

EMGT 835 - Engineering Management
Field Project

**Product Development Plan for a New Pump
Concept in North America**

By

Gregory S. Towsley

Fall Semester, 2006

An EMGT Field Project report submitted to the Engineering Management Program
and the Faculty of the Graduate School of The University of Kansas
in partial fulfillment of the requirements for the degree of Master's of Science

Linda Miller
Committee Chairperson

Tom Bowlin
Committee Member

Mike Ketchum
Committee Member

Date accepted: _____

Table of Contents

Table of Contents.....	2
Index of Figures	4
Index of Tables	4
Acknowledgements.....	5
Executive Summary	6
Introduction.....	7
Background.....	10
XYZ Rotating Pump	10
Rotating Centrifugal Pump	12
Product Description	13
Design Considerations	14
Market Conditions	22
Market Size	22
Market Segments	23
Applications	23
Sales Channels	24
Competition.....	24
Competitive Advantage	25
Marketing Mix Strategies	27
Product Name.....	27
Pricing Strategies and Position	27
Distribution	30

Promotion.....	31
Objectives & Targets	31
Final Plan	33
References/Bibliography.....	35
Glossary	36

Index of Figures

Figure 1 Efficiency Comparison.....	11
Figure 2 Small Hydraulic Comparison - 1800 rpm	16
Figure 3 Medium Hydraulic Comparison - 1800 rpm	16
Figure 4 Small Hydraulic Comparison - 3600 rpm	17
Figure 5 Medium Hydraulic Comparison – 3600 rpm.....	17
Figure 6 Rotating Pump Sizes vs. ABC Pump Hydraulic Sizes	18
Figure 7 Rotating Centrifugal Modification Mock-up.....	19
Figure 8 Threaded Pump Market Share Estimate	24

Index of Tables

Table 1 Market Potential and Served Market	22
Table 2 Benefit Comparison	26
Table 3 Five-year Sales Forecast	32

Acknowledgements

I would first like to thank Professor Herb Tuttle for all of the knowledge he has shared through my quest to complete this Masters degree and his never ceasing push to get me to the finish line.

Thanks also to the faculty and staff of the Engineering Management department at the University of Kansas Regents Center for their time and talents that they share with all experiencing the Master of Science in Engineering Management program.

I would also like to thank my committee members, Linda Miller and Tom Bowlin, who have provided guidance to this field project. Their feedback has helped me finally complete this final project for EMGT.

Finally, I would like to thank XYZ Corporation and its employees that have provide information and inspiration for this project. My former supervisor, Ole Gerlich, provided passion towards this project that will hopefully continue to realization. In our work to move this project along internally, Svend Amidsen and others in the R&D department have provided supporting data and information.

Executive Summary

The pump market in North America could be considered bland with regards to innovation in the major industrial markets. In 1990, Igor Karassik asked at the 7th International Pump Users Symposium “And What of the Future?” with regards to centrifugal pumps. He provoked the pump industry to consider innovation and change.

With a new concept, XYZ Corporation has an opportunity to bring about innovation and change in the market. With product modification for one of XYZ’s existing products, they could position themselves in the market with an innovative product for which the market has asked. As this new product utilizes existing technology, the new product can provide XYZ a more complete portfolio. As an additional benefit, this new product may assist XYZ in gaining additional market share.

The intent of this project has been to research and develop the product concept for a modification for the North American market. The information in this report provides a recommendation to proceed with the additional research and development stages to continue with the advancement of this new product in the XYZ product development process.

Introduction

XYZ is one of the world's largest manufacturers of pumps. With a focus on pumps, pump systems, and other related components, the mission of XYZ is "to successfully develop, produce and sell high-quality pumps and pumping systems world-wide, contributing to a better quality of life and a healthy environment." XYZ maintains a global presence with production plants on five continents, and over 13,000 employees working in over 40 countries.

The North American region of XYZ consists of manufacturing companies in California and Texas, and three sales companies in Mexico, Canada, and the United States. The pumps provided by XYZ in North America handle a variety of services in the market areas of commercial/industrial, plumbing and HVAC, groundwater, environmental, and sump, sewage and effluent. Sales of XYZ products in North America for the year 2005 were approximately \$1 million.

Centrifugal pumps are the most common, most accepted, and most readily available pump design to move liquids in North America. The single stage, centrifugal, frame/foot mounted pump market is the largest identified pump product in the North American region. The North American market includes many manufacturers of centrifugal, top discharge pumps. Within the large group of centrifugal designed pumps is the "threaded market", which is the biggest pump market. The threaded design pump is the most standardized pump on the market and another subgroup of centrifugal pumps.

XYZ does not currently have a centrifugal pump that is accepted in the U.S. market.

Although the XYZ company in Texas has a centrifugal pump line, it is not the XYZ brand. The XYZ branded centrifugal pump that is available is limited in hydraulic range and considered a “me-too” in the market, with no expectations to take any market share.

In addition, XYZ does not manufacturer a threaded product.

XYZ does manufacture a rotating pump, and is considered a market leader in the North American region with this design. The value proposition provides pumps users with exceptional pump for their systems and processes.

From feedback from the XYZ sales channels, a concept of a centrifugal pump with the value proposition of the rotating pump has been suggested. In addition, a possible design concept to target an existing pump population is to construct the pump to threaded pump dimensions.

The object of this project is to research and develop a new product concept for a centrifugal modification to an existing, successful XYZ pump for the North American market. It is expected that the new product modification should provide additional growth for XYZ in North America in new and expanded markets.

The summary information that will be created is considered part of the product development process at XYZ. The activities in this project should provide information

that is required to meet the first two steps in the product development process decision points.

Decision Point 1:

- Describe the idea concept
- Confirm that the concept is in accordance with corporate strategies

Decision Point 2:

- Determine the market and customer requirements
- Make initial strategic considerations regarding production, logistics, quality and service

Background

The centrifugal pump, and more specifically the threaded pump, is a standard design within given industries. The pump market is considered conservative with little innovation with regards to the basic design; however, the competition has changed the industry. Today, the industry accepts new technologies if it provides benefits to the user. The main market for threaded pumps is the replacement market (estimated to be 30% of total potential). New projects or expansions of existing facilities are minimal today. Therefore, an alternative pump must be installation-friendly and fit directly into the existing threaded piping.

XYZ Rotating Pump

The XYZ rotating pump is recognized in the pump industry as a superior product for its hydraulic range and application capabilities. XYZ continues to focus on selling to the centrifugal market by promoting the rotating pump and its value proposition. Although XYZ has success selling against centrifugal pumps, they are unable to gain significant additional business and market share.

The reliability of the rotating pump is with its design. Since the original design in 1865, numerous improvements have been made to the product. To provide a metric for the statement of good reliability of the rotating pump, XYZ considers the cost of warranty compared to the total revenue of the product. For the last 10 years, warranty costs have

been <5% of the total revenue produced by the rotating pump. These warranty costs have been primarily related to issues with an outsourced hydraulic drive.

Economy relates to the efficiency of the pump, providing a lower overall operating cost when compared to other pumps. The inherent design of the rotating pump – ductile iron, radial impeller design – provides a higher efficiency compared to that of a similar design and to the centrifugal design. The high efficiency design provides reduced motor sizes and lower power consumption. Figure 1 provides an efficiency comparison between the XYZ rotating pump and a typical threaded centrifugal pump at various flow rates.

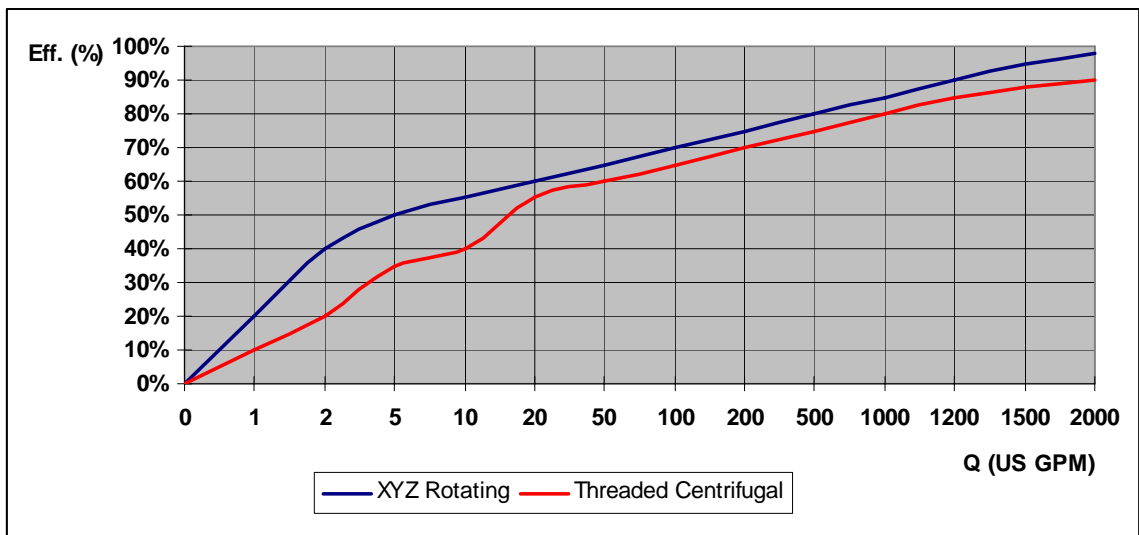


Figure 1 Efficiency Comparison

Modifications of the rotating pump provide solutions to many non-water and difficult applications. These modifications include customization options with the motor and the pump, providing literally hundreds of possible combinations to meet the specific needs of an application. The many available modifications allow the rotating pump to provide solutions with a much larger product portfolio.

Rotating Centrifugal Pump

With the existing accepted value proposition of the rotating pump, a centrifugal modification could be considered a useful alternative in the centrifugal market. In addition to the existing rotating pump value proposition, the rotating blade principal may offer an additional alternative to the centrifugal pump used today, such as price. Should the rotating centrifugal modification be manufactured to threaded dimensions, it will be able to replace competitive pumps with little or no piping changes in some of the general industrial applications. In addition, the rotating centrifugal modification could be used in other domestic building service (DBS) applications to replace other centrifugal pumps.

By using a rotating pump with the centrifugal modification, XYZ can differentiate their product from the traditional threaded centrifugal pump supplier. It would not be a “me-too product” in an already very competitive market, but may be accepted as an innovative alternative, giving new and valued benefits.

Product Description

The intent of the rotating centrifugal modification is to provide a beneficial alternative for existing centrifugal and threaded dimensional products used today. Ideally, XYZ should promote and sell the rotating pump in new applications where piping is not an issue. For those existing applications involving ductile cast iron or stainless steel pumps, the rotating centrifugal modification can replace an existing pump if better performance is required or there is justification to replace the entire pump due to damage or wear.

Hydraulic size selections can be based on one of the industry's main manufacturers, ABC, performance at 3600 rpm and 1800 rpm speeds. In reviewing the sizes, hydraulics and market acceptance, the ABC pump should be considered as a target product to focus the design. Other performance at speeds such as 1200 rpm should not be considered for design considerations. Other manufacturers' sizes and performance, such as CDE, were not reviewed, but should be considered.

The pump materials of construction and function should be in accordance with the existing rotating pump technical design. These include a cast iron and stainless steel versions. If possible, ductile cast iron, like the largest rotating pump product range is manufactured today, should be considered instead of the gray cast iron, as that material is better accepted in the industrial market in the U.S.

To support the rotating pump in the correct position, it is expected that motor supports be fabricated. The mounting of the pump and motor must be able to fit a standard base.

A goal of the rotating centrifugal modification is to be dimensionally interchangeable with the threaded pumps and fit with minimal or no modifications. As the dimensions and design of the rotating pump are unique and do not meet threaded dimensions, it is expected that modifications are made to the design to allow the pump and motor to fit.

There are 50 pump sizes. These pump sizes can be categorized into three main hydraulic groups;

- Small – To approximately 500 gpm for 3600 rpm
- Medium – To approximately 2,500 gpm for 3600 rpm
- Large – To approximately 10,000 gpm for 1800 rpm

The industry standard does not define the impeller design. Pumps are available in various impeller modifications, including;

- Semi-open (most common)
- Radial impeller
- Open Impeller

Design Considerations

During the design stage of the rotating centrifugal modification, a careful evaluation must be completed of the comparison of the base plates and the rotating centrifugal pump.

Some types and sizes may have problem areas. In some cases, the motor stool may interfere with the existing base plate. Other rotating centrifugal pumps may be too long.

The intent of the rotating centrifugal pump is to have similar hydraulic performance compared to the threaded pumps. The hydraulics of pumps of various pump manufacturers does not necessarily duplicate the recommended performance of the industry. The performance (flow, head pressure, efficiency, and horsepower) of the standard rotating pump should be the target of the designed performance of the centrifugal modification. The pump impeller is often trimmed to a diameter that provides the required performance. Final performance must be checked due to reconfiguration of the new volutes. It may be required that the rotating pump impellers be trimmed to provide a greater hydraulic coverage.

An overall comparison of the 1800 rpm and 3600 rpm the ABC pump is shown below in Figures 2, 3, 4 and 5. Larger sizes exist, but were not included in the product development review because XYZ does not have a rotating pump product to meet the requirements. It should be noted that >50% of the market potential is 6,000 gpm and below, based on information from the Hydraulic Institute and the U.S Census Bureau. Therefore, the large sizes are not considered for the rotating centrifugal modification.

The hydraulic comparison is based on the small and medium hydraulic groups and the 3600 rpm and 1800 rpm speeds (note that 4-pole is equal to 1800 rpm and 2-pole is equal to 3600 rpm);

- Small – To approximately 500 gpm for 3600 rpm
- Medium – To approximately 2,500 gpm for 3600 rpm

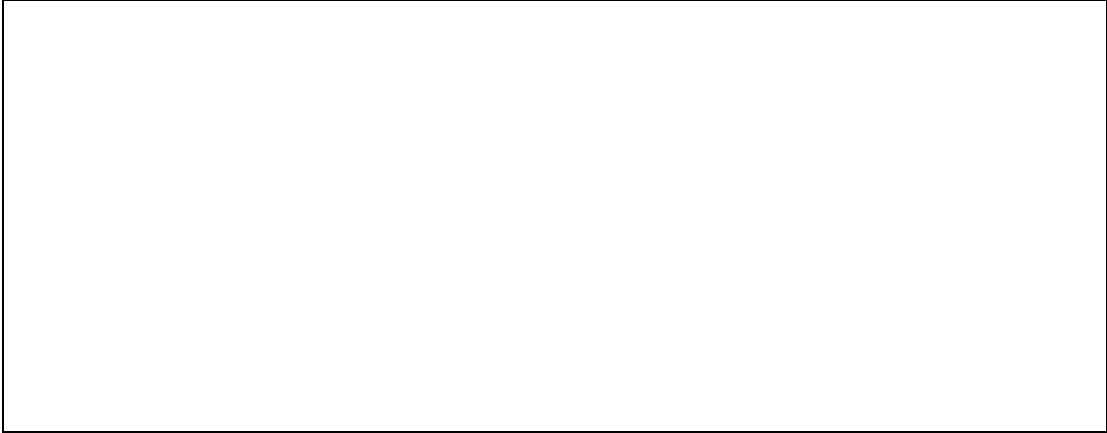


Figure 2 Small Hydraulic Comparison - 1800 rpm



Figure 3 Medium Hydraulic Comparison - 1800 rpm

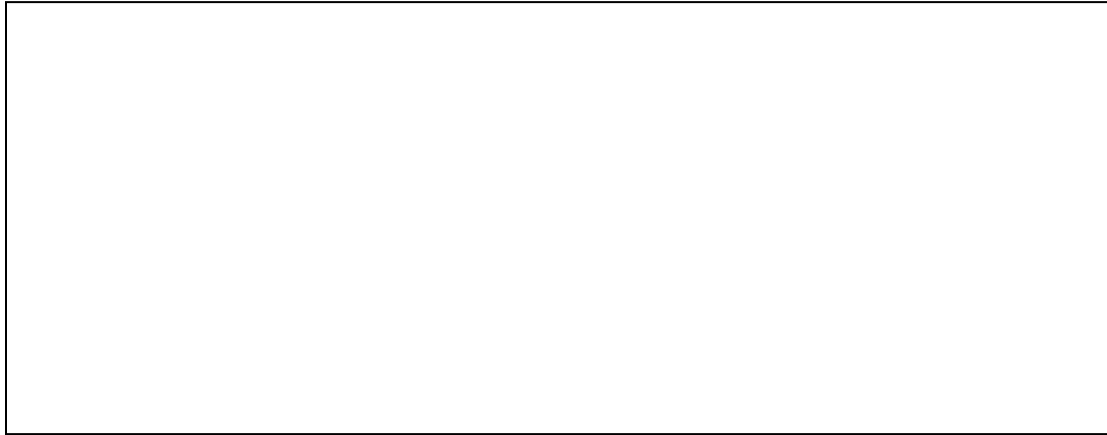


Figure 4 Small Hydraulic Comparison - 3600 rpm

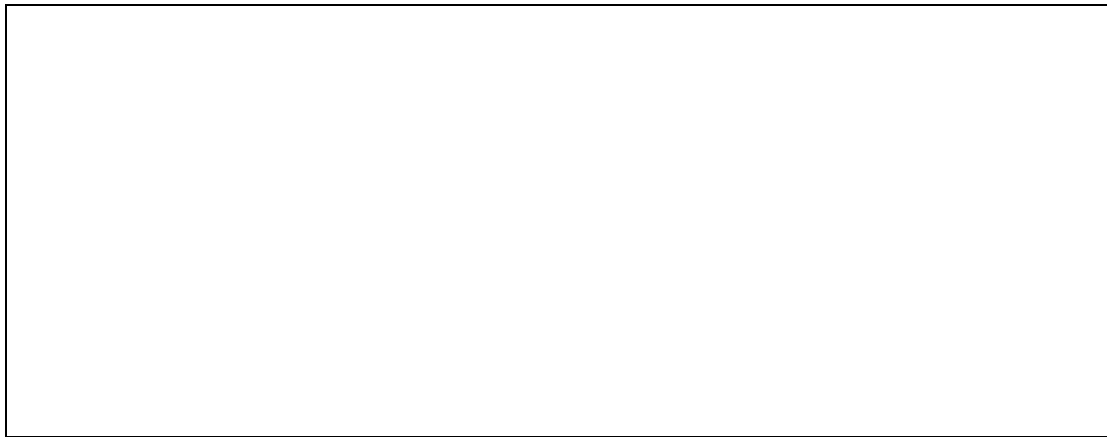


Figure 5 Medium Hydraulic Comparison – 3600 rpm

When comparing the hydraulics to the rotating pump's, the flow rates of the ABC's were divided into two or more rotating pump sizes for 3600 rpm and the 1800 rpm. At the 1800 rpm speed, hydraulic issues occur at the higher flow conditions. In addition, the efficiency drops (due to wasted energy) and the NPSH required is not as good as the 1800 rpm pump. Figure 6 provides an overview between the rotating pump hydraulic performance and that of the ABC pump sizes.

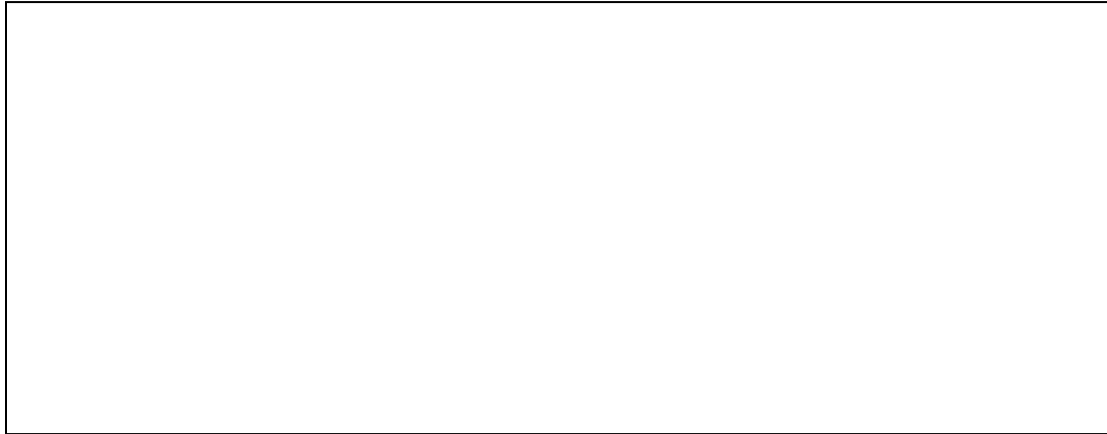


Figure 6 Rotating Pump Sizes vs. ABC Pump Hydraulic Sizes

Due to the hydraulic construction of the ABC pump and the limited number of hydraulic sizes available, the rotating pump range has a great advantage related to the pump efficiency.

The rotating pump has a smaller hydraulic range than the threaded standard. As part of the next phase of research, XYZ should determine if the market will accept the rotating centrifugal modification even though there is not a full hydraulic range (capacities greater than 1,200 gpm). However, experience shows that the reduced coverage can be accepted, as the end user can always use a traditional threaded pump for the larger capacities.

As with the standard rotating pump, this centrifugal modification must have the maximum quality level expected by XYZ. It is expected that the warranty costs for replacement units, credit, parts, labor and warranty administrative processing must not

exceed 10% annually of the total sales dollars to XYZ's sales channel. As expected by the market, the XYZ standard warranty must apply.

As with other XYZ products, the centrifugal modification is expected to be designed for recycling. The existing rotating pump is capable of being able to disassemble the pump 100% to pure raw materials, with the exception of the paint and the seal packing. It is required that this centrifugal modification has the same design feature.

The appearance of the product should be similar to the rotating pump, only mounted with a centrifugal configuration. The mock-up shown in Figure 7 provides a view of how the final centrifugal modification could look.

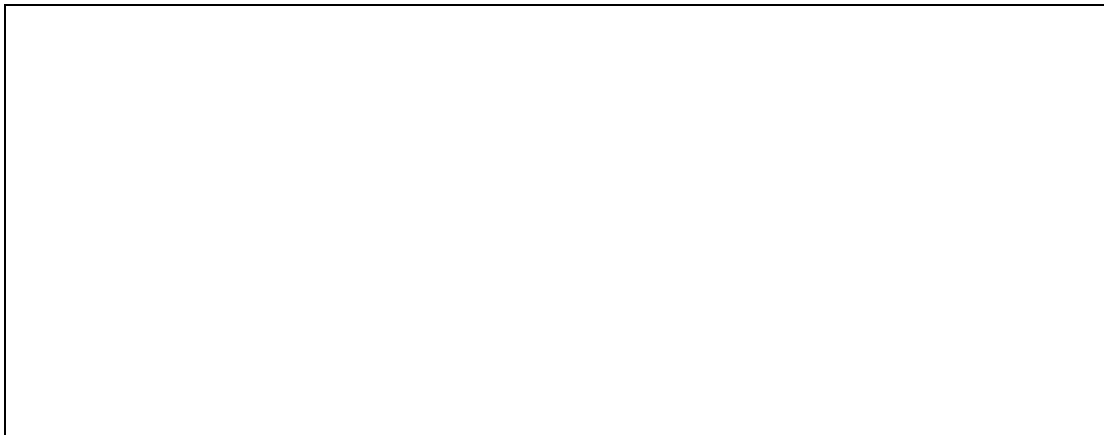


Figure 7 Rotating Centrifugal Modification Mock-up

The pump units or complete units mounted on a base must be packaged in accordance with XYZ standards and to ship without damage by truck or rail, assuming no extraordinary damage caused by negligence.

XYZ believes that the market recognizes its brand as a unique, high quality product. The rotating pump is accepted in many markets as a preferred product with features and benefits such that the rotating pump is a standard product in the market. With the success and brand strategy of the rotating pump, the centrifugal modification should be branded as the rotating pump is today.

As the sizing and selection is expected to be similar to the rotating pump, the application and customer service support should be as it is today. Internally, training should take place prior to the new product launch to get full understanding of the product by those that will support the customers. The sales distribution channels should also be trained on features, benefits, applications, sizing, and other support requirements prior to or at the beginning of the product launch.

Similar to the existing XYZ rotating pump, the following aftermarket service kits should be available for purchase by the end user;

- Parts Kits
- Packing Seal Kits
- Gasket Kits
- Repair Kits
- Bearing Kits

As is typical of market requirements, all pump spare parts not included in service kits should be available for sale. All applicable Installation & Operating Instructions, parts lists and brochures should be packed in the shipping package, as is the standard procedure for XYZ packaging.

No special or additional preventative maintenance requirements are expected.

All complete units, with pump and motor, should be designed to connect in standard piping connections. To facilitate ease in installation and replacement of an existing pump, the rotating centrifugal modification and motor should be supported.

The market accepts the value proposition of the rotating pump and the centrifugal design. The concept of this centrifugal modification of the XYZ rotating pump is feasible based on physical characteristics and the hydraulic coverage. As this centrifugal concept is a variation on a focus product for XYZ, it may be considered in line with corporate strategies. With the availability of resources, it is recommended that the next phase of research and development proceed, which includes parts design and manufacturing, prototype procurement, and performance testing.

Market Conditions

As XYZ does not currently have a market accepted product for centrifugal applications, it is expected that the rotating centrifugal modification should present XYZ an opportunity for additional growth in the North America in new markets, as well as markets that they are currently doing business. Limited data is available to assist in the analysis of the market; however, further market analysis is necessary. Further market analysis could include additional research with existing studies, engage a third party to complete a study, and conduct focus groups to obtain constructive feedback. Additional data should provide an improved capability to analyze the market and assist in developing a sales forecast.

Market Size

The data in Table 1 is based on rationalized data from the 2004 Hydraulic Institute A12 and M10 reports, and Pumps and Compressors: 2004 Industrial Report (MA333P) from the U.S. Department of Commerce. Table 1 provides estimates on market potential for the rotating centrifugal modification.

Table 1 Market Potential and Served Market

Total Centrifugal Market Potential	
Threaded - <=8"	3,900
Threaded - >8"	1,100
Total Threaded	5,000
Total Flanged (DBS)	9,000
Total Centrifugal Market	14,000

Served Market for rotating centrifugal	
50% of threaded	2,500
20% of Flanged (DBS)	1,800
Total Served Market	4,300

Market Segments

Although the centrifugal market is considered mature, Frost & Sullivan expects an annual revenue growth rate of approximately 3.5% per year. Growth of the rotating centrifugal modification would primarily be due to gains in the share of the centrifugal market.

Applications

As with the existing rotating pump product, typical applications for the rotating centrifugal modification should be water applications (32°F to 230°F, 0 to 500 psi);

- Water supply
- Light duty industrial applications

Industrial applications could be possible for this centrifugal modification. These applications include various media with viscosity and density which permit pumping with rotating centrifugal pumps. Typical applications for the rotating centrifugal modification should be various installations in the industry and in places where special demands for operating safety apply;

- Liquids with a temperature range of -40°F to 450°F, and pressure range of 0 to 500 psi - "Heavy duty" industrial applications
- Liquids with a temperature range of 450°F to 600°F, and pressure range 0 to 500 psi - High Temperature applications
- Liquids with a temperature range of 32°F to 500°F, and pressure range 500 to 1,000 psi - High Pressure applications

Sales Channels

Because of the familiarity with the existing rotating pump, the primary sales channels for the centrifugal modification should be through existing distribution models.

Competition

Any centrifugal pump manufacturer should be considered competition and a target for the rotating centrifugal modification to replace in the field. Because of the total market size of centrifugal pumps, a focus on the replacement market for the rotating centrifugal modification can be reduced to only the threaded pump manufacturers. Based on a confidential internal presentation based on market research, the primary threaded pump manufacturers and their market share is shown in Figure 8.

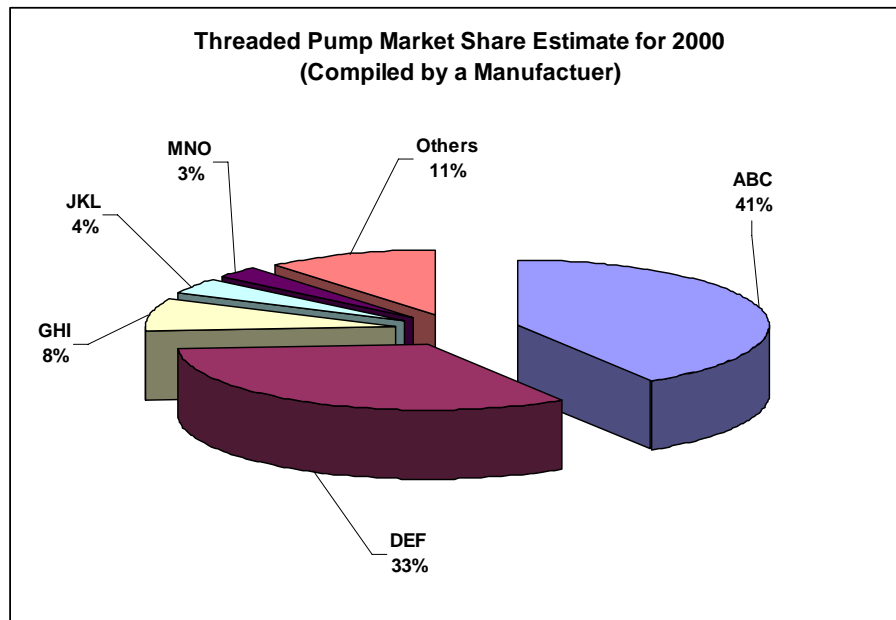


Figure 8 Threaded Pump Market Share Estimate

The primary threaded pump manufacturers are ABC and DEF. Their strength comes in their market awareness and installed base. The other manufacturers have niche market strengths and use price to obtain their growth.

It is expected that the new centrifugal concept based on the rotating pump should “surprise” the market. The primary threaded pump manufacturers could promote that this centrifugal modification is not truly rotating centrifugal pump, that XYZ does not have a full line product portfolio, and that XYZ cannot provide modifications as required by an application. However, it is expected that the competition will have concerns about the value proposition and price of the rotating centrifugal modification to the market, as they may not be able to argue against those benefits of the product. Because ABC has a similar product and market awareness, it could be expected that ABC would consider a similar modification with their rotating centrifugal pump, but most likely not, as it would go head-to-head against their own threaded pump product.

Competitive Advantage

The opportunities that can be promoted into the pump market include;

- Reliability
- Hydraulic Range
- Modifications
- Serviceability

Table 2 below provides a review of the benefit level of the feature (+) or limitation (-).

Table 2 Benefit Comparison

Reliability			
• Feature 1	+	++	++
Hydraulic Range			
• Feature 4	++	++	+
• Feature 5	-	+	++
Other			
• Feature 6	-	++	++
• Feature 7	+	++	++
• Feature 8	-	+++	++
• Feature 9	-	+	++
• Feature 10	+	+	++
• Feature 11	+	+	+
• Feature 12	+	+	+
• Feature 13	+	+++	++

Marketing Mix Strategies

Although further research with end users and sales channel representative is necessary prior to the launch of the centrifugal modification, the following is a discussion of potential marketing mix strategies.

Product Name

It can be speculated that the naming of a product in the pump industry is important to bring consistency and brand awareness to a manufacturer and their products. Most pump manufacturers maintain a series or grouping of pump products with specific naming rules. As the primary components and function of this new product will be nearly identical to the rotating pump, XYZ should consider this new product as modification of the rotating pump. With the assumption of this new product as a rotating pump modification, it should follow the same naming structure and variation designations as the rotating pump.

Pricing Strategies and Position

It is expected that selling prices should be in accordance with internal XYZ reference prices, similar to the rotating pump pricing today. It is expected that additional costs may be required for new components, if required. As mentioned, 50% of the potential is the replacement market. However, if the price for the complete rotating centrifugal

modification is competitive against the threaded pump end only, the product should be even more price competitive if a complete unit is replaced.

A price comparison should be made between the rotating centrifugal modification to possible centrifugal pumps. Data for the comparison should be obtained from existing competitive data and discussions with the sales channel. To simplify the comparison and limit the comparison to the expected market requirements, the comparison should be based on the following limited product scope;

- Rotating pump price for a specific material
- Threaded pump prices with specific material pumps with least expensive mechanical seal, without the coupling, coupling guard, base plate and motor
- Centrifugal pumps based on standard centrifugal pump products selected at the rotating pump nominal performance with other material pump only and mechanical seal, with the coupling, coupling guard, base plate and motor
- Market prices are defined as net sell to sales channel at standard rate

A limited investigation of pricing has been completed by XYZ within the scope described in the previous paragraph. (Note that the information in this investigation has not been made part of this report because of confidentiality.) Based on this investigation, the current price level of the rotating pump compared to the threaded pump product is approximately at an index of about 35-40, especially with the specific material pumps. Compared to standard centrifugal pumps, the rotating pump is much higher. It can be

expected that the market would accept a slightly higher priced pump (compared to a standard centrifugal) if the pump provided additional value. If compared to a threaded pump, the market may accept equal or slightly less pricing as long as the product was perceived to have additional value and robust enough for their market.

It is expected that the conclusion from a more complete pricing index investigation would show that the rotating centrifugal modification should be competitive with a standard threaded pump. However, it may be concluded that the pricing of the rotating centrifugal modification versus a bare centrifugal pump would show that the rotating centrifugal modification may not be competitive, especially at the larger sizes. Being non-competitive is most likely due to at least these factors;

- Materials of construction
- Design

Additional price index comparison should be made when other component costs are obtained later in the development process to compare to complete units with other accessories.

Final price to the market for a complete rotating centrifugal modification with motor should target index 50 compared to a complete threaded product. The expected pricing structure should allow for above average profitability and a price level that is attractive to those shopping prices. The price index level should push the price index above 60 or higher when compared to a complete centrifugal pump. The higher price index should be

expected as the rotating centrifugal modification would be considered a higher quality product.

It is expected that any additional costs required to support this project may be minor.

Primary costs should be in the initial development of the product. The rotating centrifugal modification could be assembled in any location that is currently assembling rotating pump products. Other development costs include;

- Literature
- Training
- Production

Distribution

As this product should be primarily used in various markets, XYZ should be able to react to the availability needs of these markets;

- These markets are located throughout the U.S.
- The need to provide the rotating centrifugal modification may occur as a quick turn around (1-2 day delivery) or as a component on a larger project (3-4 weeks).
- The pump may be required in a quantity as small as 1-2 pieces or in a larger project requiring 10 or more units.

As the rotating centrifugal modification is considered to be used in the North American market primarily, it is recommended that the product is produced in the North American region, but consider South America, Europe, and Asia. To keep the cost as low as

possible, it should be considered that Mexico or China could provide components for final assembly.

To meet the market needs, local company assembly is recommended, including satellite locations.

It can be expected that the current channels of sales for the primary markets can be used. If possible, a stocking program or factory quick-reaction program should be developed to meet expedited delivery requirements of the products.

Promotion

The primary groups that should be target for promoting this product are;

-

Objectives & Targets

The following five-year sales forecast is based on Market Potential and Served Market shown in Table 1 above, and an annual served market growth of 10%. These figures are an initial estimate based on limited information available. It is possible to utilize these figures as a basis for an economics what-if analysis to determine feasibility. Further research must be completed to provide more accurate potential sales figures.

Table 3 Five-year Sales Forecast

Year	1	2	3	4	5
Units	3,500	9,800	12,400	15,000	21,000
Value	\$40,250,000	\$112,700,000	\$142,600,000	\$172,500,000	\$241,500,000
Share of Market	12%	14%	16%	18%	20%

For Table 3 above, the sales values are based on an average sales price of \$11,500.00 per pump.

These values are based on successful launch and implementation of the various activities described previously, and the acceptance of the rotating centrifugal modification in the market. Also, all material versions must be available to achieve these targets.

It is expected that some cannibalism of the standard rotating pump product could occur, but that would be an acceptable risk with the higher market price of the rotating centrifugal modification.

Final Plan

With support from the initial investigation into the development of a new modification to an existing XYZ product, it is recommended that further research and development occur with the rotating centrifugal modification. The Research and Development department and Product Management of XYZ should continue investigation with this new product.

The next steps should be to develop potential designs and manufacture the necessary components to test prototype pumps. New components are to be manufactured. Of these components, the design of a specific component should be of most interest to the scope of the projects, as it is expected that its design should determine if the objective of hydraulic performance similar to the rotating pump can be met.

The new components should help determine the manufacturability of the components and the pump modification. During the design and manufacture of components for the prototype, it may be determined if additional personnel and production resources are required at the assembly locations. The financial resources that will be required for production the assembly locations, in the form of assembly equipment and additional inventory space, may be determined at the time of initial component design also.

Additional research with the market should occur to determine the reaction with rotating centrifugal concept with regards to concerns that may arise.

Possibly one of the most important aspects of the success of this rotating centrifugal modification is the commitment to promote and sell the product from the sales organization. The concept was the idea of sales many years ago through dialog with end users in the market. Sales must remain a champion behind the product for it to become a market success.

Development of a future marketing plan should include the following promotional activities;

- Advertising
- Selling and sales promotions
- Public relations
- Training internal staff and customers

References/Bibliography

American Society for Testing and Materials, 19xx, *Xxxxxxx*, American Society for Testing and Materials

Frost & Sullivan, 2004, North American Centrifugal and Turbine Pump Markets for Process Industries A526-12, Frost & Sullivan

XYZ Corporation, "About Us – Introduction to XYZ". [Online] Available, <http://www.XYZ.com/>, November xx, 20xx

Hydraulic Institute, December 2004, *Annual Pump Shipments, Report #A12* Association Research, Inc., Rockville, Maryland

Hydraulic Institute, December 2004, *Monthly Report of Pump Orders Booked, Report #M10*, Association Research, Inc., Rockville, Maryland

Karassik, I. J., 1990, "And What of the Future?", *Proceedings of the Seventh International Pump Users Symposium*, Turbomachinery Laboratory, Texas A&M University, College Station, Texas, pp. 119-121

U.S. Census Bureau, Manufacturing and Construction Division, August 2005, *Current Industrial Reports - Pumps and Compressors: 2004, MA333P(04)-1*, U.S. Census Bureau, Washington, D.C.,

Glossary

xxxx –

xxxx –

xxx –

xxxx –

xxx –

xxxx –

gpm – gallons per minute – typical measurement of flow with pumps

HVAC – Heating, ventilation, and air conditioning

NPSH – net positive suction head – hydraulic technical term use to describe available liquid to the pump

rpm – revolutions per minute – typical measurement of rotational speed with pumps and electric motors