Figure 7**). The current MW-CLASS market is approaching maturity and finally the Multi-Class market is in its infancy. The current 1.5 MW wind converter Xantrex supplies to GE will see rapid decline in the near future. Xantrex is developing a Multi-Class converter for another WTGM, Clipper Wind. Xantrex needs to sell 142 1.5 MW wind converters a year to cover fixed costs of the Livermore operation. This translates into revenue of $5.2M, base on its current gross margin of 19%. Xantrex's other market segment sales achieve an average GM of 35% (See **Table 1**).

In 2004, Xantrex has delivered small quantities of electronics and software to Loher as part of the partnership. The components Xantrex provides to Loher have substantially less revenue but higher gross margin (82%).[87] In order for Xantrex to cover its fixed costs with these sub-components, it will have to sell an order of magnitude more than the wind converter product volume.

Xantrex's competitive position today sits in a medium position with a high industry attractiveness rating (See **Figure 13**). The market has a medium attractiveness in the short term due to cancellation of the PTC, but a high longer-term attractiveness. If there is no change in company direction, Xantrex's competitive position will weaken. The desired state is to be in a strong competitive position in a highly attractive industry.

[87] Discussions that took place with the CEO, Xantrex Technology Inc., June 20, 2004

Figure 13 Strategic Alternatives Performance Assessment Model for Wind Converter Market



Note:
t - Today
E - Expected outcome if no change in strategy
D -Desired Outcome of each strategic choice

The external analysis, internal analysis, and multi-goal score card (See **Appendix I**) shows Xantrex in a weakening competitive position, with currently low investment in product development. The current outlook for short and long term profitability is low with a possible declining market share. This will force Xantrex to consider staff reductions, as current sales do not cover fixed expenses. The staff reductions will happen across the firm and will not affect the Livermore staff, as they are a small, experienced team needed to develop products for this market. This will affect Xantrex's other market area which will be hit with staff reductions and making it more difficult to compete, thus affecting profitability. As a public company, short-term profitability will affect share price, and Xantrex will be forced to take action if the revenue and profit shortfall from the wind converter business does not improve. Xantrex has three to six months to change the outcome in the wind business before the financial market will react.

The balance scorecard (See **Appendix F**)[88] shows a score of 51 out of a possible 115 for the status quo. The score for the financial perspective (See **Appendix E**) indicates Xantrex is in survival mode in this market. Xantrex is trying to revive the business with GE and build the Loher/Winergy business, which is in startup condition with low volume sales. The company scores very low with succeed and prosper metrics. From a customer prospective, Xantrex scores below the 50% mark, and ranks well on on-time delivery but low on new products and customer partnerships. From an internal business perspective (See **Appendix G**), the status quo will provide Xantrex adequate success. Manufacturing excellence and design reuse rate high, but technology capability, cost and design productivity rate moderate to low. From an innovation and learning perspective (See **Appendix H**), Xantrex scores low due to the weighting in technology and time to market. Xantrex lacks technology leadership in the wind converter market and has slow time to market.

9.3 Analysis of Strategic Alternatives

9.3.1 Introduction

Xantrex's mission as stated in **section 1.4** is to make a positive difference in people's lives by providing power anytime and anywhere. It is a one-stop shop for power electronics with products from 50 watts to 1.5 MW. The wind converter business is a strategic market for Xantrex and a firm cannot be considered a distributed energy firm if it is not participating in this market. The status quo will be analyzed to see if a change in strategy is needed to allow Xantrex to achieve its desired outcome. Five strategic alternatives will be described and discussed.

9.3.2 Analysis

Today, Xantrex sits in a precarious spot. 2003 was a banner year in the wind converter business due to a large contract with GE Wind. 2004 brings a reversal of fortune with the US government letting the PTC expire. This caused a drastic down turn in the US market and resulted in Xantrex's revenue shrinking from $19M US in 2003 to approximately $500,000 US in 2004. Xantrex requires approximately $5.2 M in revenue to cover fixed costs of the Livermore facility and staff. The market for its 1.5 MW wind converter is rapidly maturing and sales for this size

[88] Balance Scorecard discussions that took place with the CEO, Xantrex Technology Inc., June 20, 2004

wind converter will diminish. (See **Figure 7**) Xantrex does not have a product available for the Multi-MW class inverter segment. Xantrex is in a medium competitive position in a highly attractive market. The balance scorecard, multi-goal analysis, and performance assessment model all point to a weakened competitive position and declining market share. This will lead to financial loses in this market. If Xantrex wants to stay in this wind converter market, a change in direction is needed and if the status quo continues, an inevitable exit of the market will occur.

Xantrex has five strategic alternatives it can pursue to correct this trajectory of performance in the wind converter market; forward integrate, sub-supplier, wind turbine manufacturer, exit industry, and IP house. Two of the options were scored and discounted immediately. The first, exit industry, is not an option for Xantrex. Based on Xantrex's mission and vision, the distributed market is a key market and a firm must participate in the wind converter market to be considered a distributed energy firm. Xantrex will not exit this market. The second strategic option, wind turbine manufacturer, was also discounted due to the large investment required and drastic change in business that Xantrex would have to undertake. This option would be a large step for Xantrex and highly risky. Xantrex does not have the expertise or capability to successfully enter this market at this time. The performance assessment model places Xantrex in a strong competitive position in a highly attractive market. The Multi goal scorecard and balanced scorecard also rate this option very favorably but it is not presently feasible. As a result, the three most probable options left are forward integration in the value chain, move to a sub- supplier, and finally, becoming an IP house. The remainder of **section 9** analyzes the three most credible strategic alternatives and their fit with Xantrex strategic objectives, as measured by the balanced scorecard (See **Appendices E, F, G, H**).

9.3.3 Assumptions Made When Assessing Impact of Strategic Alternatives

Two assumptions were made as part of the assessment of each remaining alternative. First, the PTC in the US and various European countries most probably will continue into the future. This is likely to continue to drive the demand in almost every market as was seen in the results of 2003. Secondly, the Multi-Class inverters may bring generation cost down to a point where WTG will be cost competitive with alternate forms of electrical generation like thermal or Bio mass. This would reduce the industry reliance on production tax credits or tariffs. Both assumptions support a consistent demand for WTG over the next five years.

9.3.4 Forward Integration

The first strategic alternative is forward integration into the value chain. Forward integration is designing and selling the entire drive train for a WTG. The drive train would include a generator, gearbox, wind converter, and software controls. Supplying the entire drive train would place Xantrex as a premium supplier to the WTGMs and gain new OEM customers. The fastest way to achieve the forward integration would be to acquire firms like Loher and Winergy, which supply generators and gearboxes. These acquisitions would provide new distribution channels, instant access to OEMs and access to new technology. The acquisitions would provide the capabilities and manufacturing facilities in Europe to service the European market. Another by-product of this option would be the capability to design and manufacture generators. In the mobile and back-up power markets, Xantrex has had difficulties finding a suitable partner that manufactures generators. As part of the systems strategy, Xantrex could develop complete power systems in these markets and resolve the generator supply issue. This would add incremental revenue and sales in those markets.

The performance assessment model (See **Figure 13**) would position Xantrex in a strong market position in a highly attractive market. The firm would move from a medium competitive position to a strong position by providing complete system solutions to WTGMs.

The forward integration strategy, from a multi-goal analysis (See **Appendix I**), would put Xantrex in a strong competitive position, by providing customers with an integrated solution. ABB and SEG offer both generators and wind converters to the wind turbine market. By forward integrating, Xantrex could also offer gearboxes and a complete validated solution. The integrated solution would remove some of the integration burden off the WTGMs, while the system solution would give Xantrex a competitive position in the market. This alternative would require a moderate investment as compared to acquiring a wind turbine manufacturer, but a large one in respect to the current size of Xantrex. The acquisitions would cost between $200 to $300M US. A merger would be an alternative to an outright acquisition. Xantrex would increase its social responsibility by investing in clean energy market and be seen as being an environmentally sound firm. The acquisition would increase staffing in both Canada and Europe and give Xantrex a good base for European expansion in all markets. It would also increase Xantrex's GM, by leveraging the system solutions and reducing cost of sales. As a result, these would be an increase in both short and long term profits and be an immediate increase in market share.

The forward integration strategy had the highest score in the balanced scorecard, with a score of 97.4 (See **Figure 14**). From a financial perspective (See **Appendix E**), Xantrex scored 120 out of a possible 140 points, with a high probability of increasing revenue from non-converter sales, increasing market share, increasing gross margin and achieving sales from system products. Xantrex would move into the prosper section of the scorecard. From a customer perspective, (See **Appendix F**), Xantrex scored 89 out of 100 on the scorecard. Xantrex would be able to leverage development of new system products, increase its IP portfolio, have more responsive supply, especially to European customers, increase uptime for wind systems by having a proven integrated system and partner with more WTGM and move close to the customer. From an internal business perspective (See **Appendix G**), Xantrex scored high, 95 out of 130. The strategy would give Xantrex access to new technology and patents, expand its manufacturing capability, increase design productivity, and increase the number of new products introduced. Xantrex would acquire generator technology that it could leverage into the mobile and distributed market segments. The generator technology would also create integrated system solutions and increase design reuse across market segments. From an Innovation and Learning perspective, (See **Appendix H**), Xantrex scored 63 out of 90. Xantrex would be first to market with an integrated system solution, increase its number of patents issues, learn new process and technology, have a large percent of revenue non wind converter sales with the challenge of time to market as the firms integrate.

9.3.5 Sub-Supplier

The second strategic option is becoming a sub-supplier to the wind converter market. The strategy would be to expand its current partnership with Loher and Winergy and supply sub-components to the wind converter manufacturers, like printed circuit card and software. This option has appeal due to higher margins on the sub-assemblies, which are currently 82% with products shipped to Loher. The strategy does go against the current strategy of becoming a system solution house. For Xantrex to have a strong competitive position it would also have to have a strong IP position in circuit design and software. If Xantrex had a weak IP position, it would also have a weak competitive position as the sub-assemblies and software could be duplicated by competitors and easily replaced. Xantrex would not be a locked in source of supply, but a commodity product and compete on cost. This strategy would also have a side effect of increasing cost of PV converters. Xantrex leverages economies of scope and scale by utilizing the

same technology and sub-assemblies in this market. The change in strategy would increase PV converter costs.

The performance assessment model (See **Figure 15**) shows Xantrex moving from a medium to a weak competitive position due to the current weak IP position. If the IP position were strong, Xantrex would move to where the IP house is located on the performance assessment model, with a medium-strong positioning. With a strong competitive IP position, there would also be strong a GM position.

Becoming a sub-supplier would move Xantrex down the value chain to a sub-assembly supplier. This would place Xantrex in a weaker competitive position (See **Appendix I**) due to its weak IP position. Xantrex would be more vulnerable to other competitors coming in the market to compete selling sub-assemblies. Selling sub-assemblies has lower market entry barriers and there is another market selling this type of product. Xantrex would be moving into this market space. Investment into this market is lower than wind converters due to lower equipment and space costs. A firm would need less space to develop sub-assemblies. Xantrex would also be seen as less socially responsible and less environmentally friendly, as it moved out of the wind converter market. It would have less visibility in the distributed market and be one more step removed from the WTGM. There would also be a likelihood of staff reductions, as less staff would be needed to develop the sub-assemblies. Short and long term profitability is medium due to lower sales. Xantrex is in a strategic partnership with Loher and Winergy and will have difficulty attracting other customers unless it has a strong IP position. Overall, market share will be constant.

The sub-supplier strategy had the second highest score in the balanced scorecard, with a score of 66.4 (See **Figure 14**). From a financial perspective (See **Appendix E**), Xantrex scored 73 out of a possible 140 points and would stay in the survival section of the scorecard. Xantrex would retain the Loher business, but lose the GE business. It would improve GM; and increase ROE from the current levels. From a customer perspective, (See **Appendix F**), Xantrex would increase on-time delivery, but not achieve other goals like system revenue, broadening customer base, increased up time and number of co-operative projects. From an internal business perspective (See **Appendix G**), Xantrex scored, 82 out of 130. As a sub-supplier, Xantrex would increase on-time delivery, reduce its return rate, and increase its design productivity time. It would reuse much of the electrical design for each customer. This would reduce time to market. From an Innovation and Learning perspective, (See **Appendix H**), Xantrex scored 55 out of 90. This strategy would not

provide technology leadership unless the firm has a strong IP position of which it does not currently have. From a manufacturing learning perspective, Xantrex would have mature process, and lower PPM due to providing a lower complexity product.

9.3.6 IP House

The IP House strategy revolves around Xantrex changing from a wind converter design and manufacturer to a research firm developing IP for the wind turbine industry. Xantrex would then license this IP and obtain royalties from products the licensee sold. Xantrex would do contract research as well. The IP house strategy has appeal due to high margins, low capital requirements, no manufacturing and strong IP position, which is crucial for this strategy. Xantrex could become the premier research firm in the wind business.

Xantrex competitive position would move from medium to medium-strong if this strategy were undertaken as described in **Figure 13**. The competitive position would change due to the strong IP.

The multi-goal scorecard would place the competitive position as medium (See **Appendix I**). The positioning would not be considered strong as Xantrex would have IP in specific areas of wind converters and controls and rely on patent protection. As Xantrex has seen recently, the WTGM have litigated IP vigorously and Xantrex requires strong patents to make this strategy viable and be able to defend them. Investment in this strategy would be moderate, as compared to forward integration, as Xantrex would have to invest in additional equipment and staff to develop technology. The equipment and staff will have a high cost. Xantrex may also have to expand the Livermore operation. The firm's environmental and social responsibility score would be lower than other alternatives as it moves away from the direct WTC value chain. Meanwhile, staffing level, and welfare would be unchanged or slightly increased to develop new technologies. The short-term profit picture would be medium as there would be a time lag between first technology developed and licensed and the long term profitability would be high, as the IP would have high margins. The success of this strategy lies in Xantrex's ability to develop leading edge technology and IP.

The IP House strategy had the fourth highest score in the balanced scorecard; with a score of 63 (See **Figure 14**). From a financial perspective (See **Appendix E**), Xantrex scored 77 out of a

possible 140 points. Xantrex would be in between the survival and succeed section of the scorecard and would retain the current business, but lose the GE business. It would dramatically improve GM and increase market share from the current levels. Xantrex would not be following its strategy of system supplier and have a moderate chance of developing and selling IP. From a customer perspective, (See **Appendix F**), Xantrex would increase percentage sale of IP but not achieve other goals like system revenue, broadening customer base, increase up-time and number of co-operative projects. Xantrex would reduce PPM, as it would no longer manufacture products. From an internal business perspective (See **Appendix G**), Xantrex scored 67 out of 130. As an IP house, Xantrex would increase on-time delivery, reduce its return rate, and increase its design productivity time. It would reuse much of the electrical and software design for each customer, which would lower time to market. From an Innovation and Learning perspective, (See **Appendix H**), Xantrex scored 45 out of 90. This strategy would provide technology leadership due to its strong IP position. Currently Xantrex does not have a strong IP position. From a manufacturing learning perspective, Xantrex would have mature process. As Xantrex expanded its IP base, Xantrex personnel would have to learn new technologies and manufacturing process to support the IP being developed. Since Xantrex would not be manufacturing the products, it would have to work closely with suppliers and customers to keep on top of manufacturing technologies and process.

9.4 Recommended Strategy Solution

9.4.1 Recommended Strategy – Forward Integration

Of the three credible strategic alternatives, **Figure 14** shows forward integration to be the best fit. For details of the selection see **Appendices E, F, G, H**. Forward integration supports the system strategy by acquiring the capability to provide complete drive train solutions to the wind turbine manufactures. The system solutions will broaden Xantrex's product line and provide integrated solutions to customers. This strategic alternative provides Xantrex with strong competitive position and non-converter revenue. The strategy will provide direct access to a number of WTGMs, which Xantrex does not serve today. From a balance scorecard perspective, it supports the financial, customer, internal and innovation perspectives. This strategy had the highest score. A major benefit coming from the strategy is acquiring the capability to design and manufacture generators. This can be leveraged into the mobile and residential distributed markets where

Xantrex has had difficulty finding a partner. This would allow Xantrex to generate a complete solution in its three primary markets, thus bringing additional revenue streams and profit. Xantrex would then be a major competitor in all of its markets and be in a strong competitive position.

Xantrex should embark on this strategy in the next 6 to 12 months to enable it to capture market share when the Multi-Class wind turbines hit the growth period of the market in the next 12 to 18 months. Xantrex needs to get into the design cycle of these wind turbine generators immediately, as the market window for this opportunity will close at that time.

Figure 14 Balance Score Card Score for Each Strategic Wind Converter Alternative

Balance Scorecard Score	Status quo	Forward Integration	Sub Supplier	Wind Turbine Manufacturer	Exit Industry	IP house
	51	97.4	66.4	91.6	12.2	63

9.4.2 Implications

With each change in strategy, a number of implications and outcomes will emerge. Listed below are the possible implications for Xantrex if the change in strategy is undertaken.

Financing

- Xantrex has completed an IPO in March of 2004; the firm raised $67M CDN; raising all or part of the financing (Approx. $200-300 M US) in the capital market may be difficult; second alternative is a merger and stock swap.

Employee Distraction

- Xantrex is currently developing products for the other markets it competes in; an acquisition could distract staff or re-assign them to assist with the acquisition; Xantrex cannot afford to be late to market with its new products.

Integration Time

- Xantrex has a certain time window for this market

	opportunity to deliver 2.X MW class product; acquisition and integration process could take more time than the window of opportunity.
Acquisition Target	• Loher and Winergy are the most likely targets for acquisition; if these firms do not want to be acquired or merged, a second set of firms must be selected; this could waste valuable time and affect the ability to execute the strategy.
Re-organization	• As part of the merger or acquisition, Xantrex will re-organize the firm; the process may distract employees and could impact product development activities.
Increased Workload of Current Staff	• An acquisition of this magnitude should have a focused team to plan and integrate the firms. Xantrex needs to be cognizant of the workload placed on current staff and the impact of this additional work. Employee burnout or loss should be minimized.
Retention of Employees	• The employees of the firms under consideration for acquisition or merger hold the tacit knowledge and IP; integration plan must have employee retention, as key parameter; and the plan should be focused around retention of key personnel in Europe. Success of the plan will be in the people Xantrex retains.
Cultural Alignment	• Xantrex must pay special attention to the cultural differences in the different firms to make the acquisition successful; cultural integration is key.
Integration Plan	• Acquisitions and mergers focus around three themes, product line, people, or market channel. Successful firms have a clear plan for how to integrate firms for

	each theme, the themes for this acquisition is people and product. The plan should reflect those themes.
Competition	• Xantrex should place close attention to competitors in all markets, as they may react to this change in the firm both positively or negatively. Xantrex should be prepared for hostile actions as firms may think it will be time to strike while being distracted with the merger of firms.
Time to Market	• Xantrex needs to be focused on the market window for the next round of development activities with the WTGMs; the merger needs to happen quickly and smoothly to capitalize on the market opportunity.

9.4.3 Action Plan

In order for Xantrex to capitalize on this market opportunity and strategy change, the following actions should be undertaken.

- Develop acquisition / merger team including dedicated team leader.
- Define primary and secondary acquisition firms to target for acquisition.
- Develop financing plan for acquisition.
- Create a 100-day plan for acquisition including integration activities and organizational structure.
- Communicate plan to board of directors for formal approval.
- Move forward with plan.

10 SUMMARY AND CONCLUSIONS

Xantrex's mission and vision is to provide power solutions anytime and anywhere and to be a one-stop shop for power electronics from 50 watts to 2.X MWs. Distributed energy is a key market for Xantrex, and participating in the wind business is crucial in order to be considered a distributed energy firm. Xantrex has had recent success in the 2003 market, but due to a market down turn in the US in 2004, sales have plummeted. Currently, GE Wind is Xantrex's only wind converter customer.

The wind turbine market is growing with double-digit growth (10.5% AGR) over the next five years. The longer-term view is an even higher growth rate up to 2013. In the short term, there is a downturn in the US market due to the expiration of the PTC, which drives market demand in almost every geographic market. In Austria and Portugal, demand has doubled or quadrupled due to new tariffs being introduced. The wind turbine market requires consistent support from government bodies to stabilize demand. Consistent return on investment is required by wind farm investors to continue investing in this electrical generation market. The market is moving to Multi-MW Class inverters, which should bring down the cost of generation to be competitive with thermal generation and reduce the reliance on PTC. Customers want WTGM to design, furnish, and install the WTGs. They see reliability and uptime (generation capability when the wind blows) as key features going forward. Predictive maintenance will also be a new key feature, which will allow WTG owners to know when a WTG needs to be serviced, and guarantee uptime.

Xantrex's current strategy will not bring the returns and market penetration it desires. The current trajectory will make Xantrex a sub-supplier and weaken its competitive position in an attractive market. Xantrex requires a strong IP position to make the current strategy successful. The analysis indicates Xantrex needs to move its strategy to forward integration and provide complete integrated drive trains to WTGM. This requires Xantrex to adopt strategic alternative number one, forward integration, as detailed in **section 9.3.4**. The balance of the section answers the strategic questions outlined in **section 1.1.3**.

1. **Should Xantrex continue its business in wind energy?**

Xantrex can be successful in the wind converter market by forward integrating and supplying complete drive train solutions. Acquiring the capability to provide complete solutions will provide Xantrex new channels and customers. This will minimize the effect of consolidation in the industry and poise Xantrex to be a market player.

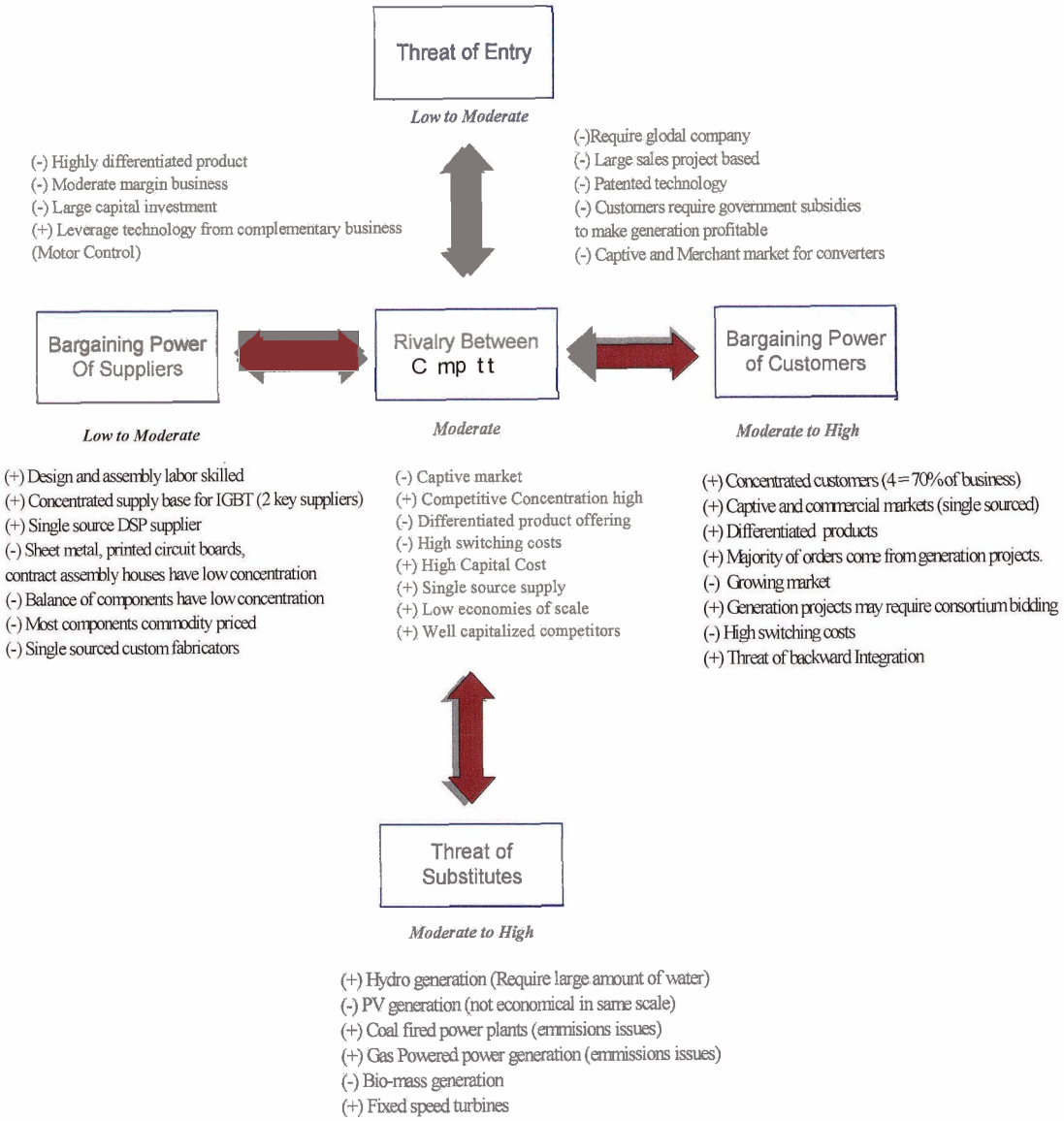
2. **Should Xantrex continue to partner with other drive train component suppliers to increase penetration?**

Xantrex should acquire or merge with Loher and Winergy or find suitable acquisition targets. The current partnership direction is forward integrating but with Xantrex holding the smallest piece of the pie. A merger or acquisition would position Xantrex strongly in the market. There is no short-term benefit to being a sub-supplier. It requires a strong IP position to make being a sub-supplier successful.

3. **Can Xantrex afford to subsidize this business during valleys of demand?**

With the recent IPO, Xantrex has the working capital to weather the current downturn in business. Xantrex cannot do this weathering for an extended period of time before the financial markets react. Becoming a more diversified supplier in the market, with more than one WTG customer, will minimize the market fluctuations. Xantrex's fate currently relies on GE Wind who has developed their own wind converter. Due to the expiration of the PTC, there is a down turn in wind converter sales. Xantrex also benefits from the economies of scale and scope with the PV business. These fluctuations in demand have negative cost implications as volumes for the technology drop and costs increase.

APPENDIX A: PORTER FIVES FORCES MODEL OF THE GLOBAL WIND CONVERTER INDUSTRY



APPENDIX B: PROJECTED XANTREX INCOME STATEMENT

	2000	2001	2002	2003E	2004E	2005E	2006E	2007E	2008E	2009E	2010E	2011E	2012E	2013E
INCOME STATEMENT 2000-2013		-3%	-5%	31%	24%	33%	31%	29%	20%	18%	19%	19%	20%	21%
Revenue														
Distributed	$ 42,152	$ 42,191	$ 29,508	$ 46,409	$ 64,214	$ 83,805	$ 117,166	$ 153,998	$ 194,544	$ 242,260	$ 297,963	$ 360,645	$ 432,562	$ 517,207
Mobile	51,805	49,737	57,642	64,375	82,491	108,892	138,455	178,562	208,801	238,769	280,707	334,633	406,552	503,554
Programmable	17,623	16,424	15,705	17,362	23,937	30,901	37,513	44,409	48,439	52,842	57,650	62,903	68,641	74,912
Total revenue	111,580	108,352	102,855	128,146	170,642	223,598	293,134	376,969	451,784	533,871	636,320	758,181	907,756	1,095,673
Gross Margin														
Distributed	10,490	12,872	7,320	11,827	25,472	34,544	49,185	65,039	82,058	101,490	124,447	150,860	180,925	216,124
Mobile	17,866	17,490	20,064	23,498	29,077	38,389	49,773	63,716	74,323	85,241	100,400	119,550	144,552	177,822
Programmable	7,133	6,502	6,653	7,874	10,160	13,353	16,650	19,936	21,778	23,793	25,997	28,408	31,048	33,936
Total gross margin	35,489	36,864	34,037	43,199	64,709	86,287	115,608	148,691	178,158	210,524	250,844	298,818	356,524	427,882
Existing Revenue (US$)							286,926	355,835	407,611	458,728	518,145	589,059	669,442	764,558
Additon with TPC funding (US$)							6,209	21,134	44,172	75,143	118,175	169,122	238,314	331,115
Total Revenue	$ 112,510	$ 109,091	$ 103,607	$ 135,935	$ 168,505	$ 223,598	$ 293,134	$ 376,969	$ 451,784	$ 533,871	$ 636,320	$ 758,181	$ 907,756	$ 1,095,673
Cost of Sales														
Labour, Material and Overhead	76,774	75,980	70,131	92,908	105,989	136,470	176,552	227,078	272,351	321,697	383,813	457,386	549,143	665,522
Depreciation	1,408	1,065	1,299	-	588	842	975	1,200	1,274	1,650	1,663	1,978	2,089	2,270
	78,182	77,045	71,430	92,908	106,577	137,311	177,527	228,278	273,625	323,347	385,476	459,364	551,232	667,792
Gross Profit	34,328	32,046	32,177	43,027	61,928	86,287	115,608	148,691	178,158	210,524	250,844	298,818	356,524	427,882
Gross Profit %	*30.5%*	*29.4%*	*31.1%*	*31.7%*	*36.8%*	*38.6%*	*39.4%*	*39.4%*	*39.4%*	*39.4%*	*39.4%*	*39.4%*	*39.3%*	*39.1%*
		121												
Operating Expenses														
Sales, Marketing and Distribution	16,755	17,234	16,783	17,442	19,378	27,950	35,176	43,351	51,503	58,726	69,995	83,400	99,853	124,907
General and Administrative	9,218	8,132	6,379	7,531	7,414	9,391	11,725	13,948	16,716	19,219	22,908	27,295	32,679	39,444
Net Research and Development	8,481	7,825	7,706	8,152	10,279	12,969	15,536	18,848	22,137	22,956	27,362	32,602	39,033	47,114
Amortization of intangibles	635	844	1,560	1,264	1,596	1,596	1,596	1,596	1,392	-	-	-	-	-
Depreciation	1,921	1,708	1,726	1,899	1,438	1,563	1,810	2,965	3,440	3,911	4,473	5,035	1,293	1,337
Total Operating expenses	37,010	35,743	34,154	36,289	40,105	53,469	65,843	80,709	95,189	104,813	124,738	148,332	172,859	212,802
Operating Income	(2,683)	(3,697)	(1,977)	6,305	21,822	32,818	49,764	67,982	82,970	105,711	126,106	150,486	183,665	215,080
			33%											
Other Expenses (Income)														
Interest	2,882	1,386	150	(345)	(296)	(769)	(1,406)	(2,102)	(2,998)	(4,053)	(5,296)	(6,651)	(8,230)	(11,151)
Foreign exchange (gain) loss		249												
Other	741	(22)	50	-	-	-	-	-	-	-	-	-	-	-
Integration	1,520	4,486	3,689	-	-	-	-	-	-	-	-	-	-	-
Other Expenses (Income)	5,143	6,099	3,889	(345)	(296)	(769)	(1,406)	(2,102)	(2,998)	(4,053)	(5,296)	(6,651)	(8,230)	(11,151)
Income (loss) before taxes and amortization of goodwill	(7,826)	(9,796)	(5,866)	6,650	22,118	33,587	51,170	70,084	85,968	109,765	131,403	157,137	191,895	226,231
Income Taxes	-	597	(1,491)	943	611	924	6,179	16,997	21,457	27,816	33,418	40,406	46,247	58,173
Income (loss) before amortization of goodwill	(7,826)	(10,393)	(4,375)	5,707	21,508	32,662	44,991	53,086	64,511	81,949	97,985	116,731	145,648	168,058
Amortization of goodwill	3,044	4,956	-	-	-	-	-	-	-	-	-	-	-	-
Net income (loss)	$ (10,870)	$ (15,349)	$ (4,375)	$ 5,707	$ 21,508	$ 32,662	$ 44,991	$ 53,086	$ 64,511	$ 81,949	$ 97,985	$ 116,731	$ 145,648	$ 168,058
EBITDA	**$ (239)**	**$ (5,637)**	**$ 3,951**	**$ 9,468**	**$ 25,445**	**$ 36,819**	**$ 54,145**	**$ 73,743**	**$ 89,076**	**$ 111,272**	**$ 132,242**	**$ 157,499**	**$ 187,047**	**$ 218,687**
EBITDA %	*-0.2%*	*-5.2%*	*3.8%*	*7.0%*	*15.1%*	*16.5%*	*18.5%*	*19.6%*	*19.7%*	*20.8%*	*20.8%*	*20.8%*	*20.6%*	*20.0%*
EBITDA from operations	***$ 1,282***	***$ (80)***	***$ 2,632***	***$ 9,468***	***$ 25,445***	***$ 36,819***	***$ 54,145***	***$ 73,743***	***$ 89,076***	***$ 111,272***	***$ 132,242***	***$ 157,499***	***$ 187,047***	***$ 218,687***
EBITDA from operations %	*1.1%*	*-0.1%*	*2.5%*	*7.0%*	*15.1%*	*16.5%*	*18.5%*	*19.6%*	*19.7%*	*20.8%*	*20.8%*	*20.8%*	*20.6%*	*20.0%*
Fully diluted number of shares			122,395	26,083	26,083	26,083	26,083	26,083	26,083	26,083	26,083	26,083	26,083	26,083
EPS			$ (0.04)	$ 0.22	$ 0.82	$ 1.25	$ 1.72	$ 2.04	$ 2.47	$ 3.14	$ 3.76	$ 4.48	$ 5.58	$ 6.44

APPENDIX C: STATEMENT OF XANTREX RETAINED EARNINGS AND BALANCE SHEET

	2000	2001	2002	2003E	2004E	2005E	2006E	2007E	2008E	2009E	2010E	2011E	2012E	2013E
STATEMENT OF RETAINED EARNINGS														
Retained earnings -opening				$ (69,432)	$ (63,457)	$ (41,949)	$ (9,287)	$ 35,704	$ 88,790	$ 153,302	$ 235,250	$ 333,235	$ 449,966	$ 595,613
Net income (loss) for the period				5,707	21,508	32,662	44,991	53,086	64,511	81,949	97,985	116,731	145,648	168,058
Sub-total				(63,457)	-	-	-	-	-	-	-	-	-	-
Dividends				-	-	-	-	-	-	-	-	-	-	-
Retained earnings -closing				$ (63,457)	$ (41,949)	$ (9,287)	$ 35,704	$ 88,790	$ 153,302	$ 235,250	$ 333,235	$ 449,966	$ 595,613	$ 763,671
Dividend Estimate				268.00	-	-	-	-	-	-	-	-	-	-
Dividend % of cash balance				0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dividend $				$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Dividend/share				$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
BALANCE SHEET														
Assets														
Current Assets														
Cash and equivalents	$ 6,865	$ 16,232	$ 17,110	$ 24,371	$ 39,851	$ 64,370	$ 97,385	$ 138,109	$ 191,545	$ 259,821	$ 340,725	$ 437,142	$ 557,605	$ 693,778
Accounts Receivable	22,686	16,717	18,476	22,862	29,037	37,368	48,990	63,000	75,504	89,222	106,344	126,710	151,707	183,113
Intercompany Receivable	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Inventories	19,122	23,513	18,894	20,201	22,894	29,343	37,937	48,783	58,473	69,099	82,376	98,165	117,797	142,706
Prepaid expenses	1,100	837	541	643	488	488	488	488	488	488	488	488	488	488
Total Current Assets	49,773	57,299	55,021	68,077	92,271	131,570	184,799	250,380	326,010	418,630	529,933	662,505	827,598	1,020,085
		41,067	37,911	43,706	52,419	67,200	87,415	112,271	134,465	158,829	189,208	225,363	268,369	326,307
Investments	298	329	297	272	297	297	297	297	297	297	297	297	297	297
Investment tax credit receivable	786	1,290	1,752	2,602	1,940	1,940	1,940	1,940	1,940	1,940	1,940	1,940	1,940	1,940
Future income taxes	1,293	875	2,608	1,986	2,608	2,608	2,608	2,608	2,608	2,608	2,608	2,608	2,608	2,608
Property & equipment	9,098	9,203	6,977	5,641										
Goodwill	69,928	65,036	47,669	47,669	47,669	47,669	47,669	47,669	47,669	47,669	47,669	47,669	47,669	47,669
Intangible assets	12,065	11,221	9,771	8,223	6,180	4,584	2,988	1,392	-	-	-	-	-	-
Other assets	52													
Total other assets	93,520	87,954	69,074	66,393	58,694	57,098	55,502	53,906	52,514	52,514	52,514	52,514	52,514	52,514
Total Assets	$ 143,293	$ 145,253	$ 124,095	$ 134,470	$ 150,965	$ 188,668	$ 240,301	$ 304,286	$ 378,524	$ 471,144	$ 582,447	$ 715,019	$ 880,112	$ 1,072,599
Liabilities & Shareholders' Equity														
Current Liabilities														
Accounts Payable	$ 17,680	$ 17,345	$ 20,361	$ 25,792	$ 22,963	$ 29,068	$ 38,107	$ 49,006	$ 58,732	$ 69,403	$ 82,722	$ 98,564	$ 118,008	$ 142,438
Intercompany Payable	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Operating Line	18,423	-	-	-	-	936	-	-	-	-	-	-	-	-
Current portion of long-term debt	999	1,883	6,656	5,785	3,461	1,461	-	-	-	-	-	-	-	-
Current portion of lease obligation		236	21											
Total Current Liabilities	37,102	19,464	27,038	31,577	26,424	31,465	38,107	49,006	58,732	69,403	82,722	98,564	118,008	142,438
		21,603	10,873	12,129	25,995	35,735	49,307	63,265						
Other	294	386	-	-	-	-	-	-	-	-	-	-	-	-
Long Term Debt	8,990	6,592	-	-	-	-	-	-	-	-	-	-	-	-
Obligations under capital lease		10												
		26,452	27,038	31,577	26,424	31,465	38,107	49,006	58,732	69,403	82,722	98,564	118,008	142,438
Shareholders' Equity														
Capital Stock	129,754	166,987	166,489	166,619	166,490	166,490	166,490	166,490	166,490	166,490	166,490	166,490	166,490	166,490
Retained Earnings (EBIT)	(33,129)	(48,186)	(69,432)	(63,725)	(41,949)	(9,287)	35,704	88,790	153,302	235,250	333,235	449,966	595,613	763,671
Total	96,625	118,801	97,057	102,894	124,541	157,203	202,194	255,280	319,792	401,740	499,725	616,456	762,103	930,161
Total Liabilities & Shareholders' Equity	$ 143,011	$ 145,253	$ 124,095	$ 134,471	$ 150,965	$ 188,668	$ 240,301	$ 304,286	$ 378,524	$ 471,144	$ 582,447	$ 715,019	$ 880,112	$ 1,072,599

APPENDIX D: XANTREX PROJECTED CASH FLOW STATEMENTS

	2000	2001	2002	2003E	2004E	2005E	2006E	2007E	2008E	2009E	2010E	2011E	2012E	2013E
STATEMENT OF CASH FLOW														
Cash provided by (used for)														
Operating atctivities														
Net income (loss) for the period	$ (10,870)	$ (15,349)	$ (4,375)	$ 5,707	$ 21,508	$ 32,662	$ 44,991	$ 53,086	$ 64,511	$ 81,949	$ 97,985	$ 116,731	$ 145,648	$ 168,058
Items not affecting cash:														
Depreciation and amortization	7,008	8,573	4,585	4,053	3,622	4,001	4,380	5,762	6,106	5,561	6,136	7,013	3,382	3,607
Foreign exchange on long-term debt		249	-	1,283	(847)	-	-	-	-	-	-	-	-	-
Other		(320)		757										
		(6,847)	210	11,800	24,283	36,663	49,371	58,848	70,617	87,510	104,121	123,744	149,029	171,664
Changes in non-cash balances														
Accounts receivable		5,969	(1,759)	(4,386)	(6,175)	(8,331)	(11,621)	(14,011)	(12,503)	(13,719)	(17,122)	(20,366)	(24,997)	(31,405)
Inventories		(4,391)	4,619	(1,307)	(2,693)	(6,449)	(8,594)	(10,845)	(9,691)	(10,625)	(13,277)	(15,790)	(19,632)	(24,909)
Investment tax credits receivable		(504)	(462)	(850)	862	-	-	-	-	-	-	-	-	-
Prepaid expenses		263	296	(102)	155	-	-	-	-	-	-	-	-	-
Accounts payable and accrued liabilities		(335)	3,016	5,431	(2,829)	6,104	9,040	10,898	9,726	10,671	13,318	15,842	19,445	24,429
		1,002	5,710	(1,214)	(10,880)	(8,676)	(11,175)	(13,958)	(12,468)	(13,673)	(17,080)	(20,313)	(25,185)	(31,885)
		(5,845)	5,920	10,586	13,403	27,987	38,196	44,890	58,149	73,837	87,040	103,430	123,845	139,780
Investing activities														
Purchase of propert and equipment		(2,878)	(813)	(1,169)	(2,949)	(3,354)	(4,397)	(3,958)	(6,325)	(4,805)	(7,000)	(6,445)	(7,262)	(15,339)
Short term investments		(75)	-	-	-	-	-	-	-	-	-	-	-	-
Investments		-	-	-	-	-	-	-	-	-	-	-	-	-
		(2,953)	(813)	(1,169)	(2,949)	(3,354)	(4,397)	(3,958)	(6,325)	(4,805)	(7,000)	(6,445)	(7,262)	(15,339)
Financing activities														
Net borrowings (repayment) of long-term debt		(1,431)	(1,912)	(2,175)	(2,033)	(2,033)	(1,475)	-	-	-	-	-	-	-
Dividends				-	-	-	-	-	-	-	-	-	-	-
Issuance of common stock		38,166	(498)	20	47,978	-	-	-	-	-	-	-	-	-
		36,735	(2,410)	(2,155)	45,945	(2,033)	(1,475)	-	-	-	-	-	-	-
Increase (decrease) in cash and equivalents		27,937	2,697	7,262	56,400	22,600	32,324	40,932	51,824	69,032	80,041	96,985	116,582	124,440
Cash and equivalents, beginning of period		(11,705)	16,232	17,110	24,372	80,772	103,372	135,696	176,628	228,452	297,484	377,525	474,511	591,093
Cash and equivalents, end of period	-	16,232	18,930	24,372	80,772	103,372	135,696	176,628	228,452	297,484	377,525	474,511	591,093	715,533

APPENDIX E: BALANCED SCORECARD, FINANCIAL PERSPECTIVE

Financial Perspective		Weight	Status quo	Forward Integration	Sub Supplier	Wind Turbine Manufacturer	Exit Industry	IP house
Goals	**Measures**	40%						
Survive	· Retain GE business		5	7	1	0	1	3
	· Retain Loher business		8	10	10	10	1	7
	· Cash flow from current product sales		3	8	4	8	1	7
	· Maintain gross margin		2	8	9	8	1	9
Succeed	· % Increase of GE Business		2	6	2	1	1	2
	· % Increase of Loher Business		5	10	6	8	1	5
	· % Increase in gross Margin		2	8	8	8	1	10
	· % Revenue from new customers		5	10	5	9	1	5
	· % Marketshare		2	10	4	8	1	3
Prosper	· Increase number of WTG customers		3	10	3	10	1	5
	· % Revenue from system products		3	10	2	10	1	4
	· Increase ROE		2	7	8	8	1	5
	· % Revenue from acquisitions		1	9	2	10	1	3
	· AVG GM > 50%		2	7	9	8	1	9
	Total Section Score		45	120	73	106	14	77
	Weighted Score		18	48	29.2	42.4	5.6	30.8

APPENDIX F: BALANCED SCORECARD, CUSTOMER PERSPECTIVE

Customer Perspective		Weight	Status quo	Forward Integration	Sub Supplier	Wind Turbine Manufacturer	Exit Industry	IP house
Goals	**Measures**	20%						
New Products	· %Sales from new customers		4	8	4	8	1	5
	· On time delivery of new products		8	7	8	9	1	5
	· %Sales from IP		3	7	5	7	1	9
	· %Sales from non-converter business		1	9	1	9	1	2
Responsive supply	· On time delivery		9	9	9	9	1	5
	· PPM of Field Failures		5	8	6	5	1	7
	· %Uptime		4	8	3	9	1	4
Preferred Supplier	· %Of customers converter purchases		2	8	5	8	1	1
	· %Of customers system purchases		2	8	1	8	1	1
Customer Partnership	· Number of co-operative design projects per customer		5	9	5	8	1	5
	· Top five WTG accounts		2	8	2	2	1	5
	Total Section Score		45	89	49	82	11	49
	Weighted Score		9	17.8	9.8	16.4	2.2	9.8

APPENDIX G: BALANCED SCORECARD, INTERNAL BUSINESS PERSPECTIVE

Internal Business Perspective		Weight	Status quo	Forward Integration	Sub Supplier	Wind Turbine Manufacturer	Exit Industry	IP house
Goals	**Measures**	20%						
Technology Capability	· Number of new patents		5	8	4	8	1	5
	· Number of new technologies acquired		1	8	3	10	1	3
Manufacturing excellence	· On time delivery		8	7	9	10	1	5
	· Unit cost		4	9	5	10	1	5
	· Yield in PMM in process and at customer dock.		6	8	8	8	1	5
	· Number of new process learned		1	9	1	9	1	5
	· Return rate		7	9	8	8	1	4
Design productivity	· % Reuse of components and designs		8	8	9	9	1	8
	· Project cycle time		4	4	9	4	1	5
	· ROI / NPV		5	7	9	5	1	4
	· Headcount per project		5	5	5	5	1	5
	· Employee retention		5	8	4	8	1	8
New Product Introduction	· Actual vs. Planned		8	5	8	7	1	5
	Total Section Score		67	95	82	101	13	67
	Weighted Score		13.4	19	16.4	20.2	2.6	13.4

APPENDIX H: BALANCED SCORECARD, INNOVATION, AND LEARNING PERSPECTIVE

Innovation and Learning Perspective		Weight	Status quo	Forward Integration	Sub Supplier	Wind Turbine Manufacturer	Exit Industry	IP house
Goals	**Measures**	20%						
Technology Leadership	· Time to first integrated system product		3	8	3	8	1	3
	· Number of patents issued		5	7	4	8	1	5
	· Number of design changes post launch		5	7	5	9	1	5
Manufacturing Learning	· Time to process maturity		8	8	9	7	1	5
	· PPM reduction		8	8	8	8	1	5
	· Outsource process maturity		8	9	9	9	1	9
Product focus	· % Of revenue from new products		6	9	5	7	1	5
Time to Market	· Time from concept to launch		5	4	5	4	1	4
	· Introduction time vs customer request		5	3	7	3	1	4
	Total Section Score		53	63	55	63	9	45
	Weighted Score		10.6	12.6	11	12.6	1.8	9

APPENDIX I: MULTI-GOAL SCORECARD

Goals	Strategy Alternatives					
	Status quo	**Forward Integration**	**Sub Supplier**	**Wind Turbine Manufacturer**	**Exit Industry**	**IP house**
Competitive Position	Weak	Strong	Weak / Strong	Medium	Weak	Medium
Investment	Low	Moderate	Low	High	Low	Moderate
Environment	3	4	2	5	1	3
Social responsibility	2	4	1	5	1	2.5
Employee welfare	Layoff staff	Increase staff	Layoff staff	Increase staff	Layoff staff	Unchanged
Short term profit	Low	High	Medium	Medium	Low	Medium
Long term profit	Low	High	Medium	Medium	N/A	High
Market share	Decline	Increase	No change	Increase	N/A	Increase

APPENDIX J: TARIFF FEED-IN RATES

Country	Rate per KWh Euro-cent	Comments
Austria	7.80	Guaranteed for 13 years.
Australia	4.40	Divided almost half & half between energy price and environmental bonus.
Belgium	7.50	The tariff consists 5.0 cents (fixed for 10 years) + 2.5 cents (green certificate).
Denmark	3.63	Consists of price from NordPool spot market plus a 1.2 cent CO2 premium. Projects established by end 2002 (applying to the repowering scheme) are paid 8 cents for the first 12,000 full load hours.
France	8.36	Rates for the initial 5 year, thereafter a reduction to 3.05 cents per kWh in high wind regimes over the following 10 years.
Germany	9.10	Feed-in law as of 2002. Modified slightly in 2003. The rates will apply for the initial 5 years of operation and thereafter the over all feed -in rate will be adjusted to reference "energy-values" for the respective location.
Greece	6.16-7.31	Rates are different by location. Mainland wind energy producers get 90% of the consumer price. Wind farms without grid access to mainland get 7.31 cents per kWh. A 40% grant of capital costs possible.
Ireland	4.8-5.3	Projects larger than 3 MW get 4.8 cents and smaller installations get 5.3 cents. Competitive bidding process have been used under the AER 5 (Alternative Energy Requirement).
Italy	9.52-6.8	Price depends on year of installation. The system undergoes changes from a "fixed price" scheme to "RES Quota" scheme with green certificates.
Japan	10.50	Rate for projects realised in 2002 and 2003. Further subsidies up to 50% of the capital cost can be obtained for public companies and 33% for private companies
Netherland	8.0-9.0	Renewable energy producers receive this price due to strong consumer demand for green energy. RECS are imported from other European countries
Norway	3.20	Government subsidies can be obtained of up to 10% of the capital cost. NordPool spot market price plus NOK 0.05/kWh (50% of energy tax)
Protugal	8.20	First 2000 full load hours get 8.2 cent. Thereafter 7 cents Regulation in force since late 2001.
Spain	6.27	Rates of two components the market price for electricity plus an incentive of 3.0 EUR cent. Price per kWh can only be obtained for producers up to 50MW size projects. Turbine owners have the option to get a full fixed price for their electricity.
Sweden	5.25	In 2003 a transition ruling was introduced where projects were subsidised with SEK 0.15/kWh for the first 25,000 full load hours.
UK	7.35-7.84	Governmental requirement of 3% renewable energy from RES (Renewable Energy Systems) and the non compliance costs 4.5/per kWh.
USA	3.73	PTC Expired at end 2003. Around 14 states now have Renewable Portfolio Standard. Accelerated depreciation will expire by end of 2004.

Source: BTM Consut ApS - March 2004

APPENDIX K: GE WIND INCOME STATEMENT

Product Description	**GE Wind 1.5MW**
	Actual Data
Engineering Project Commencement Date	2001
Date product released	Dec-02
Program Costs	
Total development costs	
2001	$ 648
2002	490
2003	492
Total	$ 1,630
Third party funding received	(250)
Net program development costs	$ 1,380
Total capital costs	
Product Data	
Average selling price ($/unit)	$ 37,497
Standard cost ($/unit)	30,094
Gross margin ($/unit)	$ 7,403
GM %	19.7%
Units Sold (actual sales and projections)	
2002	38
2003	417
Total unit sales in first three years	455
Revenue Earned (in 000's of US$)	
2002	$ 1,438
2003	15,623
Total revenue dollars in first three years	$ 17,061
Margin Earned (in 000's of US$)	
2002	$ 205
2003	2,624
Total Margin dollars in first three years	$ 2,829
Return on Investment in Year One	205%

APPENDIX L: ANALYSIS APPROACH

The analysis will use three tools to assess the effectiveness of the strategic choice; the balanced scorecard, the performance assessment model, and multi-goal analysis. Each strategic alternative will be analyzed and scored for possible successful impact on Xantrex. Each score is then reviewed with the CEO of Xantrex for validation.

Balanced Scorecard

The balanced score card is a tool which aligns the goals of the organization, with specific measures to ensure there is a balanced view based on four broad categories, financial, customer, internal business and innovation and learning.[89] **Table 10** is an example of the financial perspective scorecard for Xantrex. Each strategic alternative is rated form a scale of one to ten, with one being "will not achieve" and ten being "most likely to achieve". Each perspective is weighted on importance with the total weight being 100%. The four perspectives are then totaled for a complete score.

[89] Boardman, A. E., Vining A. R. (2003). *A Framework for Comprehensive Strategic Analysis*; Retrieved May 25, 2004, from http://www.bus.sfu.ca/homes/a_vining/ViningProject.pdf; p. 38

Table 10 Balanced Scorecard Financial Perspective

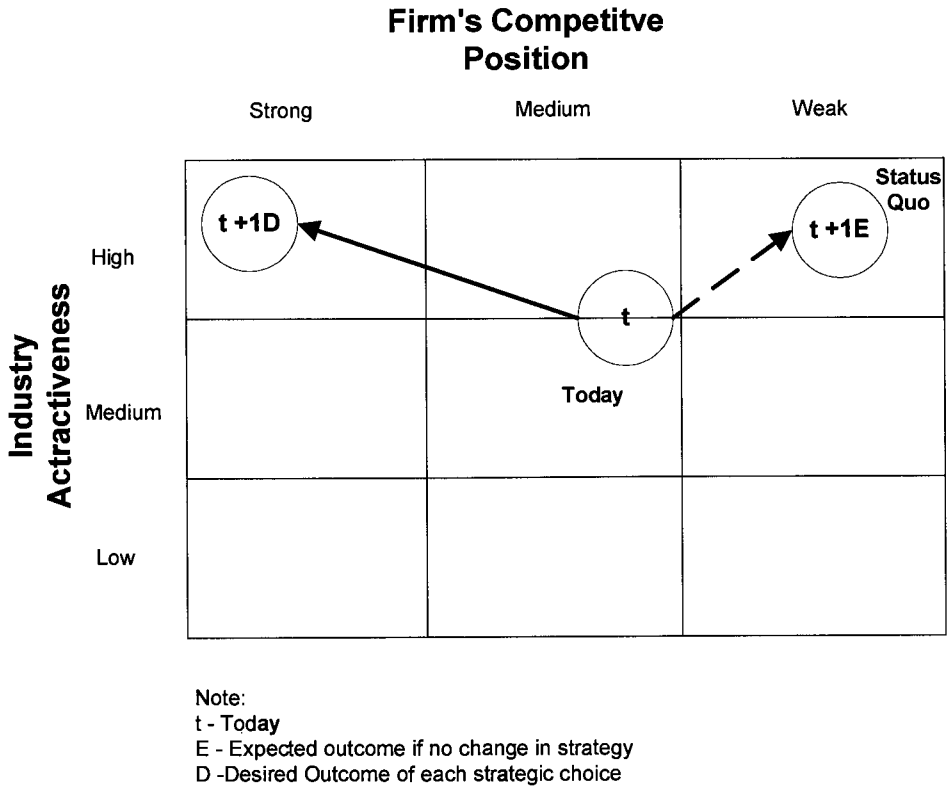
FINANCIAL PERSPECTIVE	
Goals	**Measures**
Survive	• Retain GE business • Retain Loher business • Cash flow from current product sales • Maintain gross margin
Succeed	• % Increase of GE Business • % Increase of Loher Business • % Increase in gross Margin • % Revenue from new customers • % Market share
Prosper	• Increase number of WTG customers • % Revenue from system products • Increase ROE • % Revenue from acquisitions • AVG GM > 50%

Performance Assessment Model

The performance assessment model analyzes the firm's competitive position against the market attractiveness and details the expected outcome of status quo against the desired outcome of each strategic alternative.[90] Figure 15 shows an example Xantrex positioning today, what is expected to happen if there is no change in strategy is undertaken, and the desired outcome from a market and competitive position.

[90] ibid, p. 39

Figure 15 Performance Assessment Model



Multi-Goal Model

The Mutli-goal prediction model is used to analyze strategic macro goals of the organization and the predicted outcome.[91] Each alternative will be analyzed and scored (See **Table 11**) and compared to the status quo strategy (See **Figure 16**).

[91] ibid, p. 46

Table 11 Multi-Goal Scoring Method

Goal	Scoring Method
Competitive Position	• Weak/Medium/Strong
Investment	• Low/Moderate/High
Environmental	• 1 to 5
Social Responsibility	• 1 to 5
Employee Welfare	• Layoff/No Change/Increase
Short Term Profit	• Low / Moderate/High
Long term Profit	• Low/Moderate/High
Market Share	• Low/Moderate/High

Figure 16 Example of Mutli-Goal Matrix

Goals	Strategy Alternatives					
	Status quo	Forward Integration	Sub Supplier	Wind Turbine Manufacturer	Exit Industry	IP house
Competitive Position						
Investment						
Environment						
Social responsibility						
Employee welfare						
Short term profit						
Long term profit						
Market share						

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GLOSSARY

Word	Definition
AC	Alternating Current
Balance of Systems	The components required in the connection of the grid tie inverter or inverter charger to the utility grid. These components could include power panels, circuit breakers, relays, and fuses.
Converter	An electronic device, which converts one form of electricity to another for of electricity such as AC to DC.
DC	Direct Current
Inverter	An electronic device that converts DC power to AC power
Inverter charger	A bidirectional electronic device that can produce either DC or AC power depending on the energy flow.
Kilowatts	One thousand watts.
LLC	Limited liability corporation.
Megawatt	One million watts
MRP	Material requirements planning., a business software application which utilizes bill of materials to plan and procure materials required for manufacturing.
MSW	Modified sine wave AC power. Typically produced in a square wave

	output.
OEM	An original equipment manufacturer, which designs and manufactures its own products.
Power Supply	An electronic device that converts AC to DC at a fixed out voltage and current.
PTC	Production Tax Credit: A tariff supplied to wind energy producers to generate electricity. Usually paid in cents/kilowatt hour.
PV	Photo Voltaic is the process of converting the sun's energy into DC power using solar panels.
Renewable Energy	Forms of energy, which does not produce green house gases and occurs naturally such as solar and wind energy.
Ride-through	The ability of a wind turbine generator to ride through voltage dips in the utility grid and assist in holding up the grid voltage rather than shutting off or disconnecting from the electrical grid.
SW	True sine wave AC power. Typically the same as what is produced by electrical utilities.
Truck upfitter	A firm which transforms or converts a truck chassis into a work vehicle.
Wind Turbine Generator	A large propeller driven device which converters wind energy into electricity.