STRATEGIC ANALYSIS OF A COMMERICAL PRODUCT BUSINESS UNIT

by

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PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF

Master of Business Administration

MBA-MOT Program

in the Faculty

of

Business Administration

SIMON FRASER UNIVERSITY
August 2004

APPROVAL

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Degree: Master of Business Administration

Title of Project: Strategic Analysis of a Commercial Product Business Unit

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ABSTRACT

A recently formed commercial product business unit is analysed within a Canadian high-technology company that holds leading-edge expertise in fast pressure swing adsorption technology for gas purification in the helium, landfill, and hydrogen markets. The intent of the business unit is to generate early revenues and allow the company to differentiate its focus from its current research and development activities. In order to operate as an autonomous separate unit from the company, numerous organizational changes, resources, processes, and marketing tactics need to be implemented to give the business unit the best opportunity to sustain profitability.

In this paper, the current commercial products in the global helium, hydrogen, and landfill markets are analysed to develop a strategy for the business unit to increase its revenue. The strategic analysis of the business unit includes an external analysis, based on Porter's five forces, an internal analysis, based on value chain analysis, and the resource based theory of the firm. Product strategy, research & development expenses, decision-making, and manufacturing were found to be strategically misaligned. Three strategic alternatives emerge from the analysis: a broad manufacturing strategy, a broad licensing strategy, and a focused vertical integration strategy in emerging markets. These alternatives were devised based on outsourcing non-core manufacturing activities globally, increase focus in core development & testing activities, and increase focus on more attractive emerging markets respectively. Using the balanced scorecard, the strategic alternatives are evaluated from four perspectives: financial, customer, internal, and learning & growth. The broad manufacturing strategy is recommended based on its better fit with the corporate vision.

The recommendation of the broad manufacturing strategy includes the following activities: outsource in-house plant assembly activities to fabrication shops in project-specific regions; reallocate resources from manufacturing into sales and proposals; form global offices to generate more leads; increase product support activities; maintain strong presence in regional markets; and diversify into other niche markets. By following this recommended strategy, the business unit is expected to achieve its goals on early-term revenues and to become profitable.

DEDICATION

To my lovely wife Sandy, who gave me the encouragement that I needed for all those tireless nights. She has endured lonely moments ever since she left Holland without her family and friends to be with me. Ironically, while I was working on this paper, we had seen less of each other than our times when we were apart. This paper was a big undertaking and would not have been accomplished if not for my wife having been so patient and understanding with me over the last two years.

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1 INTRODUCTION

1.1 ACME Technologies

ACME Technologies (**ACME**) is a Burnaby based technology company that specializes in developing and commercializing gas separation and gas purification products for use in existing and emerging markets. ACME has patented fast-cycle pressure swing adsorption (**PSA**) technologies to increase performance while reducing the equipment size of traditional gas purification processes. Applications for ACME products include hydrogen purification and hydrogen recovery, methane recovery from landfill gas, and helium purification.

ACME is a privately funded technology company with investors including ABC Inc., Alpha Systems, and Beta Gamma. Traditionally, ACME has had a research and development focus. The current focus of the company is to generate revenues from its commercial products. ACME is active in developing applications for other sectors, such as refinery plants, medical oxygen, and diesel engines. Currently, ACME employs about 80 people.

The focus of this paper is to provide a strategic analysis of a commercial product business unit (**CPBU**) within ACME. The CPBU is a unit that is formed to produce a revenue stream that would support the remainder of the company prior to refinancing within 2 years. The CPBU operates independently from the rest of the company. The current strategic issue of the CPBU is that it is not performing as envisaged to reach its financial goals. This paper addresses the CPBU's ability to generate early-term revenues and provides recommendations based on the strategic analysis.

The following sections in chapter 1 introduce the company, the CPBU, the product offerings, the target markets, and the current strategic issues. Chapter 2 discusses the external analysis of industrial gas purification industry based on Porter's (Porter 138-141) five forces. Chapter 3 explores the company's organizational core competencies and activities using the value chain. Chapter 4 discusses the strategic fit of the company. Chapter 5 provides an overview of the three strategic alternatives that are further discussed in chapters 6, 7, and 8. Chapter 9 compares each of the three strategic alternatives using the balanced scorecard. At the end of the paper, chapter 10 concludes with recommendations and summary.

1.2 History of ACME Technologies

The origin of ACME began in 1975 when Dr. Winnie developed breakthroughs in rapid-cycle PSA technology. At that time, the first commercial fast-cycle PSA unit called the Enterprise was developed. In 1996, Enterprise Industries Inc. was incorporated to develop prototypes for commercial applications. The following year, ABC Inc., the world's second largest merchant gas company, became a strategic partner on the development of oxygen purification systems.

In 2000, the company was renamed ACME Technologies to reposition itself as a clean energy enabler specializing in oxygen and hydrogen purification. ACME increased its association within the alternative energy sector and began focusing on developing compact gas purification systems for use in proton exchange membrane (**PEM**) fuel cell engines. By mid-2001, ACME successfully secured another strategic partner, Alpha Systems, to develop on-board gas purification systems.

Infusion of capital from ABC Inc. and Alpha had provided the growth of two major development groups within the company: the industrial gas system (**IGS**) and the compact gas system (**CGS**) groups. ACME experienced fantastic growth from 30 employees to over 130. The commercial product business continued within IGS but with minimal resources assigned to support the activities.

By mid-2002, the joint-development programs with ABC Inc. and Alpha were both unexpectedly shelved. The projected market demand for oxygen did not materialize and ABC Inc. withdrew its support for future development. Similarly, Alpha's technological roadmap shifted from on-board fuel reforming for fuel cell vehicles (**FCV**) to stationary fuel reforming in hydrogen fuelling stations. Hence, Alpha withdrew its funds to further support the development for on-board gas purification units. The temporary loss of both development programs had a significant financial impact on ACME's ability to support its current level of resources.

During the summer of 2002 when the investment hype for fuel cell technology was low, ACME suffered from weak cash flow and refinancing from the equity market was a poor alternative. As a result, the company restructured itself and dismantled the IGS and CGS departments into a matrix structure comprised of core teams and three departments known as the Advanced Development Group (**ADG**), Manufacturing & Product Development (**MPD**), and Business Development & Marketing (**BDM**). By late 2002, ACME formed the Apollo core team to develop a gas purification system for hydrogen fuelling stations and to generate revenues with the current commercial products.

By late 2002, a strategic partnership with Beta Gamma, a global business of the Royal Beta Group of Companies, was formed. ACME worked closely with Deltacorp, a joint venture between Beta Gamma and UTC Fuel Cells, on the development of a hydrogen purification device for fuel cell systems. However, the development program with Deltacorp was unexpectedly halted and the program was eventually postponed.

By 2003, the Apollo core team was disarrayed with competing priorities. BDM led the sales and marketing efforts for the commercial products but lacked the cohesive support from the core team. The core team struggled to balance priorities on product development, projects, sales support, or product support. In fall of 2003, ACME once again needed to preserve cash for financing and restructured the Apollo core team.

ACME is a privately funded company that will be raising funds for refinancing in early 2005. Given that commercially available fuels cell vehicles will be at least a decade away, ACME realizes that its current strategy as a company needs to be realigned from PSA research and development to generate early term revenues. Refinancing based on future market capitalization will provide poor valuation terms. The strategic focus to become successful with early-term revenues is now a top priority for the company.

By late 2003, ACME reorganized its strategic priorities from development activities to generating early term revenues with its commercial products. In March 2004, ACME formed the CPBU to focus on sales with its commercial products in the current markets.

1.3 The Commercial Product Business Unit (CPBU)

1.3.1 The CPBU within ACME Technologies

In February 2004, the CPBU was formed to focus on sales and order-fulfillment of commercial products. The CPBU has a hybrid structure where some resources are shared via a matrix structure and some resources are committed full-time. Like the previous core team, the CPBU was formed from selected key members in BDM, MPD, and ADG as shown in **Figure 1.1**. The goal of the CPBU is to generate $6.8 million dollars of revenues for 2004 from sales of its commercial products and to break-even with its current operations. The CPBU is meant to operate as a separate entity from ACME. Hence, ACME resources outside of the CPBU are charged accordingly.

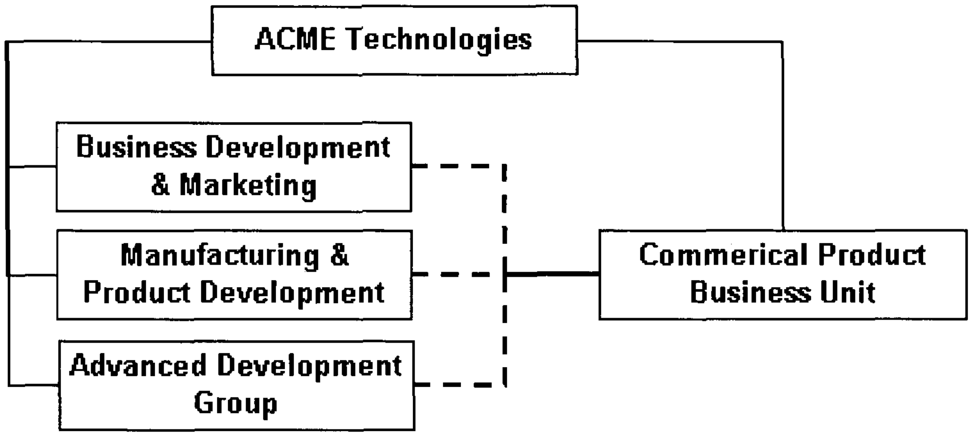

Figure 1.1: ACME Technologies Organizational Chart

BDM has two main functions: (1) Business development of new products into new markets (non-CPBU); and (2) CPBU core activities. Business development resources (non-CPBU) are involved in concluding strategic joint-development partnerships to diversify into new markets such as new applications in petrochemical and refinery. The CPBU business activities include channel development, sales and marketing, project management of orders, and product support of current commercial products. Marketing and promotion activities reside with all members within this department. The vice-president of BDM champions the CPBU and is highly involved in the daily activities of the unit.

MPD performs manufacturing and engineering design functions for new developing technologies. MPD holds the proprietary expertise in the design and manufacturability of the patented rotary valve, a core technology that enables fast-cycle PSA. Tied-in via the matrix structure to the CPBU, MPD has a crucial role in order fulfilment and product development of commercial products (CPBU related activities). The manufacturing manager, quality manager, and engineering manager lead various functions to support the CPBU. The vice-president of MPD holds a supporting champion role to the CPBU and had been active in reorganization and developing processes within the unit.

ADG is the research and development arm of ACME and has been involved mainly in supporting market development activities for developing new products. ADG holds the proprietary knowledge of the adsorbent bed technology, another core technology that enables fast-cycle PSA. Like MPD, ADG provides support to the CPBU via a matrix structure. The primary role for ADG in the CPBU is to size and evaluate bed designs for unique applications that are requested by prospective customers. Although a process development engineer is dedicated half-time to the CPBU, ADG has been supportive in providing additional resources if application testing is needed.

1.3.2 Structure of the CPBU

ACME is a relatively small company and has limited resources to have full-time support on its development, sales, and project activities. Hence, resources are shared through a mixed matrix and simple structure. These shared resources are denoted by the dotted boxes in **Figure 1.2** below.

The commercial product manager (under Order-To-Delivery (**OTD**) Management) is mainly responsible for project managing orders and controlling expenses within the CPBU (except for product development). Typically, the commercial product manager is supported by engineering and manufacturing resources from ADG, BDM, and MPD within the CPBU. Increasing secondary roles for the CPBU manager are preparing quotations, managing testing and product development, and field support.

Product engineering activities (under Engineering) within the CPBU are championed by a product engineer who is responsible for all design aspects of the commercial products. Examples of current project development activities include the multi-valve Apollo, cost reduction design, and system customization. All resources under the product engineer (Design, Electrical, Testing, Purchasing, and PSA Process) except for the process engineer are shared between ADG and MPD. The product engineer is a half-time position.

Manufacturing in the CPBU has a lead hand and two assemblers who are directly supervised by a MPD manufacturing manager (outside the CPBU). Although the CPBU manufacturing arm is an integral part of the business unit, its involvement is strictly for order-fulfillment. Currently, manufacturing out-sources its fabrication of rotary valves, equipment, vessels, and pipe spools to a North American shop. Parts are shipped to ACME and all assembly and final inspection are done in-house.

The sales and business development activities are performed by a channel manager, two account managers, and two part-time sales engineers. The channel manager is responsible to grow the commercial business by developing and implementing strategies to leverage sales and manufacturing license partners. The two account managers work in direct sales, and primarily prepare proposals supported by the sales engineers, who review the technical aspects of the applications.

Product field support is a growing function within the CPBU. A product support engineer is responsible for after-sales customer contact for installation, commissioning, and field trouble shooting. The product support engineer manages the installed equipment base and deals directly with the customer on technical issues.

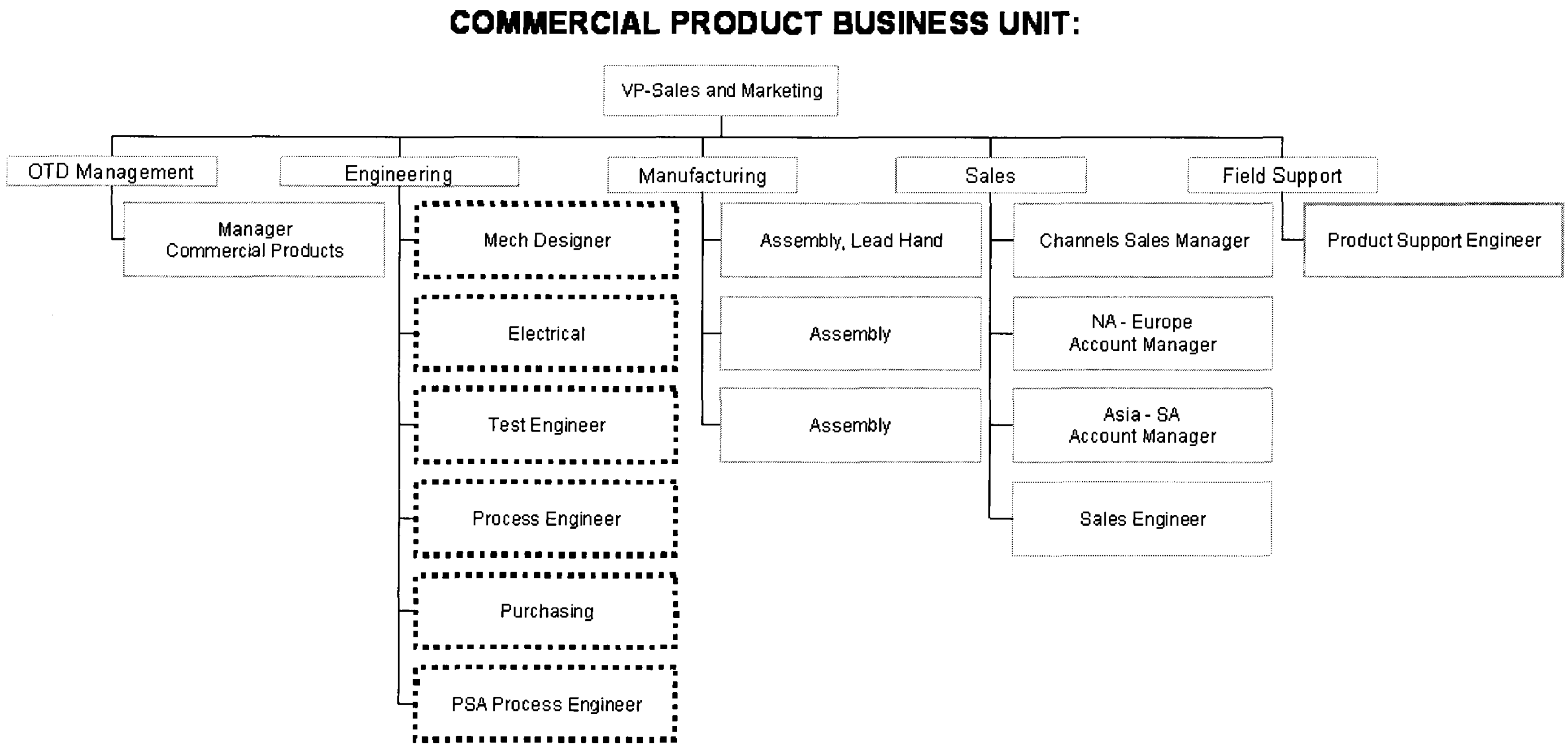

Figure 1.2: Commercial Products Business Unit (CPBU) Organizational Chart

1.4 Mission of the CPBU

ACME requires future financing from investment bankers, private investors, or the public equity market to continue its operations. Regardless of the path to be chosen in the next round of financing, the success of the CPBU would affect the attractiveness and valuation of ACME. Unlike the late 1990s, the valuation of high-technology companies is now highly dependent on revenues and not so much on potential market capitalization. Based on these strategic financial objectives, the mission statements of the CPBU are as follows:

1) To develop credibility with investors and customers with fast-cycle PSA technology.

2) To position the company as a capable manufacturer.

3) To produce quality product delivered at the required performance, with a competitive price, and with a competitive lead time.

4) To generate net cash and become profitable.

5) To be recognize as a market leader.

6) To generate customer enthusiasm with confident and recognized benefits in the products.

The necessity of the CPBU to ACME internally was to:

1) To match revenues with expenses to allow a better understanding of resources.

2) To add a focus on sales in order to meet sales objectives.

3) To demonstrate business credibility and market justification.

4) To allow faster execution on multiple fronts and decision-making.

5) To align the company to early term revenues.

1.5 Pressure Swing Adsorption and the Commercial Products

PSA is a commonly used industrial process for the purification of gas streams. The most common separation processes employing PSA are the purification of hydrogen from sources such as catalytic reformer off-gas and plant effluent gas. Hydrogen production is currently the largest use of PSA in terms of cumulative capacity and number of installed units. In addition to PSA hydrogen purification processes, PSA units have been built in a wide variety of capacities (from 1 NCMH to 100,000 NCMH) and variety of other applications (e.g. – oxygen, nitrogen, helium, methane, etc.). An emerging application of PSA technology is for hydrogen fuelling stations used for fuel cell vehicles.

Pressure swing systems are based on selective adsorbent beds. A gas mixture is introduced to the bed at an elevated pressure and the adsorbent beads selectively adsorb certain components of the gas mixtures, allowing the unadsorbed components to pass through the bed as purified product gas. In the case of hydrogen purification, impure feed enters the bottom of the adsorbent bed during the high pressure step, while purified hydrogen is delivered from the top. The pressure in the adsorbent bed is then decreased and the flow is reversed to allow purge and regeneration of the bed. Exhaust gas that contains impurities is then discharged from the bed. The process is then repeated continuously with numerous beds to allow a steady and continuous product flow.

In conventional PSA systems, a large number of motorized valves are used to equalize pressures between bed columns. The complex switching of these valves and mechanical limitations allows only low cycle frequencies with large adsorbent vessels. Especially in smaller PSA systems, the cost driven by valve and vessel costs are high with high energy inefficiencies from complicated cycles and low adsorbent bed utilizations.

The commercial products offered by ACME have the following key core competitive advantages over conventional PSA technologies:

1) **Simplification of the Conventional PSA Design:** ACME's fast-cycle PSA design has minimized approximately eighteen switching valves to two multi-port distribution valves for directional control of flows. In doing so, this system provides advantages to cost, unit size, and ease of operation. Additionally, reliability is increased by reducing the number of components and moving parts.

2) **Ease of Installation:** ACME produces skid-mounted modules that can be delivered on-site. For a given product capacity, ACME's commercial products occupy only one twentieth the volume and one quarter of the footprint to conventional PSA systems. Most conventional PSA systems are bulky and difficult to integrate with other equipment.

ACME currently has three commercial product platforms that are differentiated by capacity and pressure to capture revenues in the gas purification market:

(1) The H/He-Vision product was launched in July 2003 to target the market segment with low product flows from 10-250 NCMH[1]. The first alphabetic designation of the product denotes the application of the product. That is, the "H" and "He" denote applications for hydrogen and helium gas purification respectively. The H/He-Vision product is based on a 9 bed system utilizing a three equalization cycle design that provides competitive recovery and high productivity which allows an approximate 5 x 4 foot footprint.

(2) The H/M-Star (also known as the Apollo) product line was launched in the early 1990s to target the market segment with medium product flows from 100 to 1100 NCMH of product flow. Similar to above, the "H" and "M" denote applications for hydrogen and methane (landfill) gas purification applications respectively. Launched in 1992, the Apollo product is based on a 6 bed system utilizing a double equalization cycle design that provides a recovery at par to the competition. Incremental development programs are currently underway to increase the application window of this product.

(3) The multi-valve Apollo is still under development and is designed to target the market segments with product requirements that are greater than 1000 NCMH. The development of the multi-valve Apollo started early 2004 and was initiated from increasing interest in the market for larger hydrogen and landfill recovery applications. Currently, the CPBU is leading development of this new product with supporting resources from ADG, MPD, and BDM.

Figure 1.3 illustrates the segmentation of the target markets with the commercial products.

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[1] NCMH denotes a flow in Normal Cubic Meter per Hour.

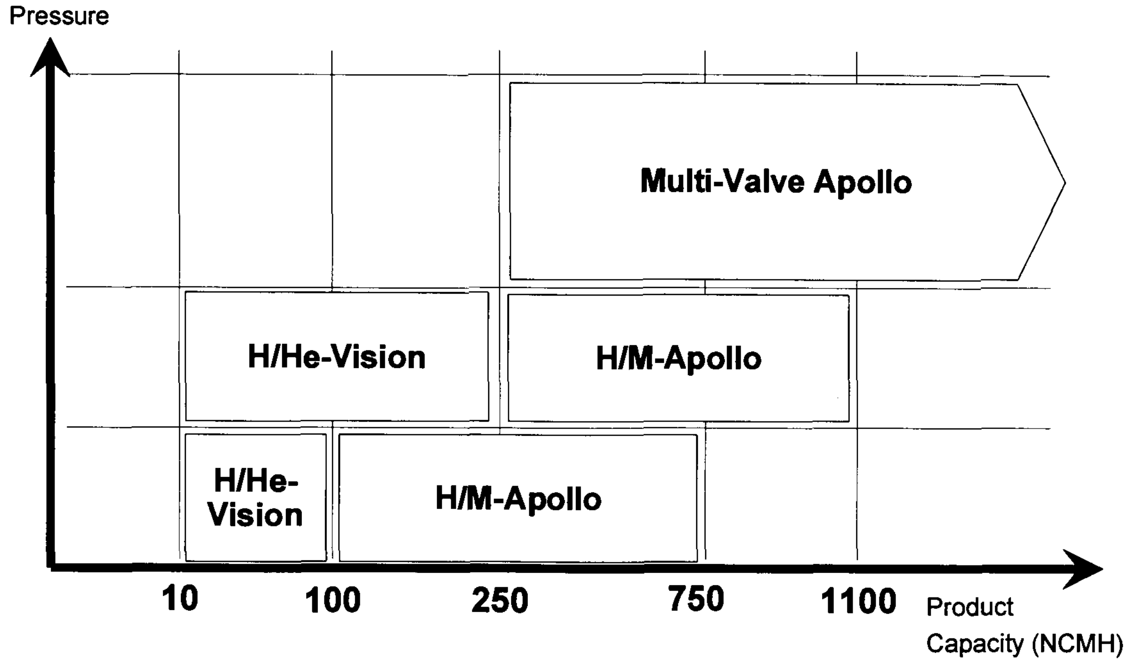

Figure 1.3: Target Market Segments of the Commercial Products

1.6 Industrial Applications and the Target Market Segments

1.6.1 The Small Industrial Gas Purification Market (10-150 NCMH)

The H/He-Vision product line was designed to target the small industrial gas market where product demand is between 10-150 NCMH for low pressure applications. Higher product capacities up to 250 NCMH are feasible with higher pressure applications, but are uncommon. Since the launch of the H-Vision in July 2003, ACME has sold 10 units of the H-Vision. Almost all of the H-Vision systems were installed by the owner for demonstration programs in hydrogen refuelling stations. The He-Vision is built on the same platform as the H-Vision and is designed as an effective helium/air separation system. As of today, ACME has sold only two commercial He-Vision units to its partner, ABC Inc. (who engineered, design, and constructed the recovery system on behalf of the user).

1.6.1.1 The Emerging Hydrogen Fuelling Station Market

The majority of emerging hydrogen companies is involved in the hydrogen fuel cell market. As publicly known, the expectancy of a commercial FCV is pushed back into the distant future and further development programs are underway to make mobile fuel cells commercially viable. Currently, the focus of the fuel cell market has been shifting towards the development of the hydrogen infrastructure such as hydrogen refuelling stations.

In 2003, the U.S. government declared its commitment to the hydrogen fuel-cell economy and proposed $1.2 billion for research and development over the next five years (Calgary Herald 2003). A large portion of this fund will be used to set the foundation for commercialization of hydrogen fuel cells and hydrogen infrastructure (e.g. – hydrogen fuel stations, reformer technology, transportation, etc.). The current fuel-cell market focus is to reform natural gas (or gasoline derived product) at the refuelling site to produce hydrogen, which would then be stored and dispensed.

Current reformer technology has allowed many hydrocarbons, including methane (natural gas) or methanol, to be reformed into a gas mixture of hydrogen, water, carbon monoxide, and carbon dioxide. This reformed synthesis gas must be purified to produce pure hydrogen gas for industrial applications where hydrogen is required for fuel cell electrical generating systems and automotive fuel cell applications. Impure hydrogen gas that is contaminated with carbon monoxide would poison the fuel cell. Thus, ongoing advances in reformer technology have brought increasing interest in distributed hydrogen refuelling systems (**DHRS**) closer to reality. Whether reformer technologies are partial oxidation (**POX**), auto-thermal (**ATR**), steam methane (**SMR**), or methanol decomposition systems, the requirement for high purity hydrogen (as for PEM fuel cells), is required.

Extensive development efforts are being focused on refuelling stations, and sales projections for the H-Vision are expected to grow. As shown in **Figure 1.4**, the cumulative number of hydrogen refuelling stations is gradually increasing around the world (Geiger 2). Although the hydrogen generation for fuel cells projects are not a large market currently, the H-Vision has strategic fit for ACME in building its partnership and position in the fuel cell market. Emerging hydrogen generation companies are early adaptors themselves and are willing to take risks with new supporting technologies. If successful, the developing hydrogen generation companies may become growth partners with ACME.

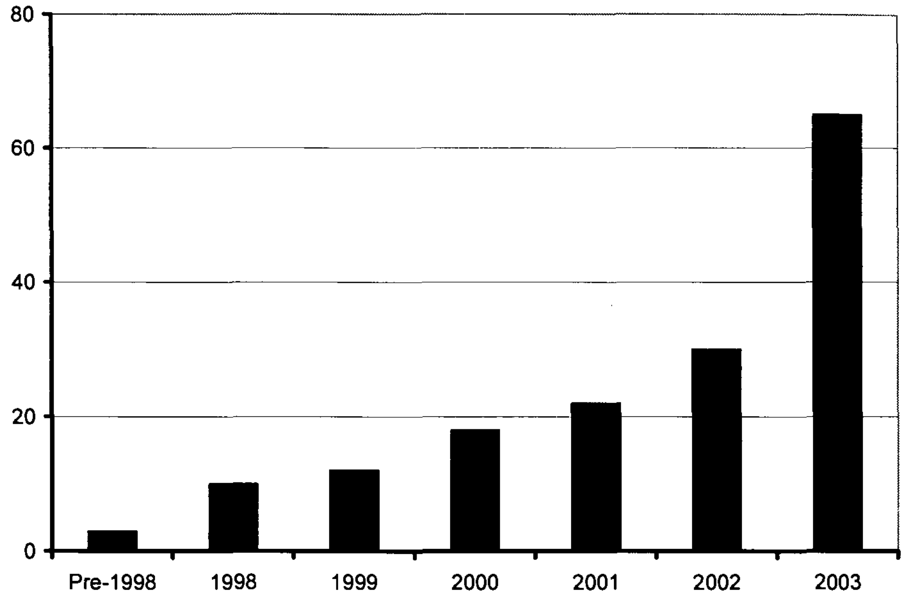

*Figure 1.4: Cumulative Global Number of Hydrogen Filling Stations**

1.6.1.2 Emerging Helium Purification Applications

A niche target application is the recovery of helium gas from air. The demand to recover and recycle helium market has been very cyclic but is gradually growing as shown in Table 1.1 below (Sheridan 32). Supply shortages are growing and conservation of this valuable resource is becoming increasingly important. Although the CPBU has leveraged its expertise in hydrogen to helium purification, the sales of the He-Vision have been low.

Helium Supply from U.S. (Billions of Standard Cubic Feet)			
Year	**US Dels**	**Exports**	**Total**
1997	2944	1122	4066
1998	3203	1058	4260
1999	3416	1019	4435
2000	3408	1407	4816
2001	3386	1636	5021
2002	3386	1701	5087

*Table 1.1: Helium Demand in the United States*γ

* (Geiger 2).

γ (Sheridan 32).

Helium recovery technologies started as part of the US Helium Act of 1960 where raw helium was recovered from the natural gas fields of Texas, Oklahoma, and Kansas (Sheridan 28). Initial market drive to recover helium came from magnetic resonance imaging (**MRI**), leak detection, and welding. However, by the 1990s, a ramp-up in fibre optics production took place that became the driver for helium recovery and recycle technology systems.

To enhance fibre quality and manufacturing productivity, the current processes for producing optical fibres use helium gas. Glass fibres are produced by lowering a silica preform into a furnace situated at the top of a draw tower. As the silica softens and melts, a thin strand of fibre is drawn from the preform, and rapidly cooled in a flow of helium before being coated with a resin for extra strength. Helium has three primary uses (Sheridan 28): (1) the carrier gas in preform glass deposition; (2) the sweep gas in preform consolidation due to its molecular size and inertness; and (3) heat transfer medium when drawing the fibres into very thin strands.

When the helium is collected and returned to the draw tower, air and other contaminants change the composition of helium. Evidently, the cooling rate and quality of the fibre optics change if the purity level of the recycled helium is changed by slightly 1%. Helium recovery rates of about 90% and purity levels of 99.99% are critical to make helium recovery systems truly economical (Hairston 43).

In the early 2000s, many fibre optics companies responded to the collapse of the telecom's growth and stalled installations of fibre optic cable networks. Helium requirements from U.S., European, and Japanese fibre optics companies have been cut by virtually 50 percent from their highs in the late 1990s (Sheridan 32). However, growth in other major demand categories (e.g. – MRI, laser welding, metal deposition, etc.) has offset the significant declines in helium volumes. By late 2003, worldwide helium sourcing plants were operating close to optimum capacity utilization. As the price of helium rises because of increasing operating and transportation costs, buyers have driven the demand for helium recovery systems.

To date, the CPBU does not have any direct communication with the end users in the helium market. The only He-Vision sale channel is through ACME's partner ABC Inc., who holds the intellectual patents with helium recovery and recycle systems using ACME's fast-cycle PSA technology. The two He-Vision systems sold to ABC Inc. were used in metal deposition development.

Despite the success of the He-Vision, the CPBU has not developed further market opportunities with helium. PSA technology is known to be as an economical process in fibre optic plants for recovering helium used in volumes greater than 20 NCMH (Hairston 41). The CPBU has been focused primarily on hydrogen and landfill gas as their key focuses. Market development and penetration into other niche gas purification markets are key areas that the CPBU has not pursued.

1.6.2 The Medium and Large Industrial Gas Purification Market (>150 NCMH)

The H/M-Star product was designed to target the medium and large industrial gas market with product capacities between 150-1100 NCMH. Higher product capacity is feasible with the multi-valve Apollo, where multiple rotary valves of an Apollo are running in parallel to increase flow. The limitation of the multi-valve Apollo has not been yet fully explored. However, higher productivity using the fast-cycle technology allows a smaller footprint, a competitive advantage over conventional PSA systems.

Since 1992, ACME has sold 8 units of the H-Star. Most H-Star systems in the field are currently decommissioned and only a few are in operation with large industrial reformers. The M-Star is built on the same platform as the H-Star and is designed for landfill recovery. As of today, ACME has not sold any M-Star or multi-valve Apollo, which is still under development. However, about 1/3 of the sales inquiries are for the M-Star or multi-valve Apollo and prospect orders for these products are increasing.

1.6.2.1 Emerging Landfill Purification Applications

Currently in the US, approximately 2,200 landfills produce landfill gas (**LFG**) from the decomposition of organic wastes. LFG contains methane, carbon dioxide, sources of greenhouse gases, and other smog-forming emissions. Mandated by the Environmental Protection Agency (**EPA**) in the US, LFG must be collected and destroyed in larger landfills (U.S. Environmental Protection Agency 2003). The most simplistic option for LFG destruction is flaring. An alternative option is to capture and process LFG as a fuel source for electricity generation and/or pipeline-grade methane (Liquid Natural Gas (**LNG**) - denoted as "high-BTU" applications).

In the past several years, the LFG processing market in the US has grown from 200 plants in 1997 to over 340 plants in 2003 (U.S. Environmental Protection Agency 2003). Currently, more than 600 other landfill sites present attractive opportunities for development. Of the operational LFG plants studied, about 70% of the processes are used for electricity generation (and the remaining 30% are used in direct operation). However, only 7 "High BTU" plants currently are in operation today.

The production of LNG is an emerging alternative for processing LFG into electricity or flaring. The key market driver for this option is having LNG as a cost-effective, low-emission fuel for heavy-duty vehicles. Diesel engine emission regulations in the US (particularly in California) have created a market demand for low-emission natural-gas fuelled engines for medium and heavy-duty applications. For heavy-duty trucks, fuel energy density is a primary concern and LNG is the preferred fuel because of lower NO_x emissions.

Over the next 4 years, LNG consumption in California alone is expected to increase by 400% (Powars 9). The continued adoption of LNG as a vehicle fuel is dependent on the following factors: (1) continued regulatory pressure to reduce diesel engine emissions; and (2) availability of high efficiency heavy-duty natural gas engines.

By installing a LFG-to-LNG system, LNG production is attractive to integrated waste management companies that operate in the landfill and LNG-fuel waste haulage fleet. The expected cost savings for these integrated operators is about 45-55% relative to the retail LNG.

Currently, ACME's platform technology offers an effective methane/carbon dioxide separation solution for systems that recover "high BTU" gas. No other technology current exists that can match the performance, cost, and size of the M-Star. Typically, third party engineering companies design LFG processing plants on behalf of landfill operators such as Waste Management Inc, the largest integrated waste management company in the USA. Although a commercial product for landfill applications has not been sold yet, ACME plans to market its technology as an original equipment manufacturer for the third party engineering companies.

1.6.2.2 Established Industrial H2 Applications

Currently, the most common market for hydrogen recovery involves capturing purged or flared hydrogen containing gas streams from refineries, purifying them, and recycling the hydrogen back into hydrogen-consuming processes. Refineries are currently under pressure to better utilize the hydrogen due to clean fuel regulations. The global market demand for hydrogen is projected to be close to 450 billion m^3, which equates to about $35 billion USD (Solar Hydrogen Energy Corporation 2003).

The main three industries that represent 95% of the worldwide hydrogen consumption are ammonia synthesis, refining, and methanol. Edible oils, fats, specialty metals, glass manufacturing, and fuel cells are remaining volumes of end-user. For fertilizer production, ammonia is a base feedstock that is formed at high pressures with nitrogen and hydrogen. In order to saturate hydrocarbons or remove sulphur and other impurities, hydrogen is used in refineries. Methanol is the simplest way of converting natural gas to a liquid form. The methanol industry is designed to convert the world's least expensive sources of natural gas to a more transportable liquid form for exportation. Hydrogenation is the main use for hydrogen in the edible oils and fats. Finally, hydrogen is used to power the emerging fuel cells technologies.

For the next five years, the market for hydrogen is expected to grow by 12% per year in the U.S. and 10% globally. The main driver for this demand is the growing stringent diesel and gasoline regulations requiring low sulphur fuels in North America and Europe. Legislation planned to reduce sulphur content in gasoline in 2004 and in diesel in 2006 will require refiners to use more hydrotreating process steps. With the cost of sweet crude oil increasing, refiners are processing more heavy sour crude, which requires additional hydrogen for sulphur removal.

To date, ACME does not have a commercial product to compete in large hydrogen purification systems. Through sales of the H-Star products only, ACME is able to capture market segments where hydrogen capacity is below 1100 NCMH. Typical hydrogen capacity from refinery off-gas recovery is between 5,000-50,000 NCMH. Currently, on-going research and development is underway to capture this market segment. The commercial release of a larger hydrogen purification product for refinery off-gas is still many year away.

1.7 Commercial Sales History

Figure 1.5 provides a history of the ACME revenues for all its commercial units. Prior to 2001, most of the sales activities were on the Apollo Series 1 (the preceding model before the H-Vision) and H-Star PSA systems, which were sold by outsourced agents. Typical prices of these units varied from approximately $100,000 to $450,000 CND, depending on the capacity, options, and customization required. In 2003, ACME launched the H-Vision and He-Vision PSA systems which replaced the Apollo Series 1 line of products. Currently, combined sold units of H-Vision and He-Vision totalled 17 and 2 respectively in 2004.

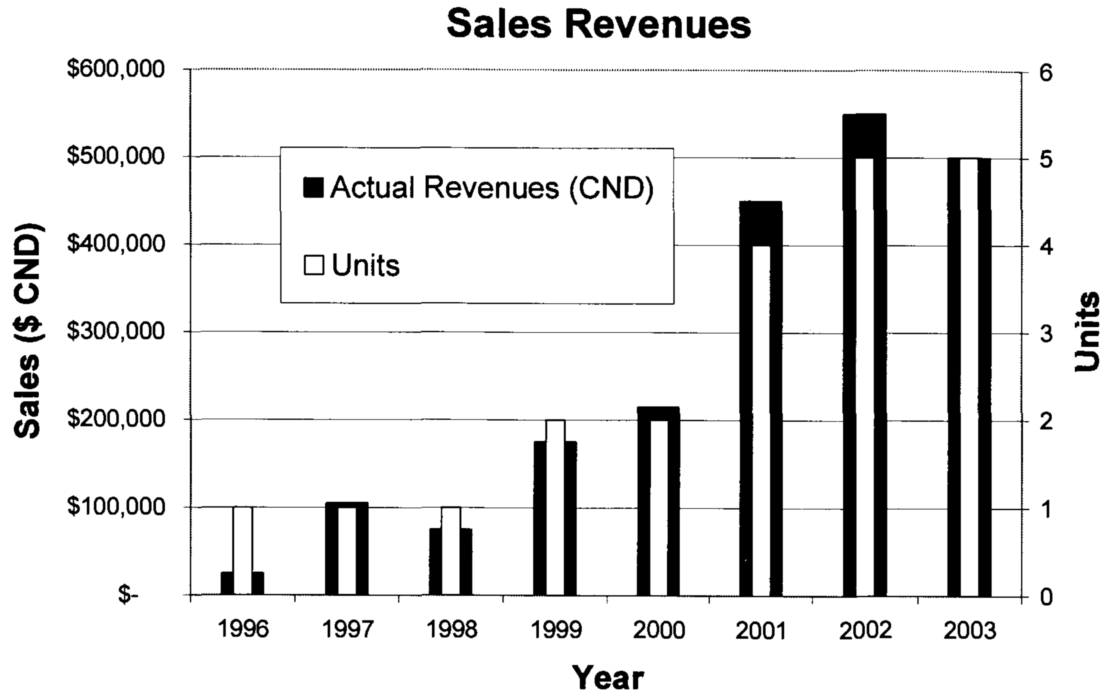

Figure 1.5: Sales Revenues of the Commercial Products[η]

1.8 Commercial Sales Projections

Due to the growth in industries requiring hydrogen, the sales of H-Star and H-Vision are expected to grow rapidly. New gasoline and diesel regulations will require increased hydrogen use. Although the fuel cell sector growth is slow, some demonstration systems for hydrogen refuelling are experiencing growth. Japan and Europe are anticipated to be major growth areas in the coming years.

Revenues for 2004 are expected to be about $5,000,000 CND. The expected sales for 2004 are 40% from landfill applications, 40% from small hydrogen applications, and 20% from large hydrogen applications. By 2005, year-end revenues are forecasted to be about $7,700,000 CND. The expected sales based on these activities are as shown in **Table 1.2**:

[η] Internal communications at ACME.

PRODUCT	FORECAST UNITS TO BE SOLD IN 2004	FORECAST UNITS TO BE SOLD IN 2005
Apollo (H-Star)	2	3
H-Vision	15	13
M-Star	3	6
He-Vision	1	2

Table 1.2: Sales Projection of Commercial Units[ϕ]

1.9 Current Strategic Issues and Problems

Since its inception, the CPBU's goals and objectives were clearly given by management. However, business and marketing strategies to meet the goals of the organization were not given. Currently, sales of both the H-Star and H-Vision have been slow and disappointing. According to the sales forecast, the revenues have been shortfall by about $1,000,000 in the first quarter of 2004. Hence, the following strategic issues and problems are currently faced by the CPBU:

1) Resources in the CPBU have been exhausted, balancing between proposals, project, development, and product support activities (e.g. – customer complaints). All members are pulled in different directions with overlapping priorities. Product development and research activities have been reactionary and based on the dynamic market demands. Technical resources are strained and pulled by balancing between new and old commitments. Thus, internal resistance of resources has still hindered commitment of sales and proposal activities.

2) Profits from projects have been lower than expected because of frequent customization. Customers have highly fragmented needs. Manufacturing is constantly developing and learning new procedures to match the endless requirements demanded from customization and scope changes. Specific needs by the customer include compliance to local regional codes and standards.

ϕ Internal communications at ACME.

3) The current target markets may be highly competitive, unstable, or too small for the revenues needed. Projected revenues were based on markets that have not materialized. Chapter 2 discusses the attractive of the market in more detail.

4) Sales and proposal activities still lack the focus of attention to produce competitive quotations. The CPBU is unable to reply promptly and effectively to requests for proposals.

The strategic intent of the CPBU within the company is to focus on early-term revenues while the remainder of ACME focuses on other medium-term and long-term development programs. Given the company's current weak cash flow and limited resources, ACME maintains a delicate balance between its current and future strategic goals. Further investment of resources and product development into the CPBU cannot be justified without sufficient revenue from its sales. In the targeted emerging markets, the needs of these customers are highly fragmented. The customers demand customized systems but with limited order volumes to justify additional resources for development. As well, additional cost for customization is difficult to sell when the prices of the commercial products are skimming the market. For this reason, the CPBU is given limited resources and it must operate within this allowed constraint.

This project addresses the issue of product strategy, capabilities, and competencies with the overall CPBU's strategic intent, which is to generate early-term revenues. The strategic analysis of the CPBU is based on an external analysis based on Porter's five forces and an internal analysis based on the value chain. The fit between the external and internal analysis is reviewed to allow possible strategic alternatives to emerge. These strategic alternatives are then compared using the balanced scorecard to determine which alternatives should be recommended.

2 EXTERNAL ANALYSIS

2.1 The Industrial Gas Purification Market

Industrial gas recovery applications are usually developed by the industrial gas or engineering companies and vary with product flows in the 10-1000 NCMH range. The gas purification market can be grouped into three areas:

1) New generating hydrogen or landfill plants: These new generating hydrogen or landfill plants are markets currently served with hydrogen or natural gas delivered by pipeline, liquid, tube truck, or cylinders. This market is expected to grow as regulations for merchant gas become more difficult.

2) Niche recovery applications in chemical plants: The niche gas purification markets consist of hydrogen refineries or special applications in speciality gases such as helium.

3) Fuel cell research and infrastructure applications in the 10-250 NCMH range: This third market is the emerging market for small scale hydrogen gas purification systems from fuel cell research. A market that will develop in the long term is the FCV and on-board mobile PSA systems.

This Chapter analyses the competitiveness of the gas purification industry by determining the collective threats and bargaining power of Porter's (Porter 138-141) five forces, namely: suppliers, new entrants, substitute products, existing competitors, and customers. **Figure 2.1** shows the global gas purification industry analysis based on Porter's five forces. The small and large industrial markets will be analysed together because the forces are similar in both markets, unless otherwise stated. Each section in Chapter 2 discusses the one of Porter's five forces. The last section summarizes the overall attractiveness of the global industrial gas purification market.

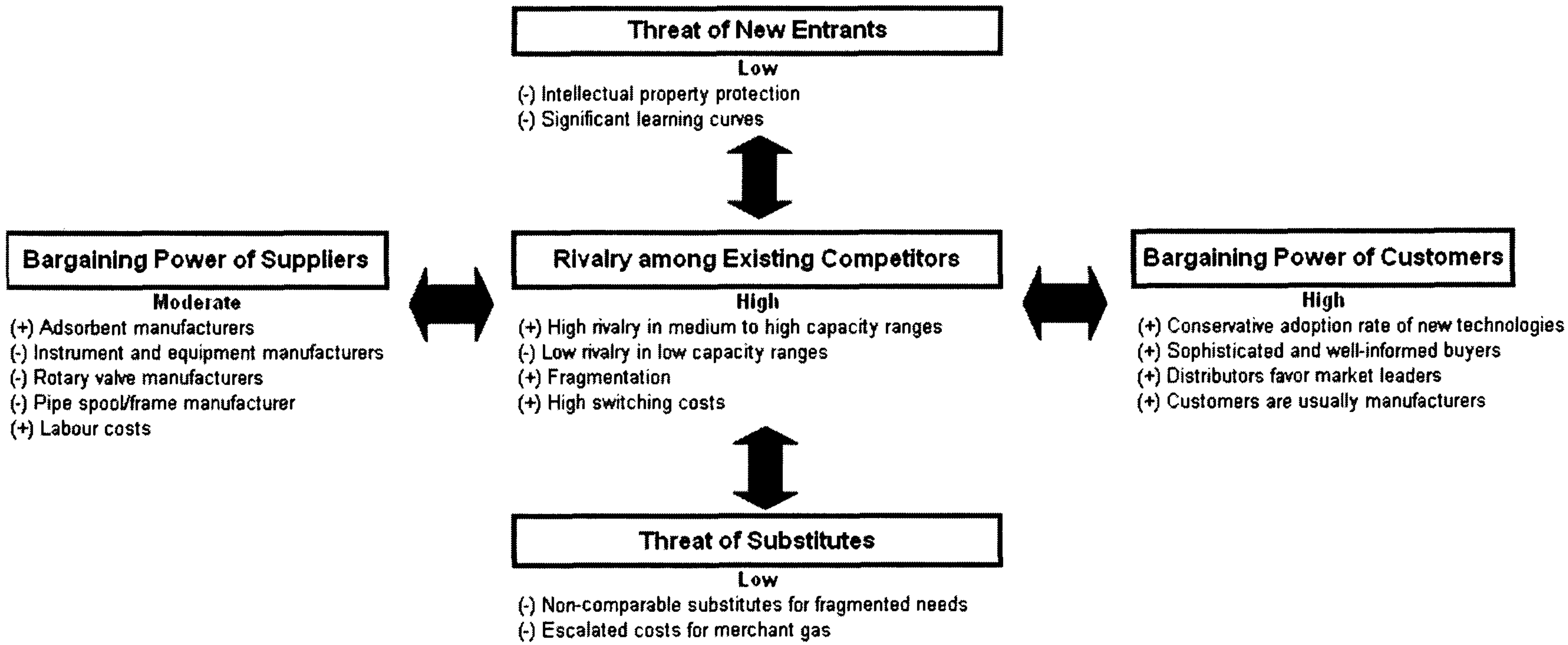

Figure 2.1: Global Gas Purification Industry Analysis based on Porter's Five Forces

2.2 Porter's Five Forces on the Global Industrial Gas Purification Market

2.2.1 The Bargaining Power of Suppliers

Overall, the bargaining power of suppliers in the global gas purification industry is moderate. Suppliers to ACME's CPBU can be grouped into the five categories: (1) adsorbent manufacturers; (2) instrument and equipment manufacturers; (3) rotary valves manufacturers; (4) pipe spool/frame manufacturers; and (5) labour cost. The remainder of section 2.2.1 describes the bargaining power of each group.

2.2.1.1 Adsorbent Manufacturers (+)

The bargaining power of adsorbent manufacturers is strong since the number of adsorbent suppliers is limited and the batch quantity of specialized adsorbent is relatively small. Switching to different adsorbent manufacturers would require considerable time and money since the adsorption capacity and performance for any new adsorbents would need to be characterized again.

Ironically, the adsorbent manufacturers are typically world leaders in traditional PSA technology for large applications. At this time, the major adsorbent suppliers view ACME as a minor competitive threat to their in-house systems and have not aggressive priced their adsorbents. However, in the long-term, ACME may need to consider sourcing and characterizing new adsorbents when the current adsorbent suppliers view ACME as a competitor.

2.2.1.2 Instrument and Equipment Manufacturers (-)

Instrument and equipment suppliers provide process components such as valves, gauges, and transmitters. This group of suppliers have small bargaining powers because the components supplied typically can be found from most industrial vendors. The majority of supply companies do not enjoy any significant differentiation between their products. Once a component part meets certain minimal criteria, it is not differentiable. However, the bargaining power is increasing for vendors with multiple certified instruments.

An increasing demand by customers is compliance to local codes and standards. For example, European Certified Atmospheric Explosive proof (CE ATEX) or Japanese Technology Institute for Industrial Safety (**TIIS**) is required for most European and Japan PSA units.

Similarly, past problems with the Japanese pressure laws and European Pressure Equipment Directives (**PED**) have forced ACME to source pressure vessels from vendors with high bargaining powers in foreign countries. ACME should work with its customers and suppliers to source vendors that have expertise in Japanese and European Codes.

2.2.1.3 Rotary Valve Manufacturer (-)

The current rotary valve manufacturer has low bargaining power because the switching cost for ACME is low. In the past, ACME worked with numerous metal fabrication shops to make the rotary valve components. The valve internals are not difficult to manufacture but do require a small learning curve to understand the tight tolerances required. Many alternative machine shops have the capability in-house to meet ACME's needs. Currently, ACME has committed to a preferred manufacturer to capture the economies of scale from high volume manufacturing.

2.2.1.4 Pipe Spool/Frame Manufacturer (-)

ACME has evaluated numerous machine shops and has outsourced to a preferred American vendor for fabricating its frame and pipe spools (the balance of the PSA system to allow for isolation, control, and structural support of the commercial products). The bargaining power of these fabrication shops is low because competition is high for simple pipe spool fabrication and welding. Given the decrease in contract manufacturing, manufacturers are eagerly cutting their prices to compete and remain viable.

ACME's commitment to a North American manufacturer was to drive cost based on economies of scale, core competency, and labour efficiencies. Outsourcing fabrication has greatly benefited ACME. However, to better serve customers in a global market, manufacturers should also be sourced in Europe and Japan who have core competencies in building spools and vessels in accordance to the local codes.

2.2.1.5 Labour Costs (+)

Manufacturing labour costs have high bargaining power because assembly of a PSA unit requires know-how and experience. This fact is especially true with rotary valve assembly and bed filling, where documents are provided but the details of the processes still require some tacit knowledge. Constructing leak-free seal faces in the rotary valves or filling bed that can potentially deactivate is difficult. ACME is developing competency with bed filling and rotary valve assembly. Outsourcing labour would require extensive training and effort. However, besides the bed and rotary valves, most of the work such as pipefitting and welding can be outsourced.

2.2.2 Threats of New Entrants

The threats of new entrants into the global gas purification industry are low. Two factors that have deterred potential entrants are intellectual property protection and significant learning curves. The remainder of section 2.2.2 discusses these two factors as strong barriers that lower the threat of new entrants.

2.2.2.1 Intellectual Property Protection (-)

The strongest barrier to entry into the CPBU PSA market is ACME's patent protected technology on fast-cycle PSA using rotary valves (Mezei 32). Infringement on the current intellectual property is not likely to occur in North America where ACME has a strong patent position. However, in some countries like China, patent protections are typically ignored and difficult to enforce. In Japan, units sold to current costumers could be reverse-engineered and altered to bypass the patent protection. Replicates of the Apollo or H/He-Vision can be made without ACME's knowledge.

2.2.2.2 Significant Learning Curves (-)

Other barriers to entry are the trade secrets and manufacturing expertise in the assembly and testing of rotary valves. If patent infringers tried to duplicate the rotary valves, incorrect balances on the sealing faces could result in poor performances, shorter service life, and/or hydrogen leakages into the atmosphere leading to potential hazards. Significant development costs would need to be incurred to learn and build the expertise in the rotary valve technology.

A smaller barrier to entry but building slow momentum is the brand development and growing loyalty from existing customers. ACME does not have the financial resources to pre-empt an entrant but has a growing reputation in the market that has resulted in several repeat orders. Several H-Vision units have already been integrated with a couple of reformer companies as part of their standard offering. As the relationship continues with the existing customers, the switching costs would become greater if an entrant were to try matching ACME's offering.

2.2.3 Threats of Substitutes

The threats of substitutes in the global gas purification industry are low. Non-comparable substitute for fragmented needs and the escalated costs of merchant gas are two factors that have made substitution difficult. The remainder of section 2.2.3 discusses these two factors.

2.2.3.1 Non-comparable Substitute for Fragmented Needs (-)

Two possible substitutes for the H-Vision (or He-Vision) are the conventional PSA and membrane systems. However, substitutes can vary considerably with the customer since every application is customized to suite the necessary requirements. For example, customers that require a very high purity hydrogen (or helium) product with high recovery rates and low consideration about capital cost may go with a liquefaction system. Similarly, high purity products with low consideration about power and pressure drop may use membrane systems. However, many of ACME's customers that demand less than 100 NCMH of hydrogen are typically emerging reformer companies. Substitutes such as liquefaction and membrane technologies generally are not preferred due to their size and high costs.

2.2.3.2 Escalated Cost of Merchant Gas (-)

ACME's Apollo customers that demand larger capacity of hydrogen are typically established industrial companies where physical size is less of an issue but reliability is paramount. Possible substitutes are hydrogen tube trailers or hydrogen gas cylinders where on-site hydrogen generation is not crucial and merchant gas is more economical (Mezei 34). However, the cost of merchant gas is escalating, and the higher cost of merchant gas would lower the threat as a substitute.

2.2.4 Degree of Rivalry

Overall, the degree of rivalry is high in the global gas purification industry. Rivalry is low in the low capacity range but extremely intense in the high capacity ranges. Other factors such as fragmentation and high switching costs have further intensified rivalry. The remainder of section 2.2.4 discusses each of these factors.

2.2.4.1 High Rivalry in Medium to High Capacity Ranges (+)

The degree of rivalry in the large industrial market for the Apollo is high (Mezei 35). Hydrogen purification market covers a large range of industries and many PSA manufacturers compete within this market segment. For large industrial processing companies, the level of acceptable innovation is low and new entrants are deterred. Market leaders in this segment have a long list of references and established reputation for service and reliability. Typically, the PSA purchases are often a smaller part of larger projects and proposals are often tenured with a combination of hydrogen generation and engineering companies. Thus, only competitive bids are considered.

2.2.4.2 Low Rivalry in Low Capacity Ranges (-)

The degree of rivalry in the H-Vision market is currently low. Typically, conventional PSA systems have many drawbacks such as larger footprint and higher operating costs that deter the main customers, reformer developers. As well, only a few PSA manufacturers compete in the smaller size capacity <100 NCMH. For the He-Vision, ACME only has one customer which is also its strategic partner, ABC Inc..

2.2.4.3 Fragmentation (+)

The industry is fragmented due to the various custom needs and niche focus of various companies with unique applications. The ability to capitalize on low scale requirements is difficult. With numerous innovative companies competing, rivalry is intensified.

2.2.4.4 High Switch Costs (+)

Once customers possess a manufacturer's unit, they are often content with the product and become familiar with its operation and use. The alternative to switch to a different product offering results in switching costs such as: replacement of accessories, training of personnel, and obsolete inventory. Customers with legacy systems typically return to their selected manufacturer. These high switching costs discourage an end-user from using a competitor's product, and thus decrease rivalry between competitors.

2.2.5 The Bargaining Power of Customers

The bargaining power of customers is high in the global gas purification industry. The factors that contribute to high bargaining power of customers are conservative adoption rate of new technologies, sophisticated and well-informed buyers, distributors favour market leaders, and customers are usually manufacturers. The remainder of section 2.2.5 describes each of these factors.

2.2.5.1 Conservative Adoption Rate of New Technologies (+)

PSA units experience a conservative adoption rate due to the product complexity and scientific credibility. Thus, the customer's hesitation gives power to the customer over the manufacturer's success or failure in the marketplace.

The product adoption cycle is not a smooth upward curve from the innovators, early adoptors, early majority, late majority, and laggards. As discussed by Gregory Moore (Moore 19), a large chasm exists between early adopters and early majority. To cross this chasm, momentum is needed in one group to create a domino effect that would prompt the next group to purchase one. Success of the PSA manufacturer depends on the ability to convince the early majority of the new technology and gain wide acceptance.

2.2.5.2 Sophisticated and Well-Informed Buyers (+)

The bargaining power of customers in the hydrogen purification market is very high. Typically, the customers are well-educated, sophisticated, and well-informed buyers. Proposals and bidding packages require upfront conceptual engineering design and many supplemental documents for large industrial companies. For smaller emerging companies, the proposals need not be as detailed, but these buyers have a tendency to ask for more details within the project. Substitutes and various technologies are often explored by the buyers before committing to a final decision.

2.2.5.3 Distributors Favour Market Leaders (+)

Some large industrial distributors or customers do not spend large effort searching for PSA manufacturers. Often, they go to the market leaders and shun out innovative equipment developed by smaller companies with limited resources. Although hydrogen purification equipment purchases tend to be small relative to the capital budget, numerous substitutes are available. ACME's commercial products of small size and lower operating cost are not viewed as equally important to some customers and only in a few cases.

2.2.5.4 Customers are usually Manufacturers (+)

Most large companies have the capability in-house to design and build their own PSA units. Typically, the hydrogen systems are a small portion of the overall plant. The need for outsource is not strong.

2.2.6 Overall Attractiveness of the Global Gas Purification Industry

The overall attractiveness of the global gas purification industry is currently between moderate and low; and the expected profitability is between average and low relative to other industries. However, the global gas purification industry is changing and will become more attractive within the next few years. Several external factors that would increase the attractiveness of this industry are:

1) The expected growth of the fuel cell market and dominance of a standard refuelling station design using ACME's PSA units. The growth of the fuel cell market is strongly dependent on the technological advances made by the fuel cell and reformer companies. Many technological hurdles must be overcome before FCVs become commercially viable. This market is unpredictable and cannot be controlled by ACME's management team.

2) The expected growth of the LNG market due to increasingly stringent diesel engine emission regulations in the US. The growth of the LNG market is dependent on the political motives of the governing US parties for a more environmental conscious society. The political agenda of the next elected party is unclear and cannot be controlled by ACME's management team.

3) The increasingly stringent gasoline regulations which require low sulphur fuels in North America and Europe. The international political leaders control the gasoline regulations. Although the trend of the energy market is for more stringent gasoline regulations, the shift for a more environmental conscious society is dependent on the agenda of the international political leaders. The likelihood for more stringent gasoline regulations is unknown and cannot be influenced by ACME's management team.

2.3 The Dynamic Global Industrial Gas Purification Market

The external analysis of the global industrial gas purification market is based on today's current static model. Over the next three years, this market is expected to grow as the emerging hydrogen and landfill market segments become more established. Smaller players in this market are expected to merge or be acquired by larger companies as technologies converge to accelerate development. A likely scenario would be the emergence of a standard hydrogen infrastructure design that is influenced by dominant reformer and fuel cell companies. In the landfill market, the commercial application of recovering landfill gas for LNG is expected to become more widely accepted as emission regulations become more stringent. Within the next three years, the attractiveness of the market is likely to change from low-medium to medium-high.

The emerging hydrogen and landfill markets would likely be influenced and shaped by the reformer/fuel cell and waste management companies respectively. The struggle for dominance in the market would eventually lead to few but stronger companies. As a result, technological convergence would lead to very high barriers of entry because standards would be established with systems that are locked-in as the industrial norm.

Within three years, the Porter's five forces would likely be shaped differently from today. New entrants would be more deterred from entering because their designs would not be easily accepted as the standard. The threat of substitutes would be lower because switching cost would be high due to steep learning curves for adopting new standards. Rivalry would be fierce because the few competitors that do exist are likely dominant players. The bargain power of customers would be low because customers are locked-in with the products. The bargain power of suppliers would likely be moderate because adsorbent manufacturers, who also are likely competitors, would likely try to lower the threat of the current rivals.

Currently, ACME is positioning itself to be a market leader in the emerging hydrogen and landfill markets. With its strategic partners, ACME continues to rally for government support on the hydrogen infrastructure and landfill recovery programs. Through joint development agreements, ACME has also locked-in its current commercial products early in LNG and fuel cell development programs. The global industrial gas purification market is evolving and ACME intends to become a dominate force in shaping the market within the next three years.

2.4 Conclusion of External Analysis

The CPBU is operating in a market that is not currently very attractive. This market is not expected to dramatically improve within the next 3 years. Possibly, this market would become more attractive in the distance future. Until then, this emerging market is dependent on the technological advances and political moves towards a greener society. Standards are currently not established and the forces governing the market are very dynamic. Thus, customers require to flexibility within this market and frequently require a customized product as they develop their needs alongside the development of the market.

3 INTERNAL ANALYSIS

This chapter explores ACME's relative competitive advantage within the global gas purification industry. An internal analysis is performed to assess the company's strengths and weaknesses to compete in a currently moderate-low industry. The sections in this chapter discuss the company's value chain, the company's core competencies and assets, the financial analysis, the organizational structure of the CPBU, and the company culture. A summary of the internal analysis is provided at the end of this chapter.

3.1 Value Chain

The intent of the CPBU is to form an independent identity to focus on primary value added activities. Many supporting and secondary activities are charged or outsourced into other departments within ACME. A general overview of the CPBU's value chain is given in **Figure 3.1.**

Firm Infrastructure	<Accounting> <Legal & Patent Services> <System Administration> [Facilities Support]		<General Administration> **FINANCING** <Secretarial Support> [Management Consulting]			M A R G I N
Human Resources	[Compensation Consulting] [Workers compensation support] <Payroll and Benefits>		[Temporary Help] [Education and Training] [Health Services]			
Research & Development	Market Research **<Business Development>** Business Case Formulation		**PRODUCT DEVELOPMENT & TESTING** [Contract Research] Design Services			
Operations Support	<Document Control Services> <Database Computer Services> <Quality Control Services>		<Quality Control> Procurement Services [Certification]			
Primary Value Adding Activities	[Brochures] Trade Shows Client Visits Marketing Quotations Channels	Warehouse Inventory [Courier] Receiving Transport Coordination	Assembly Drawings Engineering [Fabrication] [Machining] [Painting] [Welding] Project Management	Bill of Laiding Crate Handling [Packaging] [Shipping]	Commissioning Service Plan Warranty User Training Repairs	
	Marketing & Sales	Inbound Logistics	Operations	Outbound Logistics	Commissioning & Service	

LEGEND			
CORE COMPETENCY	<Outsource Internally>	[Outsource Externally]	In-House

Figure 3.1: ACME's Commercial Product Business Unit Value Chain

3.1.1 Marketing & Sales

The CPBU's primary marketing activities are mainly cold-calling potential customers, attending trade conferences, issuing direct mail, and issuing white papers. Two account managers, two part-time sales engineers, and a channel development manager handle the marketing activities for the commercial products. Upon initial contact, the customer's contact information and application data are collected for review by a series of individuals. Depending on the complexity of the proposal and the sophistication level of the client, proposal activities can range from a few days to a few months.

Before the formation of the CPBU, the commercial sales were only marginally successful since the response times were slow and quality of the proposals was low. Potential customers were frustrated. Internally, the team members were also frustrated by diverting focus between order-fulfillment projects, product development, proposal activities, and product technical support.

After the organizational restructuring of the CPBU and co-location of team members, the communication channels have improved. However, the process of primary activities still remained unchanged. Internally, the CPBU still suffers from long response time and dedicated resources to proposal management.

In typical H-Vision proposals, the effort for preparing quotations is small since most customers are innovators who develop reformers for the emerging hydrogen infrastructure. The buying processes of these customers are very flexible to accommodate ambiguity and change. However, typical M-Star and multi-valve Apollo customers are more sophisticated and they require lengthy documentation and preliminary engineering design effort. Most of these customers are early to late majority with more emphasis on upfront engineering and design work. Currently, considerable strain is placed on the CPBU to develop these quotations while lead generation and market research activities are hindered.

To date, direct sales have been the main sales avenue. Although the Apollo product line has been commercially available for over 8 years, sales have been modest and have been prone to quality control and design problems. Manufacturing licenses of the Apollo product line (without rotary valves) are being sold, but no customers yet have been interested. In the current licensing strategy, ACME would act as an original equipment manufacturer (**OEM**) of the rotary valves.

Increasing proposal and inquires have been pushing for higher capacity systems beyond the M-Star and H-Star. In order to capture these existing sale opportunities, the CPBU is selling multi-valve Apollo units despite completion of a finalized design. A multi-valve Apollo is based on the M/H-Star platform but utilizes multiple rotary valves in parallel to increase capacity. Product development efforts are still underway while sales of the multi-valve Apollo are pushed so that revenues are captured today.

In early 2004, the CPBU was able to obtain distribution and sales agreements with two of its major customers, Kite Inc. in the USA and Sogo Corporation in Japan. Kite designs reformers and requires the H-Vision as an integral component of their system package. Distribution and sales activities were channelled through Sogo in Japan. As part of a large bidding tender, the Apollo is distributed in conjunction with the Japanese partner's reformer system and marketed to Japanese energy companies.

3.1.2 Inbound Logistics

Transportation services, planning, purchasing, and receiving of resources and materials in the CPBU are handled by a purchaser. The inbound logistics have improved dramatically from the past when purchase requisitions and approvals were necessary for OTD projects. Inventory control was tracked manually and OTD projects were delivered late due to poor resource planning. Currently, the purchasing procedures are streamlined with minimum impact delivery on OTD projects.

In OTD projects, Material Resource Planning (**MRP**) is used to minimize the number of parts in inventory. MRP is handled using a program called SYSPRO which allows immediate update of inventory stock and expected deliveries. Parts are ordered in accordance with the OTD project schedule. The CPBU operates inbound logistics by the assignment of part numbers to every item that is procured. The assignment of these part numbers allows ease of inventory track and cost analysis.

Despite the increase in sales, long-lead and costly items such as frames, rotary valves, and beds are not kept in inventory. Although the volume is generally not high for procured parts, ACME was able to negotiate lower prices with primary instrument and equipment vendors. However, for commercial products sold in Europe and Japan, the CPBU has paid a premium in price/delivery to get locally approved pressure vessels from foreign countries.

3.1.3 Operations

Before the formation of the CPBU, ACME tried to create a standard product offering with options such as additional instrumentation or cold weather package. Drawings and processes were developed for multiple unit production. Standardization would allow repetitive tasks to be streamlined, allow volume discounts, and decrease manufacturing and engineering times. However, the customers for the commercial products all had different requirements. Despite the enormous efforts to create a standard product offering, all customers required some degree of customization. Hence, operations in engineering and design became a more integral part of the CPBU.

The Order Fulfillment process is managed by the OTD Manager and resources are pulled from product development, internal process development, and proposal activities. Although the OTD Manager controls project execution internally, the sales engineer continues to have primary contact with the customer regarding project progress and controlling scope changes. This practice has been working effectively since the sales engineer is able to understand the technical changes or inquiries requested.

The CPBU has been focussed primarily on assembly in the manufacturing shop and most of the manufactured inputs such vessels, pipe spools, and rotary valve components are outsourced. The CPBU wants to maintain its trade secret and intellectual properties on the complete valve design and bed fill material. For this reason, assembly and bed loading are kept in-house.

3.1.4 Outbound Logistics

Shipping and packaging of completed commercial products have been done typically with brokerage houses. The CPBU does not have strong competencies in export law and international duties. For this reason, outbound logistics have been outsourced.

3.1.5 Commissioning and Service

Once the commercial product arrives on the customer's site, the product is installed and integrated with the customer's system. The commissioning engineer from the CPBU is sent to the site for starting up and optimizing the system, conducts a performance test, and collects the operating data for future reference.

Post-commissioning activities include service or warranty work. Most technical inquiries are handed-off to engineering services. Responses and customer correspondences are directed through by the commissioning engineer. Currently, product support activities have been increasing. As more PSA units are sold in the field, the demand for global product support becomes larger.

3.2 Core Competencies and Assets

According to Prahalad and Hamel (Hamel 64; Aaker 141), core competencies represent the consolidation of firm-wide technologies and skills into a coherent thrust that is capable of being the competitive basis of its business. When defining core competencies, the value chain (as given in Figure 3.1) allows us to systematically examine a firm's resources and capabilities to provide competitive advantages. As shown on ACME's CPBU value chain, ACME has two core competencies: product development & testing and financing.

3.2.1 Product Development & Testing

ACME's core competency is product development and testing in fast-cycle PSA. With over 31 patents issued and many other patents pending, the company has attracted many large investors and development partners to provide sufficient development revenues for the next 3 to 5 years. Many commercial products are expected to be launched within the next few years. In the gas purification market, ACME is definitely recognized as a leader in PSA technology.

ACME has strong ties to many academic and private institutions and is very successful in its ability to import knowledge to propel its development efforts. For example, paper coating technology used in pulp and paper industry has propelled the development work to manufacture structured beds, where adsorbents are laminated onto a substrate. By building on the knowledge from previous work in paper coating, ACME was able to succeed with its development effort on the H-3300. As a result, future commercial products can go with faster cycle speeds without concerns for fluidization of the adsorbent beds. Currently, two core assets that have provided competitive advantages for ACME are the rotary valve and adsorbent beds.

3.2.2 Financing

Lead by the CEO and CFO, ACME was able to raise capital before and after the crash of the technology market. In the spring of 2001, ACME raised $20 million from private financing. Similarly in the fall of 2002, ACME raised $30 million. Early rounds of financing included ABC Inc., Alpha, and Beta Gamma. By partnering with these companies, ACME was able to spread its development costs, import knowledge, and increase the rate of research.

Besides raising funds through private financing, research grants to finance individual projects are often raised. For example, the US Department of Energy and Kapa helped funded the development of the H-Vision. As well, Fuel Cells Canada and Technology Partnerships Canada have assisted ACME with many development activities in the past.

3.3 Financial Analysis

As mentioned in Section 1.2, the CPBU was recently formed and officially started in March 2004. The revenues, expenses, and costs associated with the CPBU were already tallied before the official formation of the business unit since November 2003. **Table 3.1** shows the income statement of the CPBU for the second quarter of the 2004 fiscal year. Although the income statement shows a positive net income, sales revenue has been lower than the projected $2.2 million at this time.

Commerical Business Unit Income Statement		
31-Mar-04		
		2004 Q2
SALES REVENUE	$	214,111.10
COST OF SALES		
Material	$	107,622.23
Labour	$	12,477.38
Overhead	$	35,149.54
Purchase Adjustments	$	(157.04)
Indirect Expenses	$	2,404.60
TOTAL COST OF SALES	$	157,496.71
Gross Margin	$	56,614.39
% of Gross Margin/Sales:		26%
EXPENSES		
Salaries & Benefits	$	29,298.56
Project Materials	$	2,506.88
Lab Supplies	$	701.54
Test Gases	$	126.22
Consultants	$	6,434.50
TOTAL EXPENSES	$	39,067.68
Net Income (EBIT)	$	17,546.71

Table 3.1: Commercial Product Business Unit (CPBU) Income Statement

3.4 CPBU Organization Structure

Figure 1.2 in Section 1.3.2 depicts the hybrid organizational structure of the CPBU. The advantages of this structure include increased autonomy, accountability of tasks, and focus on order fulfillment as a divisional unit. However, the current structure does not have an increased focus on supporting sales, proposal, and product development activities. Due to the competitive dynamics of the current market environment, the current structure is not aligned for stronger market penetration and diversification given the company's limited resources.

The CPBU is often overwhelmed with demands from product development, processes, proposals, and projects. In many cases, conflicting priorities have put proposal and product developments as secondary functions. On occasions, many product development activities were dropped, or proposals were delivered with late responses that were marginally acceptable to the customer. Resources from engineering, manufacturing, and sales are called upon to complete an order-fulfillment. However, the structure fails for proposal and product development.

The guiding principle for the CPBU is that paying customers are the highest priority. For this reason, OTD projects became top priority and product development for continuous improvement lacked attention. In some instances, product development activities were rushed within a project in order to win the sale. In other instances, proposal activities linger due to lack of support as a team.

Since OTD work takes precedence, the account managers, who have overall responsibility in developing proposals, dedicate most of their time to quotations and lack the focus in lead generation. Furthermore, bottlenecks in the proposal process and other higher priority tasks shift resources elsewhere to inadequately support proposal activities. As a result, responses to inquiries are occasionally tardy.

Product development activities have been based on reactive design rather than progressive innovation. In many instances, product development work was initiated within a project to meet a specific customer need, and was based on only preliminary assessment. Most product development work in CPBU was regular innovation that consisted of minor cost or operation improvements. Revolutionary innovations were done outside the CPBU such as structured laminate beds.

Within the CPBU, the operation philosophy still continues with a standard product and mass production to benefit from the economies of scale. In past projects, every customer has asked for a customized design to suit their needs. Flexibility is the key attribute that must remain in the process. The CPBU has been too focused on achieving economies of scale and have neglected the customer's need. Economies of scale are benefited from a repeat design but the market demands for a differentiated product. A standard process for engineering to manufacturing makes the most strategic sense.

3.5 The Company Culture

The founders of ACME are theoretical physicists and engineers who built the company based on a research and development perspective. The basic assumptions of personal values from the founders have led to the growth of a set of corporate values. These strong R&D cultural values have lead to the strong innovative solutions and creation of many novel technologies. However, at the same time, these values have formed rigidities (Leonard 30) that have inhibited the success of the CPBU. These rigidities are risk-adversity and less autonomy.

The mentality for a R&D company emphasizes careful detailed analysis and inclusiveness of all team members in decision-making. In most development projects, researchers approach a problem by analyzing each step with care. Uncovered development paths would be explored and results would be discussed with other team researchers. Exploration of ideas would be shared and discussed until consensus would be reached after multiple iterations in meetings. Once a development path is fully explored, the researchers would then move on to the next phase. Development typically takes long periods and demands large resources to ensure the validity of each decision. Consequently, the R&D culture has promoted risk-adversity and less autonomy.

The CPBU works against this R&D culture since the dynamics of the business demand quick decision making and turnaround time. Opportunities arise rapidly and challenges need to be dealt with urgently. Hesitation or failure to respond to customers can result in lost business or poor competitive bids. Often, information is not readily available and educated guesses need to be made without a thorough study of all the options.

Although the CPBU has been given more autonomy, the decision-making power is still in a state of flux. Proposal activities and quote preparation have been demanding resources from various team members to achieve consensus or to gather the appropriate information. More importantly, quotations for sophisticated customers have taken valuable time away from the account managers and sales engineers who perform other core activities: generating leads, gathering market intelligence, working closely with current customers, and answering inquires.

The culture in ACME promotes an enjoyable atmosphere where voluntary employee turnaround is low. ACME has been able to attract and retain people who can contribute to the growth of the company. Trade secrets and know-how of core skill are not well documented and ACME is vulnerable to key people leaving. Replacement of these individuals proves difficult. However, ACME conducts very stringent interviews to ensure that the candidate fits the profile in this dynamic company. Bonuses are paid based on completed milestones. As well, corporate communication is provided frequently in the monthly "pizza and pop". A CEO committee is also formed to address any concerns or raise problems directly to senior management.

3.6 Conclusion of the Internal Analysis

This chapter analyses the company's value chain, the structure of the CPBU, and the culture of the company. The core competencies of ACME are product development & testing and financing. The core competency of finance is not directly relevant but does suggest that the company can obtain more financing when it decides to approach the financial markets. The core competency of product development is directly relevant to strategic issue but is currently not being used by the unit. The CPBU lacks focus for product development and is structured to work independently from the rest of the company for support. Hence, the CPBU cannot customize its product easily and is not leveraging its core competency. Furthermore, the current R&D culture in ACME has formed rigidities such as risk-adversity and less autonomy. As a result, decision-making is slow has hindered sales efforts. In the next chapter, the findings from this chapter and chapter 2 are used to provide an analysis of strategic fit within the CPBU.

4 STRATEGIC FIT

The theory of strategic fit suggests that competitive advantage is achieved when strategy, organizational capabilities, core competencies, and markets are aligned. The following sections provide an analysis of strategic fit within the CPBU which concludes that a number of elements are misaligned. These misaligned elements are product strategy, R&D expense, decision making, and manufacturing. The remainder of Chapter 4 defends this judgement based on the discussions from the previous chapters.

4.1 Product Strategy

The current product strategy of the commercial products is to differentiate itself in the market as a best product. However, a system lock-in strategy has been deployed in some instances to close sales. This system lock-in strategy does not align with current product strategy.

Using fast-cycle PSA technology, the CPBU has focused on reliability and size as a competitive advantage. However, the general customer's main criteria for selection (ranked from highest to lowest importance) are recovery performance, unit cost, reliability, and size. Performance and cost are generally not competitive advantages in the commercial products. Regardless, the few customers that do value size above performance are the key customers for the CPBU.

The Apollo products are known not to be the best recovery performance products in their market segment. The Apollo utilizes only two equalizations in the process cycle, a lower performing cycle design than the H-Vision and the competitors. The Apollo is known to lag the competition for performance, but ACME tries to target the few customers that value size more importantly. Hence, a differentiated product strategy with Apollo is questionable without further product development to increase recovery.

Currently, the CPBU is skimming the market and pricing its units at the same level as conventional PSA. For the CPBU, price skimming is necessary to recover the development cost of its products, to maintain high margins for positive cash flow since the CPBU is a self-sustaining entity, and to compensate for the potential warranty costs as more systems are sold.

Although fast-cycle PSA has eliminated the need for complex instrumentation and bulky units, most conventional PSA manufacturers do gain benefits from economies of scale. Competitors can typically match the lower manufacturing costs of fast-cycle PSA and price at lower margins.

The CPBU uses cost of goods plus double the industrial norm for margins as their pricing methodology for their products. Consequently, this pricing methodology has slowed the adoption of the product and forced customers to evaluate lower price systems. In order to facilitate market penetration, pricing should be dictated by the market and not by the cost of manufacturing.

For the H-Vision, the best product strategy is also not clearly perceived by all customers. The competitive gap between the H-Vision and conventional 3-bed PSA is small, since both footprints and performance are becoming similar in size. Inadequate comparable market information has made the distinction of performance difficult. To be successful in this market segment, a unique system lock-in strategy was used to close some recent sales. Using the delta model framework as defined by Hax and Wilde (Hax 12) as shown in **Figure 4.1**, the H-Vision was sold based on a lock-in strategy where the customer was convinced that the future standard of the hydrogen generation system would be the fast-cycle PSA.

The CPBU engages the customer early in their product development cycle and locks into their long term product plans. Early involvement is critical because the customer will be committing to certain technologies for each generation of product and future generation will be built upon knowledge gained from the investments made in early technologies. Customers currently entrenched in alternative purification technologies would make the fast-cycle PSA less attractive. Evidently, this strategy is risky since the standards in the emerging hydrogen economy are not established and still in a state of flux.

The commercial products are not low-priced in the market although the CPBU has adopted a low-cost manufacturing strategy. The manufacturing philosophy was to produce a standard product offering that would allow high volume manufacturing. Evidently, this strategy did not align well with the market that demanded a differentiated product that is best suited for the requirements of each installation. Of all the units sold to date, customization is required with all customers and not one unit is identical. This fact enforces the need for a differentiated strategy in order to best suite the market.

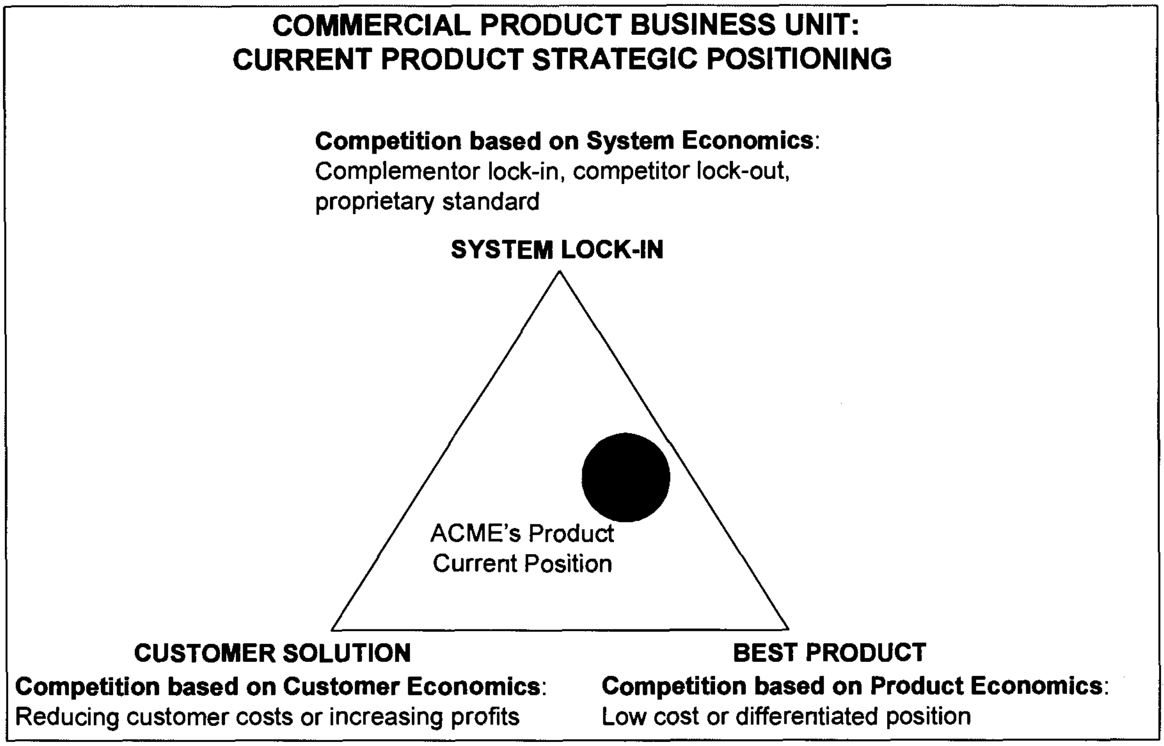

Figure 4.1: Current Product Strategy of the Commercial Product Business Unit

4.2 Research and Development Expenses

ACME has numerous high R&D expenditures with new fast-cycle PSA technology using bed structures and refinery off-gases. However, product development funds for the Apollo product line and the H-Vision have been relatively low. Product development expenditures have been small and the CPBU has been relying on customers to evaluate and better understand the limitations of the product. Development activities for improved performance in a second generation product have been on-hold until sufficient revenue is generated to justify the expense. However, the market is demanding higher recovery and better product performance. The product strategy for an innovative product is hindered without the appropriate funds for major advances in the commercial products. Hence, the strategic fit is misaligned for R&D expenses.

When the CPBU was formed, product development and testing were intended to focus on small incremental improvements to reduce cost and increase the quality of the commercial products. However, as more sales inquiries arrived, more analyses of the unique applications demanded more testing and product development activities. As a result, ADG and testing became an integrated part of the proposal process to validate the feasibility of custom applications. Variable Test Rig (**VTR**) testing and product development of a multi-valve Apollo system were necessary to respond to the growing demand for custom applications. The market has forced this realignment for greater expenditure and this development reinforces the need for a differentiated strategy.

4.3 Structure and Decision Making

ACME has a centralized structure where overall corporate strategy is determined by senior managers. For the CPBU, decision-making is less centralized and day-to-day commercial decision-making is becoming more autonomous. The CPBU was organizationally structured to become more responsive to customer requests and dynamic changes. However, the internal processes still reflect some hierarchy control, where increased autonomy of decision-making is hindered by multiple approvals for documentation control and group consensus. The current decision-making process is misaligned with the current strategy to have more autonomy within the CPBU.

4.4 Manufacturing

The manufacturing strategy of the CPBU, especially in the case for the H-Vision, is to become a low-cost manufacturer. Benefits from economies of scale are expected to be realized from high volume manufacturing. With a standard product offering, volume discounts would be expected and engineering design would be minimal. Since the initial conceptual design of the H-Vision back in 2002, high volume manufacturing and key processes have been created to standardize procedures such that flexibility to accommodate changes is low. Most cost models indicated volumes in the hundreds in order to reduce costs by about 40%. Unfortunately, this strategy did not align with the needs of the market.

Of all the systems sold to date, no one PSA units are identical. Customization was not expected to be common practice and consequently, this has created misalignment with the strategy of standardization within the CPBU. Customization has been demanded by all the customers since the needs of every customer vary significantly. Changes requested by the customer included abiding to local codes and regulations, different process operating requirements for various applications, varying levels of control and instrumentation, and different system integration requirements. Thus, a differentiated strategy best suits the needs of the market.

Despite the different requirements demanded from every customer, opportunities still exist for mass manufacturing of selected components. Core technological equipment such as the rotary valves and selected bed sizes are identical for every unit. Economies of scale can be benefited from high volume production of the rotary valves.

4.5 Labour

Manufacturing teams of the commercial products are mainly highly skilled engineers, research scientists, designers, and managers. Workers involved in the assembly of the units and clerical support for the company are considered less skilled labour but they comprise about 20% of the staff in the CPBU. Pay is considered competitive in the industry for scientists and senior management. The overall compensation package includes high bonuses, employee stock options, and additional benefits that are attractive in the industry.

When demand peaks, resources in ACME are recruited by the CPBU or sourced externally. Skilled and flexible labourers are used frequently to balance the cyclic demands in various areas of the business unit. At times when the demand in the assembly shop is high, most members of the CPBU would offer their services to manufacturing.

Senior employees of the CPBU are all experts in their disciplines. ACME attracts senior employees with competitive salaries and opportunities to grow with an emerging company. Senior management has extensive experience in developing and commercializing PSA units, including expertise in product design, research, manufacturing, sales, marketing, and distribution. The ACME senior management team are all highly recognized in their industries from reputable companies.

4.6 Marketing

The CPBU pursues a differentiation marketing strategy, but the marketing budget to support it has been minimal. All commercial products require a heavy marketing pull to educate end-users on the advantages and unique technological product offering. Distributors are not well-supported or rehearsed effectively to sell the commercial products. The account manager from the CPBU usually attends trade shows and visits customer sites related to landfill and hydrogen markets. However, the marketing approach has been ill-focused in other niche areas such as helium.

To better understand the marketplace and the weaknesses of the current technology, the CPBU needs to increase exposure and recognition of the product. The corporate website does offer some information on the commercial products, but is insufficient for some customers. The CPBU has not differentiated its marketing strategy for innovators in the emerging hydrogen company and for late majority end-users in the established hydrogen markets. Innovators require less upfront information and are more susceptible to risks. For established late majority end-users, upfront information is critical and risks are not tolerable. A continued focus must be made to take part in more diverse trade shows to generate leads in the industrial gas sector.

4.7 Risk Profile

The CPBU is a relatively small operation with limited cash flows that may not be self-sustaining if market opportunities do not materialize. The gas purification markets have many strong financial competitors that can weather a cyclic turndown. Capturing early-term revenues on the prospective growth of un-established markets and high rivalry markets is risky given the financial stance of the CPBU. The risk profile for the CPBU is high based on the following:

1) The market growth of hydrogen refuelling stations is unstable and highly dependent on the success of reformer companies to increase the H-Vision sales. Given the current low inquiry for the H-Vision, the market has likely slowed for small emerging hydrogen applications.

2) The market for landfill purification has still not materialized and is highly dependent on the success of an emerging technology to capture and liquefy methane as LNG. Although inquiries for landfill applications are high, technological risks still exist with the unproven technology of the multi-valve Apollo.

3) The market for large industrial hydrogen is lucrative, but rivalry is high with strong competitors. ACME is well-known in the emerging hydrogen markets, but the company does not have a strong brand or strong customer base in the industrial hydrogen markets. A clear advantage with the Apollo over the competitors is also uncertain. Like the landfill purification market, the multi-valve Apollo also holds technological risks in its design.

Thus, ACME is faced with the necessity of accepting a high risk profile for its CPBU if it chooses to proceed in commercializing its products.

4.8 Conclusion of Strategic Fit

This chapter discusses the elements relating to strategic fit of the CPBU as summarized in **Table 4.1**. **Table 4.1** shows that the CPBU has a few elements that are misaligned to support the differentiation strategy that is demanded by the profitable markets. The misaligned elements are product strategy, R&D expense, decision making, and manufacturing.

Cost Based Low Cost Adequate Quality		**1 … 10**	**Differentiation Adequate Cost High Quality**
Rapid Follower	Product Strategy		Innovative
Low	R&D Expense		High
Centralized	Structure		Decentralized
Less Autonomy	Decision Making		Autonomy
Economies of Scale	Manufacturing		Flexible
Mass Production	Labour		Highly Skilled
Comparative	Marketing		Pioneering
Low Risk	Risk Profile		High Risk

Table 4.1: Strategic Fit Summary of the ACME's CPBU

These misalignments have arisen because the CPBU followed a strategy that offers a standard product. In the early 2001, high technology was hyped and sales volumes were expected to be high by 2004. Unfortunately, the market did not grow as expected. Currently, the market is still emerging and undergoing constant development. A differentiated product strategy has been adopted but funds for development continued to be low for customization. The developed manufacturing practices are inflexible with the given market. Furthermore, the increased autonomy of decision-making is hindered by multiple approvals and group consensus, which could have been arisen by the company R&D culture that promotes risk-adversity.

The next chapters discuss the strategic alternatives for the CPBU. Chapter 5 provides an overview of the three strategic alternatives based on the analyses. The details of each strategic alternative are discussed in chapters 6, 7, and 8. Chapter 9 compares these options using the balanced scorecard. At the end, chapter 10 presents the recommendations and summarizes the project.

5 OVERVIEW OF THE STRATEGIC ALTERNATIVES

In this chapter, an overview of three strategic alternatives that emerge from the external and internal analyses of ACME is discussed. Using a matrix that plots industry attractiveness versus competitive position, each strategic alternative is graphically displayed and briefly summarized. Chapters 6, 7, and 8 discuss the details of each option.

5.1 The Industry Attractiveness versus Firm Competitive Position Matrix

External analysis of the industry based on Porter's five forces indicates that market has low to medium attractiveness. Despite the threat of new entrants and substitutes being low, competitive rivalry is intense and the bargaining power of customers is high. The bargaining power of suppliers is moderate for now but likely to be greater threat if the CPBU becomes successful. The revenue strategy is based on the emerging hydrogen and landfill purification markets. Although both markets are unstable for now, ACME is optimistic about securing more sales. Thus, market attractiveness may grow slightly in the near future.

Internal analysis of the company based on the firm's competitive position as a differentiated best product is between medium and weak. Although the products have an innovative technology, research expenses are low and misaligned to support the differentiated strategy. Manufacturing has been inflexible to customization of units for the customers. As well, the manufacturing activities have been focussed on economies of scale and not scope. Thus, a better fit is necessary to align the differentiated strategy.

In the performance matrix defined in **Figure 5.1**, the CPBU has a medium to weak positioning (denoted by "t" in the circle). If the current strategy is maintained, the expected performance in the near future is denoted at "time" t+1E. In this industry, the near future can be interpreted as 3 years. The market attractiveness is expected to become slightly better from growth of hydrogen refuelling stations and the emergence of the landfill purification market. However, given the current differentiation strategy, the firm's competitive position remains unchanged. Unless more research expenses are allocated or manufacturing strategy is realigned, the operations of the CPBU would continue to remain unchanged.

The CPBU's competitive position would be strong if a broad manufacturing strategy (see section 6) were followed (denoted at "time" t+1D). The desired outcome would be from the realignment of the following internal factors:

1) Greater R&D expenses would be needed to support a more differentiated product strategy across all product categories for the CPBU to be the market leader in technology and innovation.

2) Outsource manufacturing assembly to regional selected fabricators with manufacturing capabilities and know-how of customer-specific codes and standards.

3) Restructure the CPBU to place more emphasis on sales, marketing, and market development (as less resources will be needed for manufacturing). As well, increased autonomy of decision-making would be given to the CPBU.

The CPBU's competitive position would be medium if a broad licensing strategy (see section 7) were followed (denoted at "time" t+2D). The focus of the CPBU would be a know-how company. The desired outcome would be from the realignment of the following internal factors:

1) Focusing on the company's core competency, product development and testing across the full range of products currently supported by ACME. An accelerated product development program would incur expenses which would weaken the financial strength of the CPBU but increase the competitive position. Within 3 years, the competitive position of the CPBU would become stronger. Early-term revenues would be from manufacturing licensing of its current products.

2) An accelerated path to product development would increase the technological product offering and open new market opportunities in niche applications. Expansion into new markets would decrease the threat of rivalries and substitutes.

3) A reorganized structure to focus on channel development through licensing would allow further market penetration. The intensity of the competition and threat of new entrants would be less if manufacturing licenses were given to key industrial market leaders. Through licensees, markets are penetrated on a global scale.

The CPBU's competitive position would be medium and market attractiveness would high if a focused vertical integration strategy in emerging markets (see section 8) were followed (denoted at "time" t+3D). The desired outcome would be from the realignment of the following internal factors:

1) Focusing sales and manufacturing efforts on the small emerging hydrogen and landfill gas purification market. The medium and large industrial hydrogen gas business would be sold to a PSA manufacturer.

2) Restructuring of the CPBU to build competency in engineering and manufacturing resources to support customization and customer solution packages. This constitutes a vertical integration strategy in the emerging market segments.

3) Sales activities would focus on customer solution packages and bundling of services to increase customer lock-in through customization and learning.

Although the majority of the CPBU's market is in the large hydrogen gas purification applications, other gas purification applications are subject to huge influence by the following three factors:

1) More stringent engine emission regulations to decrease greenhouse gas emissions that would in turn increase the demand for gas purification applications (e.g. - LNG for diesel engines or hydrogen for FCVs).

2) Breakthrough of a dominant design in hydrogen refuelling stations that would stimulate market growth for emerging hydrogen gas purification applications.

3) Increasing oil prices that would revive the demand for alternative energies such as LNG from landfills or hydrogen for fuel cells.

In a best scenario situation, the focused vertical integration strategy in emerging markets would be the best choice since revenues would be captured by the increased focus on the emerging hydrogen and landfill purification markets. For the worst case scenario, the best option would be the broad licensing strategy because the CPBU would be focused on product development and less affected by a poor market. For the expected scenario, which would be between the best and worst cases, the best option would be the broad manufacturing strategy, which focuses on market penetration, global sales, and outsourced manufacturing assembly.

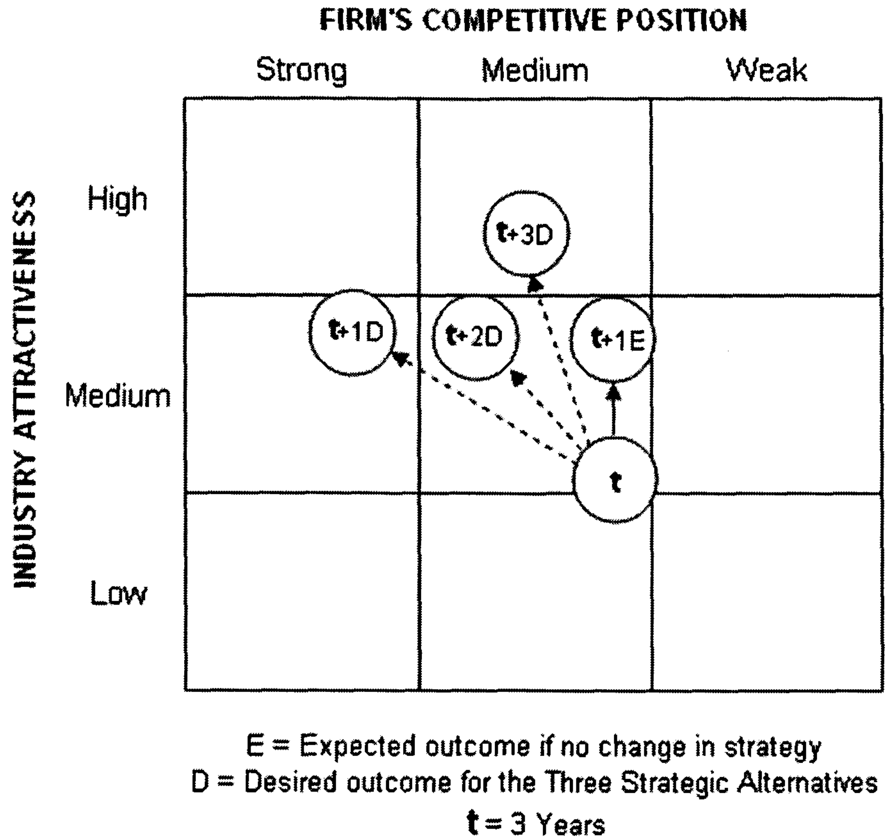

Figure 5.1: Competition Position/Market Attractiveness Matrix of the Strategic Alternatives for ACME's CPBU

5.2 Summary of Overview of Strategic Alternatives

As technology, ecological awareness, and standards co-develop, the market is likely to become more attractive and the customers become more sophisticated. The ability of the CPBU to generate revenues from its current technology is dependent on customized product offerings. ACME has the competency in product development and testing to increase sales. However, the legacies of the organizational culture for a standard product offering and the need to pull more R&D resources from longer term projects have created challenges for the CPBU. Currently, the CPBU is not producing the revenues as expected. The CPBU cannot remain unchanged if ACME plans to achieve its financial goals. The market needs customization and strategic alternatives need to be examined.

The broad manufacturing strategy, the first strategic alternative, would result in a strong competitive position. The company's core competency in development and testing would be leveraged by reallocating resources freed by outsourcing non-competency activities in manufacturing assembly. Product development work would be more focussed on customized engineering work and diversifying into new markets.

The broad licensing strategy, the second strategic alternative, would result in a medium competitive position. In this strategy, the company's core competency in development and testing is fully leveraged by reallocating resources freed by licensing out all current primary activities. A major drawback of this strategy would be higher R&D expense in the next 3 years.

The vertical integration strategy in emerging markets, the third strategic alternative, would result in a medium competitive position. Customer lock-in through customization and learning is focussed by offering customer solution packages. However, building competency as a customer solution provider would require learning and large investment.

Chapters 6, 7, and 8 discuss the first, second, and third strategic alternatives respectively. In each chapter, the framework of each strategy is given in more detail. Chapter 9 then uses the balanced scorecard to compare the three strategic alternatives. Summary and recommendations are given in chapter 10.

6 THE FIRST STRATEGIC ALTERNATIVE: A BROAD MANUFACTURING STRATEGY

In this chapter, a broad manufacturing strategy is discussed as the first strategic alternative. This strategy is the same current strategy of the CPBU but with a stronger focus on market penetration, product development, and outsourcing non-competency activities such as manufacturing assembly. The following sections discuss the strategic plan for each of the commercial products, a new organizational structure for broad manufacturing, and a new sales strategy to reach the global markets.

6.1 The Future of the H-Vision: Outsourcing Assembly to Regional Fabricators

The objective of the CPBU is to generate early-term revenue from the sales of industrial commercial products into established existing markets. With the uncertain growth of the fuel cell market and the new hydrogen economy, the growth of demonstration projects for hydrogen refuelling stations rests with companies developing reformer technology. ACME initially launched the H-Vision to capture the developing market in SMR reformer applications. However, early-term revenues based on uncertain fuel cell markets has high risk and uncertainty. Cost reductions based on economies of scale from high sale volumes are overly optimistic at this time. Inquiries for the H-Vision have fallen drastically in 2004 although ACME is still optimistic about the future of this market segment. Currently, rivalry is low and barriers of entry are high. Although the bargaining power of customers is high, only a few customers exist.

Despite the market uncertainty in small hydrogen applications, the H-Vision has strategic importance to build ACME's continuing alliance and partnership in the fuel cell market. ACME and its investors have strong interest to see a commercial available product utilizing fast-cycle PSA technology. The H-Vision is a crucial part of the fuel cell refuelling station value chain and enables fuel cell technology to become commercially feasible. Future financing efforts by ACME would be hindered if the H-Vision were to be discontinued.

Developing a strategy in a business undergoing revolutionary technological changes is a daunting proposition. A high level of uncertainty exists about the needs of the customers, the products and services that will prove to be the most desired, and the best configuration of activities and technologies to deliver them. Focus on operational effectiveness on a standard product offering is premature at this time without a dominant design in this market.

The best strategic option for the H-Vision is to focus on its core technology offerings: the rotary valves, drives, and beds. Fabrication of vessels and balance of plant assembly would be given to regional fabricators where ACME becomes an OEM with its valves, drives, and bed. PSA process engineering and design services, core competencies of ACME, would be kept in-house. These regional fabricators would be ACME's partners and hold expertise in best manufacturing practices that comply with local design codes.

This strategy holds merit because key activities on the core technologies are more focused in a dynamic and uncertain market. In the absence of a dominant H-Vision design, customers are given the option to select their own piping/skid layout and select customized items with support from ACME's engineering services. For ACME, non-core competency activities such as balance of plant procurement and assembly are outsourced to a fabricator that is familiar with the customer's local codes. In doing so, ACME can focus on building its core competencies in rotary valve and bed assembly relative to the status quo. Risk in the market is minimized with less overhead and outsourcing non-competency activities.

6.2 The Future of Apollo: Outsourcing Assembly & Targeting Large Industrial Markets

The H/M-Star and the multi-valve Apollo are potential commercial products that can capture the established hydrogen and landfill markets. Although sales have been dismal with these commercial products, the margins from a sale of a multi-valve Apollo can equate the sales of several H-Vision units. Inquiries for the Apollo product lines have always been high. However, the CPBU needs to develop competencies with different marketing and strategic positioning of the Apollo.

In this market, the customers are sophisticated and have high bargaining power. Upfront engineering and design work is necessary to provide more aggressive biddings. Rivalry is intense and barriers to entry are low with conventional PSA technology. Marketing and proposal efforts should be focused on new large hydrogen plants and retrofitting or replacement of existing legacy conventional PSA systems.

Like the H-Vision, the best strategic positioning for this market is to focus only on the valves and beds. PSA process engineering and design services, the core competencies of ACME, would be kept in-house. Balance of plant fabrication and assembly would be entirely outsourced to regional fabricators. To prepare aggressive bids in a high rivalry market, a proposal and project engineering structure needs to be developed to support this strategy.

6.3 Organizational Structure for the First Strategic Alternative: Building Global Strength

The business unit needs to be restructured as shown in **Figure 6.1** where the CPBU is more focused on sales and proposals and where manufacturing plant assembly is outsourced. Assembly of the rotary valves and beds would be done in-house to keep the intellectual property and maintain learning curves. Manufacturing and assembly of the balance of plant would be outsourced to fabricators in project-specified regions to allow ease of conformance with local project-specific codes.

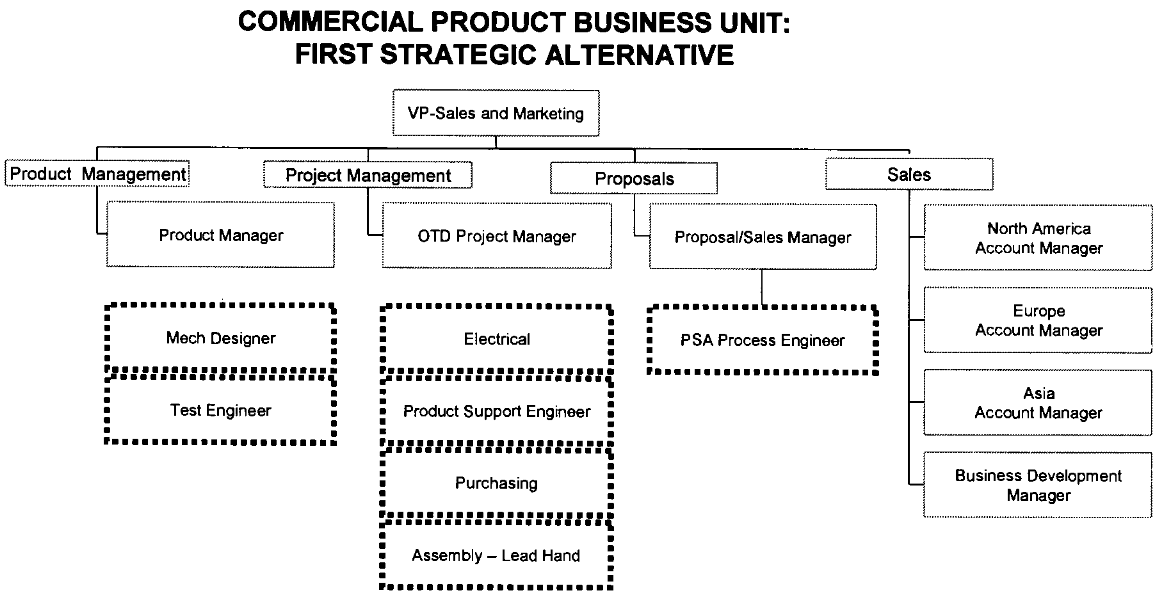

Figure 6.1: Organizational Structure of the Broad Manufacturing Strategy

In this organizational structure, emphasis is placed on lead generation, business development, and proposals. The rationale for this organization is as follows:

1) The M/H-Star and multi-valve Apollos are higher margin products. Customers are sophisticated and require a market pull by the account managers to generate the necessary leads and manage prospect customers. The focus of the account managers

would be strictly to gather the customer's data and determine the competitive position of the commercial products. These account managers would be regionally located in North America, Japan, and Europe.

2) The market development manager would be responsible for channel development but also to investigate the potential into other markets. Market diversification into niche applications is needed to increase the portfolio offerings.

3) The proposal manager would take on the quotation activities done currently by the account manager and provide a customer focus in sizing, estimating, and pricing quotations. Currently, proposal activities are frequent distractions among the OTD project manager, channels manager, account manager, and sales engineers. By creating a proposal manager position, the proposal process would be better streamlined to allow the CPBU to focus on their primary activities. The proposal manager would be the communication bridge with the regionally located account managers and ACME.

4) The OTD project manager would be responsible for order fulfillment where ACME would assemble only the valves and beds. The OTD project manager would control project execution, manage vendors/partners, and manage customer communications. Bed sizing and selection would be done in-house. The balance of plant would be outsourced to the partner shop for fabrication, assembly, and end-of-line testing.

5) Product development is managed by a product manager who would focus on innovative improvements based on customer needs. Currently, the product engineer shares a dual role as a sales engineer and lacks the focus necessary to reduce cost and improve performance on its existing products.

Resources in dotted-boxes in **Figure 6.1** will be shared by the CPBU and the other divisions in ACME through the existing matrix structure. The most significant change in this structure from the existing CPBU is the reduction of the assembly hands since the majority of the assembly would be outsourced. Only valve and bed assembly would be done in-house which would require less manufacturing expertise.

6.4 Marketing and Sales Strategies for the Commercial Products

Market diversification into niche gas applications and market penetration into medium/large industrial gas applications would be the key foci for the CPBU. The small hydrogen purification market for the H-Vision is not large and growth of this segment is dependent on the rollout of hydrogen refuelling stations. As well, sales of the H/M-Star and multi-valve Apollo require more attention to provide competitive bidding package that are more appealing to the medium and large industrial end-users.

Niche gas purification markets have not been fully explored and understood. Many large rivals do not wish to compete in these small and fragmented segments such as neon and krypton gases so ACME has opportunities to pursue these applications with low competition. A clear focus is necessary to explore other market opportunities and a dedicated business development manager should be allocated full-time to this task. With the possible upswing of fibre optic productions and steady growth in demand for helium, the CPBU should explore other sale and distribution channels than through our partner and competitor, ABC Inc.

Regional sales offices complemented with a proposal department for the H/M-Star and the multi-valve Apollo would allow for further penetration into the medium and large industrial gas markets. The Japanese distributor may find this advantageous, since the dealings with a local representative would ease communication and provide more technical support to problems or accessing information. For ACME, a local representative would allow a more regional focus on sales and provide more valuable market information back to the CPBU. Account managers would be able to spend more time with the customers and understand the strengths and weaknesses of the current products. As well, local prospect clients could collect more information readily.

This marketing strategy may be augmented as a non-revenue growth strategy because regional offices are additional expenses. However, by having regional offices, revenue would be expected to grow and lower costs. The reasoning for higher revenue growth would be as follows:

1) Regional offices would allow the account manager to follow leads more closely and provide the attention and upfront work necessary for bidding in large engineering packages. The presence of local representation would increase global market penetration and increase the company's visibility.

2) Regional offices would allow regional partner fabricators to communicate effectively with design and manufacturing issues. The account manager could streamline information directly from the customer or fabricators to the OTD manager.

3) Regional offices would allow ease of information to the product support engineer and provide more responsive replies to problems or issues in the field.

A slight deviation from this alternative is to have local representation using agents. However, a considerable amount of time is required to train agents with the technology and services. As well, pushing the products using agents in the past has been unsuccessful. An agent will also create a distance between ACME and the end-users. Thus, only by being closer to the customers, the regional markets can be penetrated further.

6.5 Conclusion of the Broad Manufacturing Strategy

The broad manufacturing strategy is the same current strategy of the CPBU but with a greater focus on global market penetration, product development, and outsourcing non-competency activities. The broad manufacturing strategy includes setting-up regional offices and a proposal office. Non-core competency activities in manufacturing assembly would be outsourced. As a result, core competency in product development & testing would be leveraged by reallocating the freed resources from outsourcing.

The competitive position of the CPBU is expected to be strong if the broad manufacturing strategy is implemented. However, the question of whether the whole current strategy of the CPBU is flawed or poorly implemented cannot be answered without further comparison with possible other strategic alternatives. Thus, chapters 7 and 8 explore two other strategic alternatives, the broad licensing strategy and the vertical integration strategy in emerging markets. By checking these other strategic alternatives, the strategy that is better fit for the CPBU can be validated.

7 THE SECOND STRATEGIC ALTERNATIVE: A BROAD LICENSING STRATEGY

In this chapter, a broad licensing strategy is discussed as the second strategic alternative. The rationale for this strategic plan is outlined with a proposed organizational structure. The strategic plans for the target markets, the advantages of licensing, and the disadvantages of licensing are discussed.

7.1 The Licensing Strategy

The CPBU has limited resources and has many developing and inefficient processes in its manufacturing, sales, and operations. In addition, the CPBU is not large enough to maintain manufacturing overhead, sustain the product development activities needed to keep its product lines competitive, and develop strong sales activities. For this reason, ACME should sell manufacturing licenses of its commercial products and focus on its core competency in product development and testing. The CPBU would be focussed on accelerating second generation products to replace the H/M-Star and the multi-valve Apollo.

ACME should adopt the strategy employed by some development firms and sell off their technologies once they reach the open market. Like a biotech firm, ACME products require intensive years of development and research, much like drug approval times. ACME should sell manufacturing licenses to a large PSA manufacturer. In addition, ACME should restructure or phase non-core competencies in sales, distribution channels, and marketing out of the ACME value chain, resulting in operations that are more efficient.

With a near term focus on research and development, the CPBU would not need to expend resources trying to compete in an industry that favours large economies of scale, high rivalry, and high bargaining power of customers. As well, ACME would not require marketing competencies to generate market interest during a lengthy adoption period. Manufacturing issues, such as supply chain management and manufacturing dissatisfaction with customization would no longer need addressing. ACME would able to focus and compete intensely on technological innovation. The resources and cash freed from sale of its technology allow for the development of more new technologies in the pipeline, and thus create a diversified portfolio of R&D projects to mitigate risk.

The trade-off from focusing on only the R&D portion is exclusion from earning revenues through direct sales and accelerated expenses for development. There would also be costs associated with the dismissal of the obsolete or reduction of non-core internal departments such as marketing, sales, and manufacturing. As well, there would be additional costs associated with managing manufacturing licensees.

7.2 Organizational Structure of the Business Unit

By licensing off the commercial products, the CPBU would be restructured to focus on product development and channel development as shown in **Figure 7.1**. Revenues would be generated from manufacturing licensing agreements and sales of the H-Vision. In the past, ACME has been able to generate revenue by addressing the market's unmet needs with product development programs. Current research programs such as structured beds can be accelerated with freed up resources. Hence, revenues can be generated by focusing on ACME's core competencies, raising capital for programs and R&D work on developing new products.

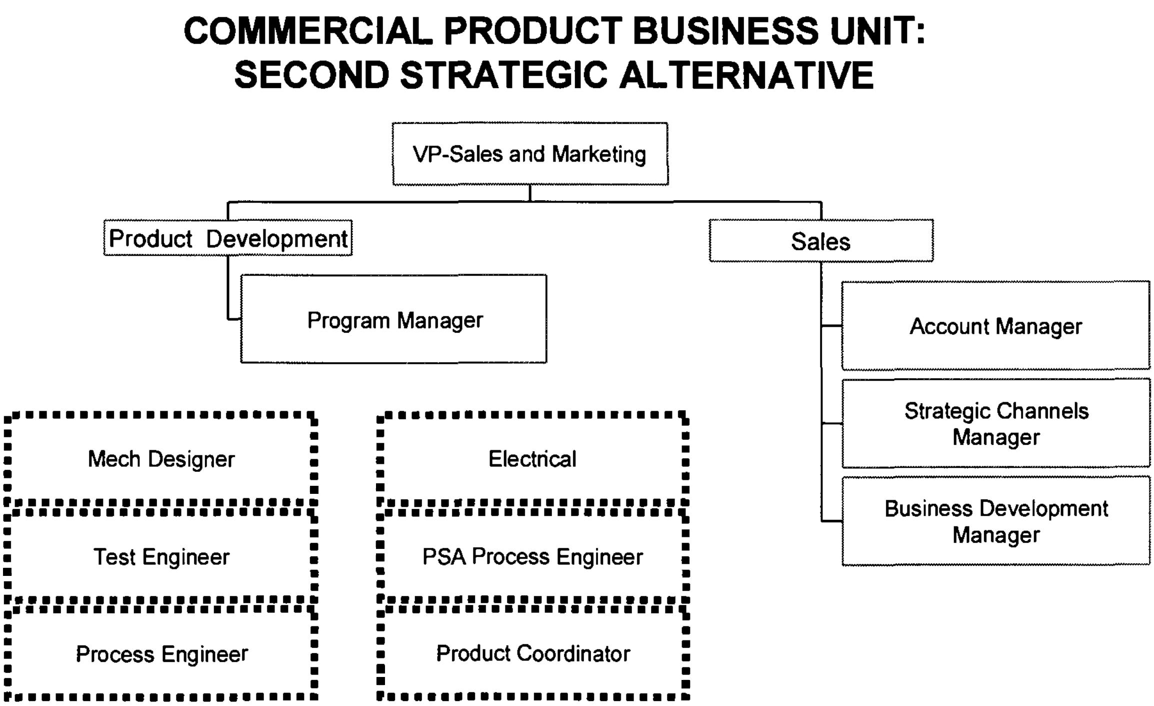

Figure 7.1: Organizational Structure of the Broad Licensing Strategy

7.3 Manufacturing Licenses of the Commercial Products

7.3.1 The Commercial Products for Small Gas Purification Markets

The CPBU has a strong market position in the emerging hydrogen economy to supply PSA solutions to hydrogen generation and distributed power equipment. During the customer's product development and early deployment phases, the CPBU has generated revenue through the supply of the PSA systems. Upside revenue potential is possible if the hydrogen economy materializes and the manufacturer succeeds in a high volume commercial rollout. The key aspect to this business plan is timing of the market.

Although the emerging hydrogen market is an attractive market, sales projections are aggressively based on optimistic projections. The timing and the extent to which the market will develop is widely debated. The assumption of near term markets for small hydrogen generators in traditional hydrogen markets is also questionable.

Manufacturing licensing for the H-Vision can be given to the reformer companies. The possibility of bypassing patents is less since the interest of these reformer companies is not PSA technology. For the small emerging hydrogen market, Kite has been the major customer and a manufacturing license would seem most appropriate. The problem with this strategy is that Kite would lock-out other reformers from using the H-Vision and thus limit the sales of the H-Vision.

Manufacturing licensing for the He-Vision can be given to ABC Inc. The benefit of this relationship is two-fold. Firstly, the CPBU would generate revenue from a market segment in which the CPBU have little chance to penetrate based on restricted channels to the end-users and possible intellectual property infringement on the entire system design. Secondly, the CPBU would be able to penetrate into global markets more quickly and competitively.

An option that is considered in the CPBU is bundling the H-Vision to increase the capacity for targeting the M/H-Star segment. If bundled using the current cost structure, the price of a bundled H-Vision system would not be price competitive in the M/H-Star segment. However, volume discounts and high volume manufacturing from economies of scale would benefit which would allow a price decrease. If so, manufacturing licensing to a world-class manufacturer with global manufacturing capabilities in high volume manufacturing would be most desirable.

7.3.2 The Commercial Products for Medium and Large Gas Purification Markets

The M/H-Star is based on a maturing rotary valve design that has been commercially available for over a decade. Although not a best product in the industry, the M/H-Star would attract potential licensees who see the benefits of a smaller footprint from fast-cycle PSA technology. Currently, the CPBU is offering manufacturing licenses of the M/H-Star to prospect customers. Manufacturing licenses of the entire M/H-Star would still be aligned with the current CPBU strategy.

The multi-valve Apollo is the highest margin product but targets a very hostile market. The large industrial gas market has strong rivalries and high bargaining power of customers. Most customers purchase these units through a distributor as a bidding package of an entire chemical complex. Hence, licensing the technology to a PSA distributor/manufacturer is likely the best option since direct sale channel is not favoured by the customers. As well, by licensing off this technology to the distributors, customization engineering work would be under the scope of the distributor. Early-term revenues from the sales of a landfill multi-valve Apollo is risky since the market is still small and unstable.

The CPBU has not built competency in the area of manufacturing, and pricing is perceived high as compared with sophisticated manufacturers. Magnified by the lock-in channels to the end-users by strong rivals, a reasonable option for ACME is to license out its commercial products. In the hydrogen and recovery markets, Linde would be the obvious choice for the H-Star since it has dominated the world with small hydrogen generating plants. The positives of this approach would be the benefits gained from key references and operating experiences from high profile installations. As well, ACME would be able to learn from a world class manufacturing company to improve its internal processes. Another contender is Kapa, a leader in the hydrogen recovery market and has in the past help funded the development of the H-Vision. However, the relationship with Kapa in the past had been turbulent since ACME is a direct rival in the small hydrogen market.

7.3.3 Advantages to Manufacturing Licensing

The advantages to manufacturing licensing are as follows:

1) Licensing would pre-empt potential competitors and create strong barriers to entry.

2) Licensing would allow faster penetration into market segments not accessible by direct sales. Hence, new sources of revenue would be gained. Direct sales would become more focussed on channel development.

3) Licensees have manufacturing resources and capability to customize systems and high volume manufacturing. Hence, a lower cost system would allow further penetration into existing markets. The CPBU's overhead in manufacturing and inventory would be gone.

4) Licensees can provide market intelligence for further product development work and users.

5) ACME would still be recognized as a technology leader by signing with key market leaders.

7.3.4 Drawbacks to Manufacturing Licensing

The issuance of manufacturing licenses comes with many drawbacks. A list of the cons to manufacturing licensing is as follows:

1) Many potential licensees are also ACME's competitors, such as the Japanese manufacturers who are highly eager to hold a manufacturing license. The problem with the manufacturing licensing approach is that Japanese or large global companies are well-known for reverse engineering and bypassing patents. Interestingly, smaller global and reputable energy companies are also known to behave similarly. However, this risk is lowered if ACME continues to innovate with new rotary valve design and equalization cycles. Bypassing patents would be less relevant with new designs.

2) Customer control and knowledge will be lost because manufacturing licensees would own the customer relationship. End-user feedback and market intelligence would be limited and reduced.

3) Service revenues will be lost since the licensee would deal directly with the customer.

7.4 Summary of the Broad Licensing Strategy

In this chapter, the broad licensing strategy is discussed as the second strategic alternative. By selling manufacturing licenses of its current commercial products, the CPBU could focus entirely on new products by leveraging its core competency in product development and testing. The freed resources and cash from licensing would be used support R&D activities. Although the broad licensing strategy has many advantages and drawbacks, this strategy would exclude earned revenue from direct sales and increase product development expenses. Chapter 9 evaluates this strategy more closely with the other strategic alternatives using the balanced scorecard. The following chapter 8 discusses the last strategic alternative, the focussed vertical integration strategy in emerging markets.

8 THE THIRD STRATEGIC ALTERNATIVE: FOCUSSED VERTICAL INTEGRATION STRATEGY IN EMERGING MARKETS

In this chapter, a focussed vertical integration strategy in emerging markets is discussed as the third strategic alternative. The rationale for this strategic plan is given and an organizational structure is proposed.

8.1 The Future of the Commercial Products into Integrated Customer Solutions

A revenue growth strategy that can be pursued by the CPBU is to combine the PSA units and services into a seamless offering that addresses the customer's need. Many companies inquire about additional services such as system engineering, consulting, control, and component integration with the PSA units. Examples of these services include engineering and design for gas pre-treatment activated carbon beds, integrated compressor packages, and programmed control logics for entire system control. The downstream market in customer solution is increasing and often requested with the unit. Currently, many customers internally struggle with these system integration issues.

Vertical integration involves adding an operation that requires new competencies differently marked from the CPBU's current business as a PSA product supplier. This strategic option is based on a wider offering of products and services to increase the customer's market share. By bundling a broad array of products and services that is targeted and customized to a specific customer's need, a stronger bond is formed with customers (Hax 13). By having a closer proximity to the customer, the bond can constitute a significant switching cost for the customer. For the CBPU, vertical integration would result in customer lock-in and immediate revenue growth from increased project scope.

To deploy this strategy and run such an integrated operation successfully, a drastic departure from the current strategy of pursuing all market segments must be taken. These trade-offs are essential to strategy and limit what the company can offer with the limited resources given. The market segments for emerging hydrogen and landfill purification applications offer greater opportunities for customer solutions since the market has less rivalry. In the market of large hydrogen purification applications, competitive rivalry is intense with many large engineering and contracting firms. Becoming a customer solution provider in niche and emerging markets should be the revenue growth strategy for the CPBU.

The medium and large industrial hydrogen gas business would be sold to a PSA manufacturer. Resources to compete as a solution package provider in the established hydrogen market would be high. In most instances, many large hydrogen PSA manufacturers have in-house capabilities to integrate the PSA and expertise in these applications is more common. Thus, to compete as a customer solution provider in the emerging markets, resources would be reallocated to support projects in the emerging hydrogen and landfill applications.

8.2 Organizational Structure of the CPBU for the Third Strategic Alternative

The CPBU would be restructured as shown in **Figure 8.1** such that additional resources are recruited for engineering and manufacturing services. Building competency and experience as a customer solution provider would be the key focus. The customers in the emerging hydrogen and landfill markets have different needs. In order to customize for each customer's specific need, projects need to be differentiated by applications.

COMMERCIAL PRODUCT BUSINESS UNIT:
THIRD STRATEGIC ALTERNATIVE

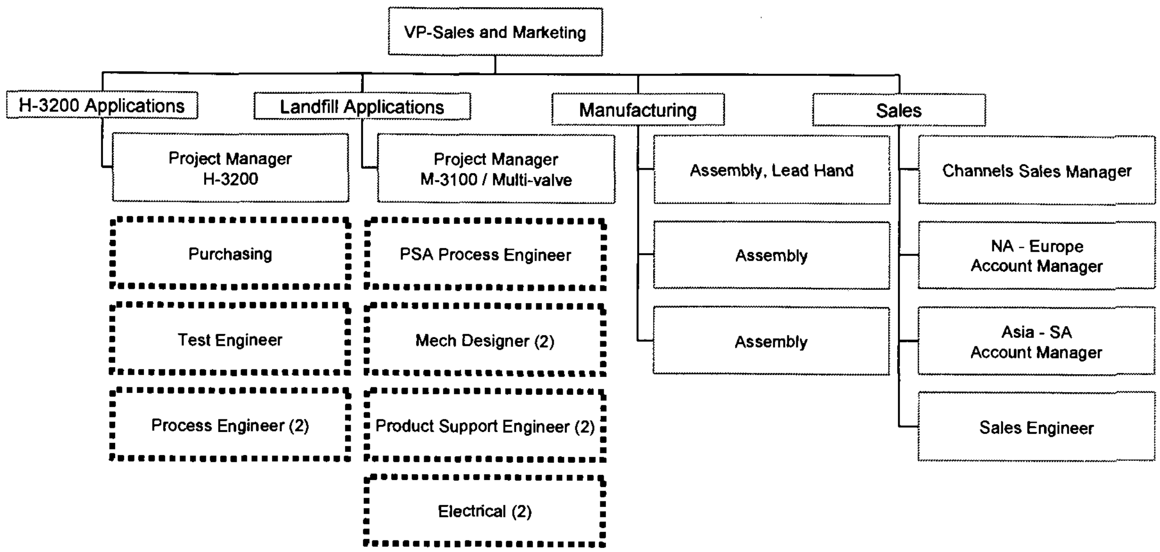

Figure 8.1: Organizational Structure of the Focused Vertical Integration Strategy in Emerging Markets

In this organizational structure, emphasis is placed on customization, engineering services, and project management. The rationale for this structure is as follows:

1) Projects would be handled by application and lead by one of the two project managers. A project manager dedicated for a particular application would allow building competency and expertise within the particular application and would thus overcome significant learning curves. The resources to support projects would be recruited from the functional departments via the matrix structure.

2) Manufacturing would maintain current level of resources but adopt a customization principle rather than the current low-cost manufacturing strategy. To meet customer-specific fabrication requirements, expertise needs to be developed in-house to understand regional manufacturing codes. Suppliers and fabricators would be sourced globally to meet the customer's needs.

3) Customer targeting would be the sales strategy for the CPBU. To enhance customer interfaces, account managers would focus on developing key relationships by exploring opportunities in improving the customer economics in their value chain. An example would be to offer additional services in exploiting joint developments with PSA and

reformer technology. Alliances would be explored with vendors (e.g. – compressors, control software, etc.) for bundled solutions. Increased customer lock-in through customization and learning would be the strategic goal.

8.3 Summary of the Focussed Vertical Integration Strategy in Emerging Markets

The third and last strategic alternative, the focussed vertical integration strategy in emerging markets, is discussed in this chapter. In this strategy, the needs of the market are met by providing full customer solution packages. Customization would form strong bonds with the customers and eventually results in customer lock-in. Although this revenue growth strategy has its merits, investment in building competency and experience as a customer solution provider would be required. Chapter 9 compares this strategic alternative with the first and second strategic alternatives using the balance scorecard. The recommended strategy and summary are given in Chapter 10.

9 THE BALANCED SCORECARD

In this chapter, the balanced scorecard is used to evaluate each of the three strategic alternatives. Each section discussed the three strategic alternatives from one of the four perspectives (Kaplan 72): financial, customer, internal, and learning and growth. The recommended strategic alternative is given in Chapter 10.

9.1 The Four Perspectives

The best way to determine the optimal strategy for the CPBU is to understand the business unit's vision. Given the three strategic alternatives, the best strategic fit for the CPBU is that of which best aligns with the mission statement. When strategy, organizational capabilities, core competencies, and markets are in synch, then competitive advantage is achieved.

The balanced scorecard philosophy allows a company to objectively view its alignment of corporate vision from four perspectives (Kaplan 72): financial, customer, internal, and learning and growth. No single measure is sufficient for providing a tangible fit to align strategy and the firm's objective. For this reason, the balanced scorecard is an ideal tool that can provide direction to decompose the vision into strategies, critical success factors (goals), and measures. By looking at each perspective specifically, we can analyze the strategic fit of each alternative to the goals and operational measures of ACME. At the end of this section, the balanced scorecard for the CPBU is shown in **Figure 9.1**. The rating for each strategic alternative and the weighting of each measure from the four perspectives are given in **Table 9.1**.

9.1.1 The Financial Perspective

The financial performance measures indicate if the organization's strategy, implementation, and execution are contributing to the bottom line. From the perspective of the shareholders, the CPBU has two goals: succeed in early-term revenue growth and maximize the use of existing assets and resources. Given the measures of revenue, income, and costs, we can evaluate the fit of the three strategic alternatives.

Strategic alternative one, the broad manufacturing strategy, has a revenue growth which involves market penetration, a focus of sales and proposal, and outsourcing plant assembly activities. Regional offices would provide more leads, collect market intelligence, and provide product support. By outsourcing manufacturing and assembly of balance of plant activities, the use of assets would be maximized. Manufacturing overhead would be reduced to lower cost. Thus, this strategy has good fit with the CPBU's goals.

The second strategic alternative, the broad licensing strategy, has a revenue growth model using manufacturing licensing which would allow penetration into markets not accessible by direct sales. However, the success of revenue growth is dependent on the licensee. Although manufacturing overhead would be dissolved, large expenses would be incurred to accelerate product development and research efforts. These R&D expenses would lower the attractiveness of the company for refinancing in the short-term. For long-term revenues, this alternative would be attractive. For short-term revenues, this alternative would be less attractive.

The third strategic alternative, the focused vertical integration strategy on emerging markets, has a revenue growth strategy which involves bundling solutions. By offering customer solution packages, revenues would increase but new resources need to be added to build competency in the CPBU. Additional engineering expertise and time would be required. From the financial perspective, this third strategic alternative is fair since higher revenue from bundling solutions could be offset by expenses used for building competency in engineering services.

9.1.2 The Customer Perspective

The customer perspective is the view of ACME that is seen through the eyes of the customers. Typically, the customer evaluates a firm based on its performance in four areas: time, quality, product performance, and cost. For the CPBU, these measures are translated to the delivery of orders, quality of the commercial products, responsive to inquiries, and market leadership.

In the broad manufacturing strategy, regional offices are located closer to the customer to increase customer relationship. With dedicated sales and proposal resources to support the regional sales offices, responses to inquiries or product support activities would be more prompt. As well, by being closer to the customer, the CPBU would have a better understanding of quality to maintain market leadership.

In the broad licensing strategy, licensees would be dealing directly with the customers. The CPBU would have less access to the end-user and less understanding of customer's needs. Although market intelligence would be provided by the licensees, feedback may be slow or not representative of the market. The quality of customer relationship would be highly dependent on the licensees. For this reason, this strategic alternative does not have a strong fit.

In the focused vertical integration strategy in emerging markets, customer's economics are focused and solution packages are offered that are customized to specific needs. Customer bonding would allow the CPBU to anticipate needs and work jointly to develop products. Evidently, using the customer perspective, the third strategic alternative is a very good fit.

9.1.3 The Internal Business Process Perspective

To become successful, companies need to look internally at their existing operational processes. Key areas of focus are typically cycle time, quality performance, and productivity. For the CPBU, this internal business goal is manufacturing excellence.

In the broad manufacturing strategy, assembly of rotary valves and bed assembly are all done in-house. Manufacturing and assembly of balance of plant are outsourced to regionally selected fabricators. By doing so, regional fabricators with manufacturing expertise in the local codes would increase the quality and productivity of the overall product. Customization would allow a shorter cycle time. Hence, this alternative is not aligned with the CPBU's goal.

The broad licensing strategy involves selling manufacturing licenses of the commercial products. The internal perspective would be non-applicable to total outsourcing of manufacturing since manufacturing excellence cannot be achieved. The vision of the CPBU to become a capable manufacturer does not align well with selling manufacturing licenses. Thus, this second strategic alternative does not fit with ACME's current vision as a PSA manufacturer.

The focused vertical integration strategy in emerging markets involves increasing the level of assembly work with customized solution packages. Flexibility in manufacturing assembly would be required and new skills need to be developed to meet the customer's needs. In the short-term, manufacturing excellence would not be possible because of learning curves. Customization would require longer cycle times and new quality measures. Hence, the third alternative does not fit with the corporate short-term vision for manufacturing excellence.

9.1.4 The Innovation and Learning Perspective

The innovation and learning perspective looks at the organization's initiatives for making continual improvements to their existing products and processes. To support a strategy, the organization's capability to align its resources is examined. The CPBU's goals in this perspective are for manufacturing learning and to innovate with its current products.

The broad manufacturing strategy focuses on building a strong competency with its core technologies. Manufacturing activities would only include the assembly of the rotary valves and beds. Hence, learning in manufacturing is enhanced. Although the focus of the CPBU would be sales, more funds would be allocated to product development. Learning and innovation is fully supported. Hence, this strategic alternative has good fit with the CPBU's goals.

The broad licensing strategy has a strong focus on innovation and learning. Product development efforts would be accelerated to release next generation products. As well, improvements with the manufacturing processes would be developed. Hence, this second strategic alternative is also aligned with the CPBU's goals.

Like the other strategic alternatives, the vertical integration strategy in emerging markets has also a strong focus on innovation and learning. Learning about customer's needs and working closely with the customer to innovate new products are the basis for customer solution packages. In manufacturing, new skills would be learned from customization. From this perspective, this third strategic alternative is also aligned with the CPBU's goal.

Financial Perspective	
Goals	**Measures**
Succeed in revenue growth with the H-3200 and HyQuestor line of products	Quarterly sales volume & operating income by CBU
Maximize the use of existing assets in the CBU	Budgeted versus Actual Costs per project

Customer Perspective	
Goals	**Measures**
Responsive delivery on Orders	On-time delivery identified by customer
High quality product and services	Number of non-compliance reports outstanding & lower warranty costs per project
Responsive replies on inquiries	Lag time for reponses to inquiries per year
Market Leadership	Ratio of Wins and losses per year

Internal Business Perspective	
Goals	**Measures**
Manufacturing Excellence	Number of non-compliance report outstanding & improved cycle time per project

Innovation and Learning Perspective	
Goals	**Measures**
Manufacturing Learning	Number of distractions in assembly per project
Product Innovation	Number of product improvements per year

Figure 9.1: Commercial Product Business Unit Balanced Business Scorecard*

9.2 The Balanced Scorecard Conclusion

In this chapter, the balanced scorecard is used to evaluate the three strategic alternatives. From the financial perspective, the broad licensing strategy and the focused vertical integration strategy (strategic alternatives two and three) are not good fit because of the incurred costs from

* Metrics were defined through internal company meetings.

product development and building engineering/manufacturing competency respectively. From the customer perspective, the broad licensing strategy would create distance between CPBU from the customer through the licensee (which would negatively impact the measures). From the internal business and innovation and learning perspectives, only the broad manufacturing strategy has the most impact. The second and third strategic alternatives are strong (and stronger) in product improvements but the weighting in this category is relatively low. Thus, the broad manufacturing strategy has the most positive impact given the company's goals. As summarized in **Table 9.1**, the broad manufacturing strategy has the best fit with the corporate vision. The points given for each measure are drawn from the discussions in the preceding chapters.

Perspective	Measures	Weighting	Strategic Alternatives		
			#1	#2	#3
Financial	Sales Volume	20%	++	+	+
	Operating Income	20%	+	-	-
	Actual Budgeted/cost	20%	+	-	--
Customer	On-time Delivery	5%	+	-	+
	Non-compliance Report	5%	+	-	+
	Lag-time for Responses	5%	++	-	+
	Proposal Wins/Losses	5%	++	+	++
Internal Business	Internal Non-compliance	5%	++	--	-
	Cycle Time	5%	+	--	-
Innovation & Learning	Distractions in Assembly	5%	+	--	-
	Product Improvements	5%	+	++	+
	Total:	100%			

LEGEND: "--" denotes very poor fit with corporate vision
"-" denotes poor fit with corporate vision
"+" denotes good fit with corporate vision
"++" denotes very good fit with corporate vision

Table 9.1: Balanced Scorecard Weighting over a Three Year Period

10 RECOMMENDATIONS AND SUMMARY

Given the current weak state of the world equity market, early-term revenue has become important for ACME to raise funds for refinancing. As a corporate strategic shift from research and development, the CPBU was formed to focus on capturing revenues from sales of its current commercial products. However, sales have been dismal and lagging projections.

The current problems with the current business unit are: (1) unclear product and marketing strategy for growing revenues; (2) process and organizational structure lack focus on supporting sales; (3) manufacturing issues from customization and abiding to customer's local standards; and (4) current markets are too small, undeveloped, or too hostile for projected revenues. In order to rapidly grow the business, three strategic alternatives were evaluated.

The broad manufacturing strategy is recommended for the CPBU based on the balanced scorecard approach. The first strategic alternative is better aligned with all of the CPBU's goals in all of the four perspectives. As shown in **Table 9.1**, the broad licensing strategy and the focused vertical integration strategy in emerging markets were not as good a fit with the CPBU's goals. By weighting the measures in each perspective according to the priorities of ACME, the broad manufacturing strategy is favoured. Thus, the key recommendations for the CPBU are as follows:

1) Create regional offices in North America, Europe, and Japan to penetrate further into global markets. These regional offices would help generate leads, provide quicker responses to inquires, gather market intelligence, and provide local product support to customers.

2) Restructure the CPBU with a proposal office to provide sizing, engineering, cost estimation, and pricing for competitive quotations. The proposal department would support regional sale activities and provide a customer focus to inquiries.

3) Outsource manufacturing and assembly of the balance of plants to local fabricators in North America, Europe, and Japan. Compliance to customer's local codes and quality of workmanship would be easier. Hence, manufacturing overhead

would be reduced to allow a stronger focus on the rotary valve and bed assembly. Resources could be reallocated to product development and sales.

4) Diversify the product portfolio into other gas separation applications. The additional sales would allow expansion into new avenues for revenues.

The broad manufacturing strategy is the same current strategy of the CPBU but with a stronger focus on market penetration, product development, and outsourcing non-competency activities. This current strategy is still best and is supported by three underpinning assumptions that need to be checked:

1) The industrial gas purification market is attractive enough to support the sales goal of the unit although the size of the market is currently not as large as initially estimated.

2) If the industrial gas purification market is attractive, sales cannot be gained without additional product support activities outside the CPBU. Since the market is still developing and standards are not established, customers require customization and flexibility to continue forward with their development efforts.

3) More investment is needed into the CPBU to ensure it can cope with the process of selling into this low attractive market. The market is not expected to grow dramatically over the next 3 years and the CPBU must change to achieve its financial goals.

A major risk of the broad manufacturing strategy is poor head office support for the regional offices. Regional offices may become stranded without support due to time-zone differences and poor communication channels. To minimize this risk, the ACME management team must formalize a process to ensure that information between the head and regional offices are always frequent and adequate. Hence, sales reporting would become scheduled meetings to ensure priorities are understood and responded promptly.

A further recommendation is to revisit all the strategic alternatives annually. External factors that could signal the need for a strategy change are changing emission regulations, stimulated market growth in alternative energies, and oil & energy prices. The best strategic alternative is subject to huge influence from these factors.

ABBREVIATIONS

ADG	Advanced Development Group
ATR	Auto-thermal Reformer
BDM	Business Development & Marketing
CGS	Compact Gas Group
CE ATEX	European Certified Atmospheric Explosive Proof
CPBU	Commercial Product Business Unit
DHRS	Distributed Hydrogen Refuelling Systems
EBIT	Earnings before Interest and Taxes
EPA	Environmental Protection Agency
FCV	Fuel Cell Vehicle
ACME	ACME Technologies Inc.
IGS	Industrial Gas Group
IP	Intellectual Property
LFG	Landfill Gas
LNG	Liquid Natural Gas
MPD	Manufacturing & Product Development
MRI	Magnetic Resonance Imaging
MRP	Material Resource Planning
OEM	Original Equipment Manufacturer
OTD	Order to Delivery
PED	European Pressure Equipment Directive
PEM	Proton Exchange Membrane
POX	Partial Oxidation

PSA	Pressure Swing Adsorption
SMR	Steam Methane Reformate
TIIS	Japanese Technology Institute for Industrial Safety
VTR	Variable Test Rig

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