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NYPRO CHINA MRO SPEND ANALYSIS

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Abstract

In many organizations MRO (maintenance, repair, and operation) spending represents an area of significant cost savings. The primary goal of this project is to analyze the current MRO spending for the Nypro Pan China region and to estimate the potential savings that could be achieved through a more strategic MRO management. This project proposes a potential MRO supplier classification system, MRO vendor reduction model, among other recommendations for Nypro China to implement to achieve their over-arching goal to improve the MRO purchasing process.

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1 Introduction

A tightening economy, rising cost pressures, along with a more technology-enabled and competitive marketplace are forcing companies to look to new areas to achieve cost savings. Nypro China has identified MRO (maintenance, repair, and operating) spending as a potential area that can generate a significant cost savings. However, the current MRO purchasing practice for Nypro China has received little attention from management because it has typically been viewed as a small area for savings. This project suggests that through strategic management MRO operations can generate a significant cost savings across Nypro China.

The goal of this project is to provide potential cost reductions that could be achieved through a more effective management of MRO related suppliers for Nypro China. The objectives of this project were established with the support and guidance of the Nypro China supply chain team. Over the course of seven weeks the project team visited Nypro's facilities in Tianjin (NTJ), Shenzhen (NSZ), Guangzhou (NGZ), and Suzhou (NSU). The project team worked closely with the Nypro China supply chain team in order to confirm data accuracy and request suggestions and feedback about progress.

One of the primary objectives of the project team was to create a master MRO supplier directory for the Nypro China region (NTJ, NSZ, NGZ, and NSU). This directory includes supplier spend and contact information directly from Nypro's MRP system, called BPCS (spend information for FY08 Jul 1st 2007- Jun 30th 2008). The project team used this information to interview the MRO buyers at each facility. During these interviews the supplier directory helped to assure the MRO buyers were providing accurate details about the specific items purchased from each supplier. Interviewing the MRO buyers was a necessary step for our project because it

provided the project team with the information needed about each facility's MRO suppliers to move forward with a supplier classification system.

Another objective was to develop and implement a classification system for all MRO related suppliers. This classification system was designed to be robust enough to include all MRO items, but detailed enough to provide a specific description for each item. The project team used this classification system to provide a comprehensive review of MRO spending across Nypro China for FY08. The team discovered that the MRO spend for Nypro China is a very large amount and that there are many areas for improvements that could generate a significant cost savings.

The classification system along with the master MRO supplier directory also helped the project team to complete another objective – identify and eliminate waste. By combining the spend information with the classification system the project team was able to identify MRO commodities with a high potential for supplier consolidation. Because the one of the goals of the project was to provide the potential cost reductions that could be achieved through improving the MRO buy, identifying and eliminating these wastes is necessary objective to estimating a potential cost reduction.

The project team's final objective was to create a supplier reduction model that can be used to determine an overall rating for each MRO supplier. This rating is based off many supplier evaluation metrics that provide a comprehensive review of supplier capabilities. Using this model Nypro China can determine which suppliers may be consolidated and which suppliers could take a more strategic role in the organization.

It is clear that through a more strategic, and standardized MRO supplier selection and purchasing process Nypro China will be able to leverage its MRO spend across a smaller supply

base to generate better supplier relationships, better supplier performance, and cost savings. Although it is difficult to measure exactly, industry trends show that improvements in MRO operations can result in a ten to fifteen percent reduction in total cost.[1] For Nypro China, MRO spending represents over 40 million dollars annually and this could result in four to six million dollars in potential savings per year (FY08).

It is important to have a clear understanding of the background information that is relevant to this research. The company profile, background, methodology, findings, and overall recommendations are detailed in the following chapters.

2 Company Profile

Nypro Inc. is headquartered in the small New England town of Clinton, Massachusetts and is a leading driver of innovation and quality throughout the plastics industry. Nypro's core businesses deal with varying aspects of the plastics industry– from product design and development through mold building, injection molding and assembly.

During fifty-one years of operation Nypro has established successful long-term relationships throughout the global marketplace serving companies in the following markets: Electronics and Telecommunications, Consumer and Industrial, Packaging, Healthcare, Automotive, and Contract Manufacturing. Some of their customers include Abbot Pharmaceutical, Motorola, and Procter & Gamble.

"Start-to-finish" services allow Nypro to produce quickly while minimizing costs to deliver "reliability, repeatability, and consistency – worldwide." However, it is not only the innovative and efficient operations of Nypro's facilities that have positioned this company for continued growth and success. Nypro has created a network of state of the art facilities that are

[1] (Kemp, MRO Today, 2003)

located throughout the world in most developed and many developing areas. With 52 facilities in 17 countries Nypro is able to meet worldwide standards and tackle the most challenging projects for their customers whenever and wherever needed. One area where Nypro has grown tremendously in the past decade is China. With over nine facilities in China they are well positioned to benefit from the increasing success that China is experiencing in its growth as a nation.

2.1 Nypro Tianjin

Yaguang Nypro Precision Molding (Tianjin) Co.Ltd.is a Sino-American Joint venture established by Nypro Inc. and Zhonghuan Group Co. The company was registered in August 1996 in Tianjin Economic Development Area (TEDA).

Yaguang Nypro is located in the XiQing microelectronic industrial park in Tianjin, which consists of various state-of-the-art technologies such as high precision injection molding, painting, printing, assembly, laser marking, gasket dispensing and etc. Due to the rapid expansion of customer base and market share, another advanced design manufacturing plant was established in 2005 to meet the increasing demands, both in quality and quantity, of existing and new customers.

Yaguang Nypro has earned itself high praise and recognition in the molding and contract manufacturing areas by its technological strength, strict quality standard, sound management system, high caliber employees and most important, customer-oriented corporate culture. It has ranked in the Best 100 Enterprises of TEDA over the past couple of years. This state of the art facility has received authentication by SGS, and ISO9001:2000 and ISO14001 certification. To date, Nypro Tianjin encompasses 30,826 square meters in total, with more than 4,300 employees.

2.2 Nypro Shenzhen

Nypro Shenzhen is backed by Nypro Inc., a company committed to be the best in the world in precision plastic injection molding and other related manufacturing operations. The combination of molding expertise, technology and dedication to success is present in every facet of business at Nypro Shenzhen.

With Nypro Shenzhen as a partner, customers benefit from expertise in thin wall molding, insert molding, bi-component molding, in mold decoration molding, and also traditional injection molding. When more than just molding is needed, Nypro Shenzhen offers an extensive array of precise secondary operations, such as cosmetic painting, decoration, and assembly. In fact, contract manufacturing services are a particular strength of Nypro Shenzhen, with nearly all components receiving at least one secondary operation prior to shipping.

Since opening in 1993, Nypro first plant in China, Nypro Shenzhen has provided injection molding products and services, in partnership with customers, for the consumer/industrial, electronic/telecommunications and healthcare industries.

2.3 Nypro Guangzhou

Nypro Guangzhou Molding Plastics Products Co., Ltd. is an entirely American ventured company belonging to the American parent company. It was acquired by Nypro in 2001, located in Yi Xing Industrial Estate, Donghuan Street, Pan Yu, Guangzhou, and covers 16,000 square meters. The company started with about 120 employees and has grown rapidly since 2001 to include more than 800 employees.

It brought a high level of experience in molding technology, sophisticated decorative solutions and electronics/mechanical assemblies. Some of Nypro Guangzhou's customers include Microsoft, Motorola, Nokia, Johnson & Johnson, Plantronics, and Philips.

Nypro Guangzhou's core capabilities include precision injection molding, bi-component molding, vertical insert molding for plastic parts and components. In-mold decorating and in-mold labeling capabilities provide added proficiency in the molding of decorative windows, lenses and covers for electronics and telecommunications customers.

Nypro Guangzhou has recently expanded production capacity to a second location adjacent to the facility, providing an additional 94,000 sq. ft. This additional capacity will empower Nypro Guangzhou to meet the growing challenges from the global customers in electronics and telecommunications, healthcare products, consumer and industrial devices, as well as in the automotive industries.

2.4 Nypro Suzhou

Nypro Suzhou was established in December 2000, located in the FengQiao Industrial Park, Suzhou New District. Nypro Suzhou is specifically designed to provide contract manufacturing for Nypro's molding and assembly customers and complete plastics solutions for customers in the electronics/telecommunications, consumer/industrial, and automotive industries.

Nypro Suzhou has more than 700 employees and annual of about 20 million U.S. dollars. With a Class 100,000 clean room, and specializing in product assemblies and final pack-out, Nypro Suzhou has earned high praise and recognition from customers for their technological strength, advanced equipment and processes, exacting quality standards, sound management systems and world class team of employees. The company's products are widely used in electronic communication devices (cell phone/laptop case), auto parts, medical equipment and

personal care products (toothbrush, razor handle). Some of their customers include Motorola, Cisco, Sunstar, HTC, and RIM Blackberry.

The company has large plants with a total area of 11,000 square meters, with 4,000 square meters of 100,000 dust-free clean workshop, equipped with advanced production equipment industry, and has achieved product quality and management system certification: ISO9001: 2000, QS9000, TS16949, ISO13845, which reflected the company's production and management processes have reached the advanced world level.

3 Background

Over the past decade organizations have turned towards operations and supply chain management to create a more efficient, effective, and *lean* business. Procurement is an area of operations that is rapidly changing as technology has helped ignite the growth of a more dynamic and globalized marketplace. According to a recent survey from Purchasing Magazine, March 2008, 88 percent of purchasing processionals say that their buy is more strategic today than it was five years ago. Newer and more widespread accessibility to technologies has enabled purchasers to develop methods to process purchase orders, monitor inventories, and mange supplier relationships more effectively. For many organizations procurement is an area full of room for improvement and cost savings.

3.1 The Purchasing Department

Essentially, the mission of the Purchasing Department is to effectively implement strategies for the acquisition of goods and services in a way that provides added value to the

organization.[2] This follows the old adage that the Purchasing Department's role is "to deliver the right material (or service) in the right amount to the right place at the right time and at the right price." [3] The responsibilities of the purchasing manger today have extended far beyond the processing of purchase orders. According to Sollish, "Purchasing mangers today must have the ability to assess and respond effectively to current market conditions and the foresight to envision the future needs of the organization."[4] Purchasing mangers must be able to continuously deal with change and be experts in the latest strategies and best practices throughout the industry.

When it comes to purchasing there are two kinds of spend that make up the entire buy of an organization – direct materials spend and indirect materials spend. The way this spend is categorized and defined can vary across different organizations however, the general concepts are the same. Direct materials spend is typically characterized by the purchasing of goods or services that are value adding and are crucial to the production of the final product. For Nypro China direct materials spend is defined as any spending that is a materials cost. On the other hand indirect materials spend consists of materials that are not integral to the production of the final product.[5] A key component of the indirect spend is on MRO or maintenance, repair and operating supplies. The following section provides a clear definition of what MRO purchasing is and is not.

3.2 MRO Purchasing

MRO (maintenance, repair, and operating) spending is typically an area of purchasing that generates many low-dollar, unplanned buys, and for most organizations it is an area that can

[2] (Sollish, 2005) pg 23
[3] (Sollish, 2005) pg 4
[4] (Sollish, 2005) pg 4
[5] (SAP)

generate significant operational advantages and cost reductions through strategic management.[6] Experts estimate that MRO purchasing averages about 20 percent of the total buy for US manufacturers. Although the MRO spend makes up only a small percentage of the total buy it consists of frequent, small purchases – making up about 80 percent of all purchasing transactions.[7]

3.2.1 Trends in MRO Purchasing

When it comes to purchasing the traditional best practice is to make purchasing decisions primarily based on price, however organizations need to break this traditional way of thinking and approach purchasing with a strategic plan. As many industries are becoming e-commerce enabled the MRO purchasing operations is slowly becoming electronic. Using procurement management companies can upload their suppliers into an "electronic catalog" and better monitor the suppliers they select.[8] As the overriding trend in MRO purchasing is to elevate its importance and try to align the MRO purchasing process with that of direct materials in order to generate a cost savings, many organizations are investigating supplier relationship management (SRM).

3.3 Supplier Relationship Management (SRM)

Supplier relationship management comes into play when a supply chain recognizes the benefits that can be achieved through strategic sourcing. According to the APICS Dictionary, 11th edition strategic sourcing is defined as "The development and management of supplier relationships to acquire goods and services in a way that aids in achieving the immediate needs

[6] (Kemp, MRO Today, 2004)
[7] (Kemp, MRO Today, 2004)
[8] (Arabe, 2001)

of a business." If organizations focus on developing their suppliers and creating a strategic sourcing policy this represents a significant opportunity for improving the MRO purchasing process and generating savings. Across the industry there are many sources that can be analyzed to better understand and determine the best methodology for implementing a plan for SRM. One comprehensive source is from APICS, the Association for Operations Management. From the APICS Certified Supply Chain Professional Learning system, Module three, Managing Customer and Supplier Relationships, there is a complete overview of SRM principles and best practices for implementing these strategies throughout the organization.

3.4 Negotiation in China

Since the scope of our research involves doing business outside of the United States it is fitting to provide an overview to the way negotiation is viewed and carried out in China. There are many technicalities to the way business in China is conducted and without a clear understanding of these details your business may be seriously hindered. When it comes to MRO purchasing at Nypro China the buyers are responsible for confirming the price for the purchase order with the suppliers. This may require negotiating a price, quantity, delivery, or even technical specification. According to Ashley Tang, an MRO buyer at Nypro Tianjin, the majority of their MRO buy is done locally because it makes delivery easier and many of their suppliers actually need to be nearby to provide services to the plant. Therefore, it is vital to make sure that these buyers are well trained to interact professionally with the local Chinese to avoid being deceived or damaging a potential relationship.

The Chinese people view negotiation much differently than most business people from the United States. While negotiation in the US may be *strictly business* and can be fairly quick and impersonal the Chinese want to get acquainted before they do business. Instead of rushing

into negotiations the Chinese seek to "soften their visitors up" by extending their hospitality and appreciation of the finer things in life, such as eating and drinking.[9] For many foreign negotiators who come to China this formal introduction phase of negotiating can be frustrating because it is time consuming. One technique commonly used by Chinese negotiators is to use go-slow techniques in order to get impatient adversaries to give away more than they planned.[10] An ideal approach to speeding up this part of negotiation is to arrive with introductions from one or two people who are known and respected by as many Chinese people as possible.[11]

Chinese negotiation is characterized by two distinct phases – *the technical phase* and *the commercial phase.* These two phases typically involve two separate negotiation teams; one team is specialized in understanding the technical information and the other team specializes in price negotiation.

Despite claiming to negotiate on the principle of equality and mutual benefit the Chinese can be very blunt while negotiating. Oftentimes holding back on information and pointing out what may be fair to the foreigner has nothing to do with the circumstances in China.[12]

The technical phase will come first in the negotiation process and it is generally the most drawn-out and detailed. It is important for foreigners to understand how the Chinese view introducing new technologies to avoid revealing too much information. During these presentations the Chinese expect all of the technical information to be shared with them, without necessarily giving anything in return.[13] After the "*jishu jiaoliu"* or "technical transfer," if the Chinese side decides to make a deal the negotiation will shift to the commercial phase.

[9] (Mente, 1994) pg 110
[10] (Mente, 1994) pg. 120
[11] (Mente, 1994) pg. 112
[12] (Mente, 1994) pg. 111
[13] (Mente, 1994) pg. 114

During this phase price negotiators who are especially good at beating the other side down on cost and other factors will come in to make a deal.[14] According to De Mente, the Chinese attitude is that foreign companies have a lot while they have nothing or only a little – the more they can get from the foreign company, the fairer it is for them and for China. "They see each encounter with a foreign group of technology experts as a valuable learning process, regardless of whether or not the meeting results in a business deal."[15]

For all of these reasons it is crucial for foreign business people who participate in technical presentations in China to know exactly where to draw the line when preparing presentations to avoid revealing too much knowledge for free.

All in all, there are two keys to successful negotiations with Chinese business people – patience and preparation. Patience coupled with proper etiquette and respect for Chinese customs will merit respect in return for the foreign negotiator. Also to avoid being taken advantage or offending the Chinese it is important to prepare enough for your negotiation to understand some of the basics differences among Chinese negotiations.[16]

4 Methodology

In order to improve the MRO purchasing process there are many steps that need to be taken. The project team pioneered the MRO purchasing analysis for Nypro China. The team's methodology was established based off industry best practices, suggestions from the Nypro China supply chain team, and the original thinking of the team. An overview of the team's methodology is presented in Figure 1: Methodology Overview.

[14] (Mente, 1994) pg. 114
[15] (Mente, 1994) pg. 115
[16] (Mente, 1994) pg. 117

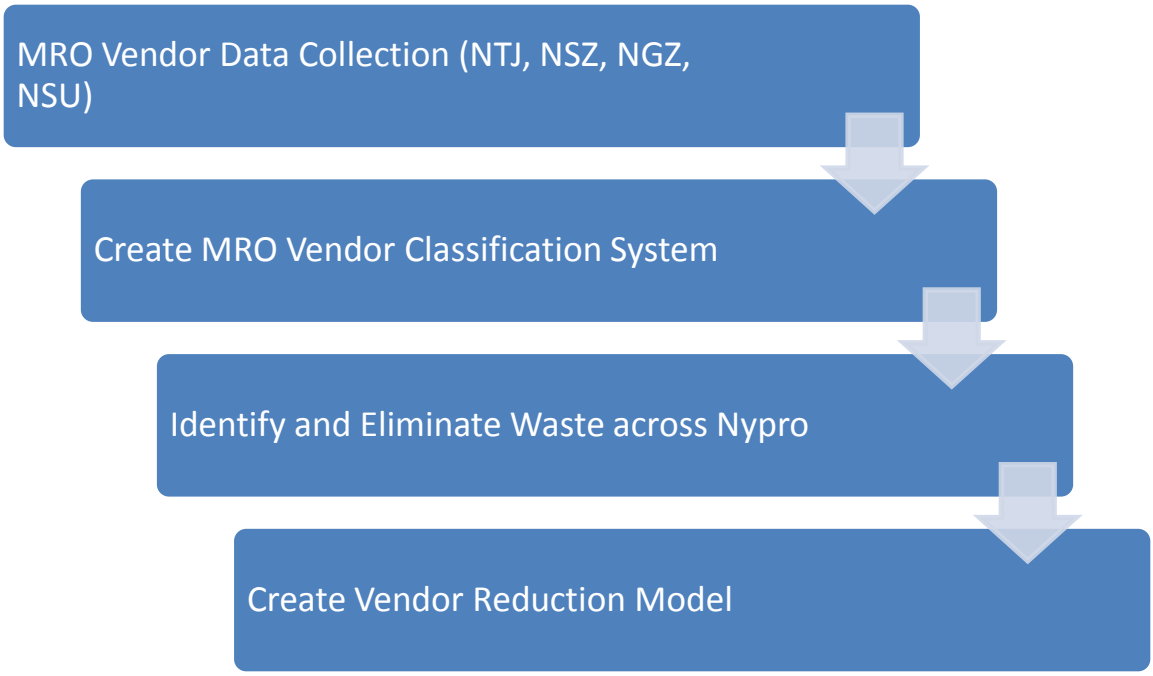

Figure 1: Methodology Overview

4.1 MRO Vendor Data Collection

The most challenging and time consuming part of completing an MRO spend analysis for was centralizing and collecting information about all of the MRO related vendors for Nypro China. However, as Dr. Robert Kemp from MRO Today suggests getting the enterprise-wide information about each vendor is a necessary first step to improving the MRO buying process.[17]

4.1.1 BPCS System Information

The first information that the project team collected included the vendor identification number and vendor name of all of the MRO related suppliers for each of the four Nypro China facilities. With the help of the Nypro China supply chain team the team received reports from the BPCS system detailing all of the indirect (MRO) related vendors for each facility. The

[17] (Kemp, MRO Today, 2004)

information included the vendor number and vendor name for every indirect vendor that has ever been used at the four Nypro facilities.

In order to supplement this basic information the project team also collected all of the contact information available for every MRO related vendor from the BPCS system reports. This contact information includes vendor addresses, contact names, telephone numbers, and fax numbers. This information is valuable; 1) Because it could be used to identify vendors that may be repeated in the system under different names; 2) Because it could be used to contact vendors when moving forward with supplier evaluation.

However, there were some difficulties compiling the contact information. First, the project team discovered that this information may not be complete. For example some vendors only have partial contact information (address available but no contact name, telephone or fax numbers) and some vendors don't have any contact information at all. Secondly, the team notes that some of this information may be outdated or inaccurate because supplier information is not frequently updated in the BPCS system.

The last report the team collected from the BPCS system provided the spend details for the MRO vendors at each of the Nypro China facilities. This spend information was taken during fiscal year 2008, FY08 (July 1st 2007- June 31st 2008). Because the total spend for each vendor was not given directly from the spend report the project team calculated the total spend summing all of the purchase orders for each vendor. Using this method the team also counted the total number of purchase orders used for each vendor during FY08.

The project team's next step was to combine all of the information from these separate reports into a master MRO vendor directory for all of Nypro China. The team managed this directory using a Microsoft Excel worksheet. This directory is one of the major accomplishments

of the project team because it combines information that was scattered in several different reports into one centralized, comprehensive directory. This directory is also a resource that the project team used in order to facilitate interviews with MRO buyers.

4.1.2 MRO Buyer Interviews

Once the project team created the MRO supplier directory the team still needed more information about the MRO vendors in order to create an accurate MRO classification system and to complete the other project objectives.

To get more information about the vendors the project team interviewed buyers from NTJ, NSZ, and NGZ about the specific items purchased from each MRO related vendor. This is where the information from the centralized MRO vendor directory was most useful. Using Microsoft Excel's auto filter feature it was easy to filter the vendors to quickly find vendors during the interviewing process.

The project team's process for interviewing buyers was simple and effective. Because the scope of the project only allowed for about one week at NTJ, NSZ, and NGZ the team needed to be effective with time management. In order to save time the project team conducted group interviews rather than individual interviews. During the interviewing process the project team presented the vendor number, vendor name, contact information, and spend information from FY08 for the all of the MRO related vendors used at the facility under investigation. Then, using this information, the buyers would talk openly among themselves, other members of the Nypro China supply chain team (when available), and our team members to determine the best item description for each of the vendors.

In order to check the accuracy of descriptions and help ensure the quality of the information of the buyers the project team also presented additional details about the vendors.

For each vendor we presented the BPCS report of the specific items that were purchased from the vendor in question during FY08. If the buyer was unable to provide an accurate description for the supplier using this information the team called specific departments for more information or consulted the details of prior purchasing requisitions until the supplier description was determined.

Despite the project team's concerted effort to obtain the most accurate data possible there may be some errors in the vendor descriptions. Because of the limited time at each facility the project teams was unable to meet with representatives from related technical departments to confirm the accuracy of the MRO buyers information. The project team's major concern is that the buyers may not have provided best description of the suppliers because they may lack technical training.

Another concern that affects the quality of the descriptions is the accuracy of Chinese to English interpretations. Because many of the item descriptions were only described in Chinese and the MRO buyers in some cases did not speak English very well there may be some errors in these descriptions due to translation errors. Despite these potential areas for error the project team is confident that these descriptions provide an accurate starting point for further investigation into understanding and improving the MRO buy.

Due to time limitations the project team was unable to visit the NSU facility for long enough to complete the descriptions for NSU's vendors. However, the project team suggests that a similar methodology is followed in order to complete the missing information.

4.2 MRO Classification System

Once our team finished interviewing the buyers from each Nypro facility we created our MRO classification system. Creating the MRO classification system was challenging because

there is no standardized methodology for classifying MRO vendors and MRO vendors provide a large range of items and services. The project team worked closely with the Nypro China supply chain team to make sure that the proposed classification system is valuable for Nypro China's operation. In order to determine accurate classifications the project team toured the Nypro facilities and noted MRO items in operation. The project team also solicited feedback and suggestions from the Nypro China supply chain team throughout the course of the project.

The design and details of this classification system are discussed later in Findings One – MRO Classification System.

4.3 Identify and Eliminate Waste

In order to identify waste in the MRO operation the project team used the MRO classification system to help compile a comprehensive MRO spend analysis. Using the MRO classification system the project team identified spend by commodities and sub-commodities. This allowed the project team to identify commodities that have the best opportunity for potential cost savings. Dr. Kemp, MRO consultant from MRO Today, proposes a similar methodology for identifying waste in his article "*Improving the MRO Buy*." [18] After reviewing the spend analysis the team identified three major kinds of waste – *vendor redundancy*, *high quantities of purchase orders*, and *low-volume vendors*. These three wastes are explained in detail in Findings Two – Waste Identification and Elimination.

4.4 Vendor Reduction Model

The final objective of the project team was to develop a vendor reduction model. This model was created to help standardized the supplier evaluation process and is a useful tool for

[18] (Kemp, MRO Today, 2004)

improving the efficiency of the supply chain. As Sherry Gordon, Vice President of Supplier Performance Intelligence, states "measuring the performance of suppliers is vital to ensuring a well-functioning supply chain."[19]

The vendor reduction model suggested by the project team is designed to be easy to implement and can be used as a starting point for identifying key suppliers for Nypro China. The details of the proposed vendor reduction model are documented in Findings Three – MRO Supplier Evaluation Model.

5 Findings One – MRO Classification System

One of the primary objectives of the project team was to create an MRO supplier classification system for Nypro China. This system was designed and implemented using industrial engineering concepts to satisfy the design capstone graduation requirement for WPI industrial engineering students. The following sections document the proposed classification system in details.

5.1 Constraints

Creating an MRO classification system was not an easy task for the project team. As the first team to develop MRO classifications for Nypro China there was limited prior information to use as starting point. Therefore, the project team worked closely with the Nypro China supply chain team to define the constraints of the system. It was important for the project team to work closely with Nypro in order to create a result that is easy to deploy and valuable to the Nypro China Operation.

[19] (Gordon, 2006)

The first constraint identified by the project team was that the final MRO classification system must be very clear and easily understood by all users. It was critical that the design of the system is complex enough to satisfy the other constraints of the system, but simple, effective, and easy to implement. This system was designed to be intuitive so users can quickly and accurately identify which suppliers provide specific items.

The second constraint identified by the project team was that the classification system must be robust enough to classify every MRO supplier at each Nypro China facility. Nypro's need for an MRO supplier classification system was inspired from a lack of MRO knowledge across the operation. The project team's classification system was created to better understand the range of MRO items purchased across Nypro China and to determine what suppliers are providing these items. For these reasons, it was a critical constraint of the project team to ensure that every MRO supplier can be identified in the proposed MRO classification system.

The third constraint of the project team's classification system is that system must include detailed vendor descriptions without any overlaps across classifications. It is important to ensure that every supplier is accurately described in the system and that each supplier classification is detailed enough so that it cannot be confused with other classifications.

5.2 Design

The classification system that the project team designed for Nypro China is the first of its kind and was created based off information collected during the project. In order to organize the suppliers into specific classifications the project team started with a broad, preliminary classification. The preliminary classifications established a starting point for refining the system and determining accurate MRO classifications.

After analyzing the preliminary classifications it was clear a three-level classification system should be used for MRO classification. This structure works best for MRO vendors because it is robust enough to include the entire range of vendors, but detailed enough to give specific vendor descriptions. The project team worked with the Nypro China supply chain team to define the three levels of the classification system.

The first level is a commodity grouping. This is the most basic grouping, but it is one of the most important levels because these groupings represent the major areas of MRO spending. The six level one classifications are *Equipment and Spare Parts, Supporting Goods, Maintenance/Service, Chemicals, Gases, Oils, Lubricants, Direct Material Suppliers,* and *Other.* The Direct Materials Suppliers and Other classifications are special classifications that will be explained in detail later in this chapter.

The second level of the project team's proposed MRO classification system is a sub-commodity or department grouping. This is the best grouping for level two because the majority of the vendors that are used throughout Nypro China are used by only specific departments or the items that they provide fall into distinct sub-commodities. There are 30 level two classifications in the proposed MRO classification system; these classifications are defined in Appendix A: MRO Classification Definitions.

The third level of the proposed MRO classification system is the supplier's specific item details. This is the most detailed level of the classification system. This level is designed to clearly distinguish exactly what the vendor is providing to Nypro. There are 165 level three classifications.

An overview of all three levels of the proposed MRO classification system is shown in Appendix B: MRO Classification Guide.

5.2.1 Classification Overlaps and Keyword

During the classification process the project team discovered that there was overlap across some of the three levels of the classification system. Figure 2: Level One Classifications shows the six level-one classifications and Figure 3: Classification System Overlap shows the four areas of overlap.

Level One Classification
Equipment and Spare Parts
Supporting Goods
Chemicals, Gases, Oils, Lubricants
Maintenance/Service
Direct Material Suppliers
OTHER

Figure 2: Level One Classifications

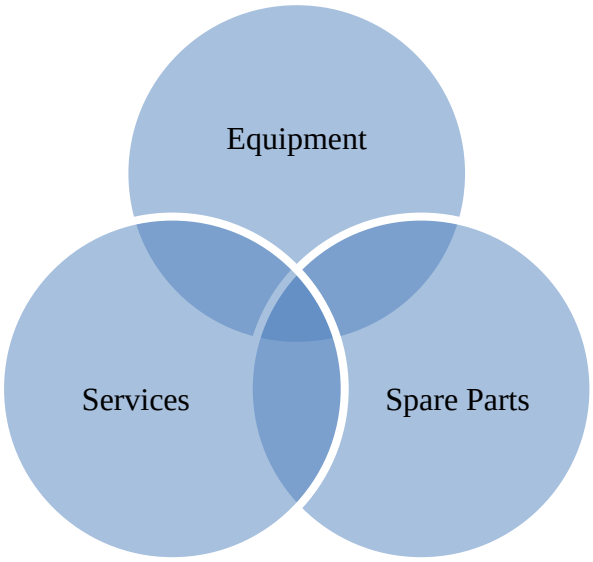

Figure 3: Classification System Overlap

The project team solved this overlap issue by creating an additional keyword description. The keyword gives more details about what the supplier is providing without adding any additional levels to the classification system. For example, consider a supplier who provides only spare parts for a molding robot. Using the proposed three-level system with the keyword the supplier would be classified as shown in Figure 4: Classification Example.

Level 1	Level 2	Level 3	Keyword
Equipment and Spare Parts	Molding	Molding Robots (Pick-up Robots)	spare

Figure 4: Classification Example

In order to implement the keyword all suppliers with level 1 classification “Equipment and Spare Parts” or “Maintenance/Service” are given a keyword description. The keyword identifies if that supplier is providing *just* equipment, *just* spare parts, *just* a service, or some *combination* of the three without complicating the level 1, level 2, or level 3 classifications. Figure 5: Classification Screenshot shows a screenshot from the project team’s MRO supplier directory to highlight how the keyword is used.

Vendor Name	Level 1	Level 2	Level 3	Keyword
威猛工业自动化系统（上海）有	Equipment and Spare Parts	Molding	Molding Robots (Pick-up Robots)	equip
龙致（中国）有限公司	Equipment and Spare Parts	Molding	Molding Robots (Pick-up Robots)	equip
深圳市龙岗区平湖镇先基制造厂	Equipment and Spare Parts	Molding	Molding Robots (Pick-up Robots)	spare
星塔机械(深圳)有限公司	Equipment and Spare Parts	Molding	Molding Robots (Pick-up Robots)	spare
深圳市龙岗区横岗锐格模具厂	Equipment and Spare Parts	Molding	Molding Robots (Pick-up Robots)	spare
东莞艾尔发自动化机械有限公司	Equipment and Spare Parts	Molding	Molding Robots (Pick-up Robots)	equip and spare
FERROMATIK MILACRON	Equipment and Spare Parts	Molding	Molding Robots (Pick-up Robots)	equip and spare
深圳市宝安区公明快精通五金商	Equipment and Spare Parts	Molding	Molding Robots (Pick-up Robots)	spare
米拉克龙贸易（上海）有限公司	Equipment and Spare Parts	Molding	Molding Robots (Pick-up Robots)	spare
基恩士国际贸易（上海）有限公	Equipment and Spare Parts	Molding	Molding Robots (Pick-up Robots)	spare
东莞凤岗嘉模五金机械商行	Equipment and Spare Parts	Molding	Molding Robots (Pick-up Robots)	equip and spare
深圳市威远精密技术有限公司	Equipment and Spare Parts	Molding	Molding Robots (Pick-up Robots)	spare
威猛工业自动化系统（上海）有	Equipment and Spare Parts	Molding	Molding Robots (Pick-up Robots)	equip
史陶比尔（杭州）精密机械电子	Equipment and Spare Parts	Molding	Molding Robots (Pick-up Robots)	equip and spare
WITTMANN ROBOT (SHANGHAI) CO.,	Equipment and Spare Parts	Molding	Molding Robots (Pick-up Robots)	equip and spare
穆格控制系统(上海)有限公	Equipment and Spare Parts	Molding	Molding Robots (Pick-up Robots)	spare
天津丹纳赫传动有限公司	Equipment and Spare Parts	Molding	Molding Robots (Pick-up Robots)	spare
上海精锐广用动力科技有限公司	Equipment and Spare Parts	Molding	Molding Robots (Pick-up Robots)	spare
广州永邦机电科技有限公司	Equipment and Spare Parts	Molding	Molding Robots (Pick-up Robots)	equip and spare
GHS AUTOMATION AG	Equipment and Spare Parts	Molding	Molding Robots (Pick-up Robots)	equip and spare
史陶比尔（杭州）精密机械电子	Equipment and Spare Parts	Molding	Molding Robots (Pick-up Robots)	equip

Figure 5: Classification Screenshot

5.2.2 Direct Materials Suppliers Classification

The level one classification “Direct Materials Suppliers” is a special classification because direct materials suppliers are typically not included in the MRO spend. However, during the classification process the project team noted that there are many suppliers that are predominately direct materials suppliers that *are* included in the MRO spend. According to the Nypro China supply chain team these direct material suppliers are included in the MRO spend because they were used to purchase direct materials samples. Direct materials samples are purchased for testing and trial purposes when evaluating new vendors or new product

specifications. These samples are not included in the direct materials spend because they are not considered a materials cost, instead Nypro views them as an additional or special spending cost that is part of MRO. The project team created the separate classification called “Direct Materials Suppliers” so that it is easy distinguish this spending from the rest of the MRO spending.

5.2.3 Other Classification

The level one classification “Other” was created to classify suppliers that have a special relationship with Nypro. This classification deals with two different kinds of special supplier relationships.

First, some Nypro facilities create a vendor in the BPCS system that is used only to make small one-time purchases or to request product samples. Thus, instead of adding a new vendor to the system every time a one-time buy is placed facilities can use this vendor. For example, Nypro Tianjin maintains a vendor in their BPCS system called “NTJ OTHER VENDOR” that is used for these reasons.

Secondly, suppliers that are a Nypro facility or subsidiary of Nypro are included in this classification. This includes Nypro Tool facilities and major Nypro facilities such as Nypro Tianjin, Nypro Suzhou, or Nypro Shenzhen.

5.3 Implementation

Using this classification system the project team successfully classified 822 MRO related suppliers for Nypro Shenzhen, Nypro Tianjin, and Nypro Guangzhou. The complete directory of MRO related vendors for Nypro China includes the classification information centralized in a Microsoft Excel worksheet. Using pivot tables and the auto filtering feature of Microsoft Excel it is easy to find suppliers and calculate spend reports by classifications. Unfortunately, the project

team was unable to create classifications for NSU's vendors due to the limited time spent at the NSU facility. However, Nypro can use the same methodology as the project team to complete these classifications. The initial impressions of the project team's MRO classification system from the Nypro China supply chain suggests that it is a very good system that establishes a great starting point for future investigation of the MRO operation of Nypro China.

6 Findings Two – Waste Identification and Elimination

One of the primary goals of the project team was to identify and suggest ways to eliminate waste in the MRO operation of Nypro China. After collecting information about Nypro's MRO operation and creating a vendor classification system the project team was able identify three major areas of waste – *vendor redundancy, high quantity of purchase orders,* and *low-volume vendors.*

6.1 Vendor Redundancy

The project team identified that there are many vendors in the BPCS system that are repeated at the same facility or across the Nypro China region. Vendors are repeated in the BPCS system because there is a lack of communication across facilities and each facility is allowed to create their own unique vendor identification. It is important to identify and correct these problems because they represent incomplete and inaccurate information in the BPCS system. This information may also be used to leverage the MRO buying power of the region.

6.1.1 Identify

The project team identified 77 different instances of vendors that are repeated in the BPCS system. Identifying the vendors that were repeated across all of the Nypro China facilities

was not an easy task. Because each facility creates their own unique identification for vendors the same vendor may be entered into the system under multiple different vendor names and/or vendor numbers. Therefore, it is impossible to identify the same vendors across multiple facilities by comparing just vendor numbers or vendor names.

The project team used many features of Microsoft Excel including pivot tables, auto filter, and vlookup to compare the vendor numbers, vendor names, and contact information of all of the MRO related vendors to identify redundant vendors. By comparing all of this information the project team could successfully identify common vendors. After completing this analysis of all the MRO vendors the project team identified four major kinds of vendor repetition.

The most common kind of repetition that the project team identified is when the same vendor is entered into the BPCS system with different vendor numbers across multiple facilities. The project team identified 41 of these redundancies across Nypro China. An example of these vendors is shown in Figure 6: Redundancy One below and the complete list of these redundant vendors is documented in Appendix C: Redundancy One

Same Name Different Vendor Numbers Across Nypro China

Seq. Number	Vendor Name	NGZ	NSU	NSZ	NTJ
		Values Represent Vendor Numbers			
1	亚光耐普罗精密注塑（天津）有	50062		20046	
2	耐普罗机械（苏州）有限公司		40395	70240	30455
3	ITW TRANS TECH			10156	30008

Figure 6: Redundancy One

The next kind of vendor redundancy that the project team identified is when the vendor has the same name but multiple vendor numbers for the same Nypro facility. The project team identified 20 of these redundancies across Nypro China. An example of these vendors is shown in Figure 7: Redundancy Two below and the complete list of these vendors is documented in Appendix C: Redundancy Two

Same Name, Multiple Vendor Numbers at Same Facility

Seq. Number	Vendor Name	NGZ	NSU	NSZ	NTJ
		Values Represent Vendor Numbers			
1	AKZO NOBEL COATING (JIAXING) C		73086/70657		
2	阿克苏诺贝尔涂料（东莞）有限	70306/70571			
3	东莞市佳鼎贸易有限公司		70286/70281		

Figure 7: Redundancy Two

The third kind of vendor redundancy that the project team identified is when there is a different vendor name and a different vendor number for the same vendor within the same Nypro facility. All in all, the project team identified 11 of these redundancies. An example of these vendors is shown below in Figure 8: Redundancy Three and the complete list of these vendors is documented in Appendix C: Redundancy Three

Different Name and Different Vendor Number at Same Facility

Seq. Number	Vendor Name	NGZ	NSU	NSZ	NTJ
		Values Represent Vendor Numbers			
1	米拉克龙贸易(上海）有限公	71778			
	FERROMATIK MILACRON MASCHINENB	72613			
2	深圳市龙岗区布吉镇宝升综合商			71251	
	阿特拉斯科普柯(上海)贸易			71995	
3	深圳市宝安区松岗丰裕喷涂设备			71886	
	东莞市黄江广聚模具配件店			73388	

Figure 8: Redundancy Three

The last kind of redundancy identified by the project team is when there is a vendor with a different name and a different vendor number across the Nypro China facilities. The project team identified 5 of these repetitions. An example of these repeated vendors is shown below in Figure 9: Redundancy Four and the complete list of these vendors is documented in Appendix Four: Redundancy Four.

Different Name and Vendor Number Across Nypro China

Seq. Number	Vendor Name	NGZ	NSU	NSZ	NTJ
		Values Represent Vendor Numbers			
1	Dell computer (china) Co., Ltd		70223		
	DELL计算机（中国）有限公司				30080
	戴尔（中国）有限公司			20085	
	戴尔计算机（中国）有限公司	50019			

Figure 9: Redundancy Four

6.1.2 Recommendation

The project team's recommendations for eliminating all of the vendor redundancy waste are relatively straightforward and simple to implement. First, the project team recommends that all of the identified vendor redundancies are corrected in the BPCS system. This will make sure that information that currently exists in the BPCS system is accurate and up to date.

Secondly, in order to prevent the creation of more repetitions in the BPCS system the project team recommends that a standardized new vendor adoption process is established for the Nypro China region. The flowchart of this process is shown in Figure 10: Proposed New Vendor Adoption Process.

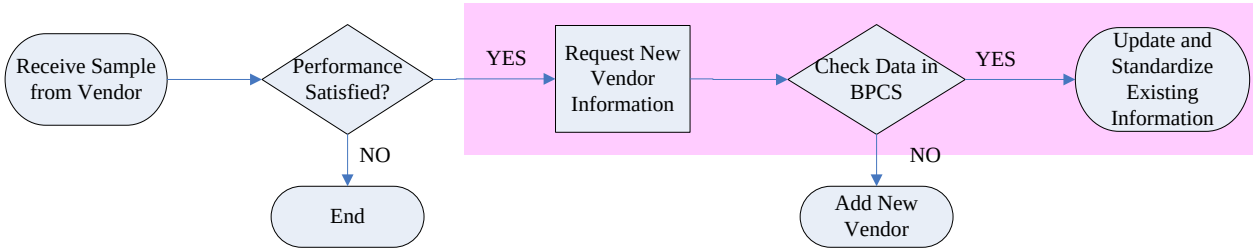

Figure 10: Proposed New Vendor Adoption Process

The processes that are highlighted in light pink will eliminate the creation of vendor redundancies. The project team suggests that once the decision to add a vendor to the BPCS system is made more information is collected about the vendor and this information is checked in the BPCS system. The project team recommends that the Nypro China region updates their

current new vendor adoption form to include all current contact information *AND* prior company names and addresses. This additional information can be used to perform a search in the BPCS system to see if the vendor already exists under a different identification. If the search is not successful then the chances of that vendor existing in the BPCS system is unlikely. However, if the vendor is found then a standardized vendor identification can be created. This process also identifies vendors that are common across multiple facilities and could be considered for a strategic relationship.

6.1.3 Value

Through implementation of these recommendations Nypro China will benefit in several ways. Implementation of a standardized process for adding new vendors to the BPCS system will benefit Nypro China because vendor repetitions will no longer be created in the BPCS system. Adoption of this process creates a standardized vendor identification across the Nypro China region. The benefits of standardized vendor identification are two-fold:

First, standardized vendor information allows for better communication and shared knowledge across facilities. This creates a shift towards a more strategic purchasing process that is done at the regional level, rather than the plant level.

Secondly, the adoption of this process helps to identify vendors that are used at multiple facilities and could be potential strategic vendors. Through supplier negotiation techniques, quantity discounts, long-term relationships and other strategic relationships may be established with vendors that are common across multiple facilities to achieve a cost-savings.

6.1.4 Limitations

It is important to explain the limitations that the project team experienced during the identification of vendor redundancy waste. Because the project team was unable to collect contact information for all of the MRO vendors at each facility there may be more unidentified redundancies in the BPCS system. However, using the same methodology as the project team the Nypro China supply chain team can update the missing vendor information and search for any additional redundancies.

6.2 High Quantity of Purchase Orders

The second kind of waste identified by the project team is a high quantity of purchase orders during FY08. The project team identified that Nypro is processing a very high quantity of purchase orders with some vendors. For example, during FY08 Nypro Tianjin processed more than 457 purchase order with one vendor! This accounts for more than two purchase orders every working day. In order to make this problem clear the project team considered two assumptions: Nypro is processing too many purchase orders and that there is a better purchasing method to process less purchase orders.

6.2.1 Identify

In order to calculate the number of purchase orders for each vendor the project team used the pivot table feature of Microsoft Excel to count *each* unique purchase order number from *each* vendor during FY08. After this analysis the project team discovered that Nypro China processed 11,162 purchase orders during FY08. The top three vendors with the highest quantity of purchase orders processed for each facility during FY08 are shown in Figure 11: Purchase Order Quantity.

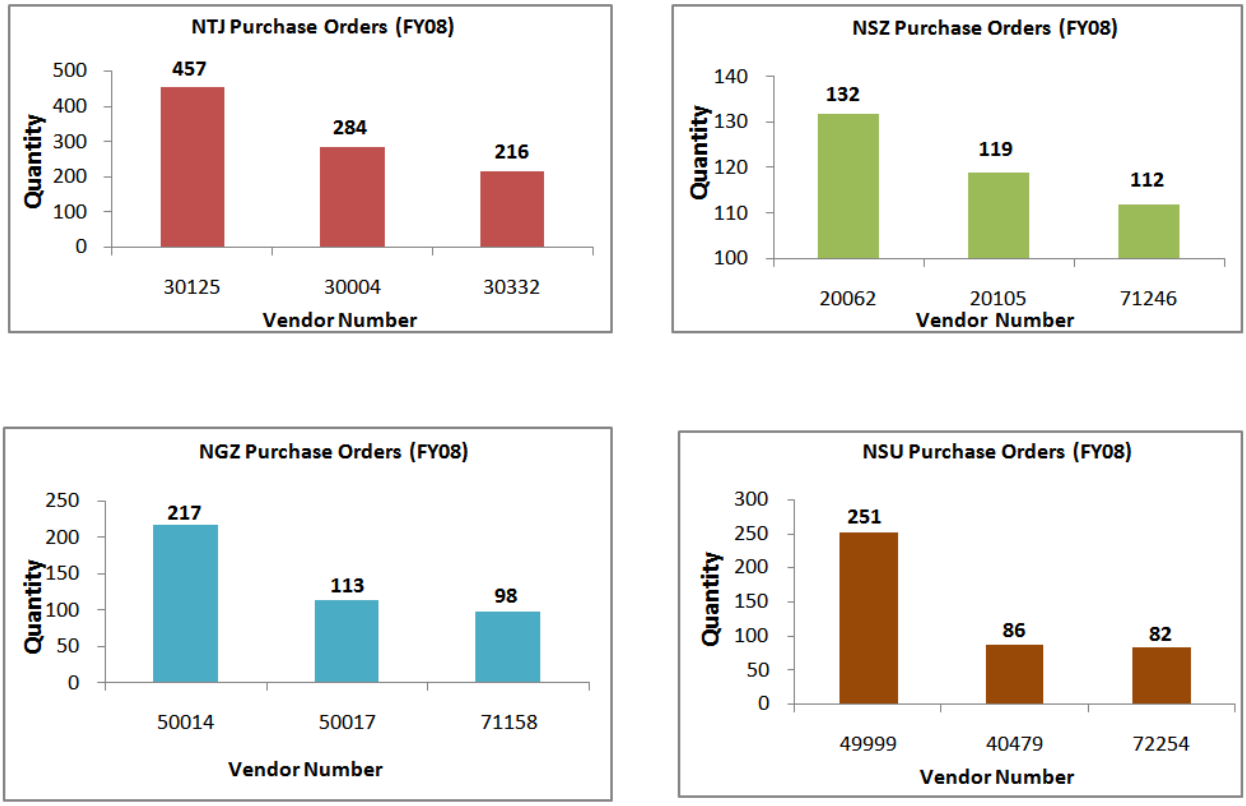

Figure 11: Purchase Order Quantity

Figure 11: Purchase Order Quantity shows, that there are a lot of purchase orders being processed with individual vendors at each facility in the Nypro China region. The project team suggests that there is potential to reduce the quantity of purchase orders that take place with vendors at each facility in the Nypro China region. In order to identify what kinds of suppliers are generating the highest quantity of purchase orders the project team also calculated the total quantity of purchase orders processed for each level one classification. The project team discovered that the level one classifications "Equipment and Spare Parts" and "Supporting Goods" produced the greatest quantity of purchase orders during FY08. Figure 12: Level One PO Quantities shows the number of purchase orders processed by level one classification at NSZ, NTJ, NGZ, and the three facilities combined. These figures are also shown in Appendix D:

Purchase Order Quantity A complete analysis of the quantity of purchase orders processed for all classifications is included in Purchase Order Quantity Report.xls.

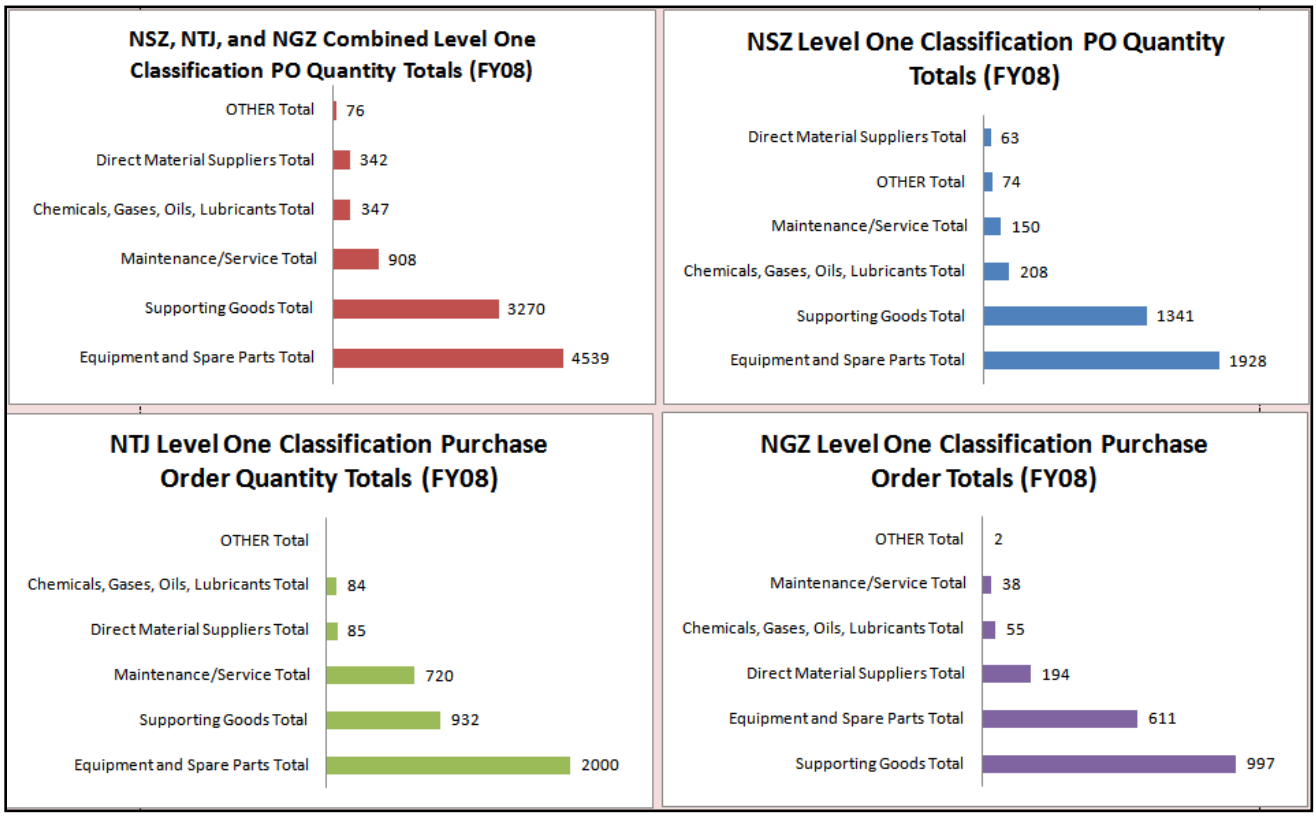

Figure 12: Level One PO Quantities

The problem with processing so many purchase orders is that it is a time consuming process that represents a large amount of non-value adding activity. The project team was able to estimate that in Nypro China it takes about two hours to process one purchase order. Therefore, if Nypro can reduce the quantity of purchase orders processed it will result in a significant time savings, where Nypro employees can focus on strategic planning or value adding activities.

6.2.2 Recommendation

The project team recommends that Nypro investigates the feasibility of implementing the use of blanket purchase orders with suppliers that they frequently process purchase orders with. The purpose of implementing the use of blanket purchase orders is to increase the efficiency and

productivity of the purchasing process. A blanket purchase order is typically used for items or services that are used repeatedly and is effective for a fixed period of time. Using a blanket purchase order makes managing relationships with suppliers with a high quantity of purchase orders easier because it consolidates multiple purchase orders on one blanket purchase order.

There are several steps in order to successfully implement the use of blanket purchase orders. The first step that the project team recommends is that the Nypro China supply chain team determines what commodities are most suitable and have the best chance of success for implementing the use of blanket purchase orders. It is an industry best practice that blanket purchase orders work best to improve the purchasing process of repeatedly purchased low-value items.[20] For Nypro China this could represent items that are bought within the "Supporting Goods" MRO classification.

Secondly, the project team suggests that prior purchasing data is used to forecast the demand for MRO items. This information can then be used to determine the time period for establishing the blanket purchase order. This information could also be shared with suppliers to establish better performance and to help builder a better relationship.

The next step in order to effectively implement a blanket purchase order strategy is to determine which suppliers are willing to establish blanket purchase order relationships. Maintaining a blanket purchase order is not an easy job for some vendors and this kind of relationship requires a sophisticated and qualified supplier. The proposed vendor reduction model discussed in Findings Three – MRO Supplier Evaluation Model could be used to help qualify suppliers for blanket purchase order use.

The last step to implementing an effective blanket purchase order strategy is to negotiate terms with vendors. The Negotiation in China section of this report explains in details some best

[20] (Carter, 2002)

practices for negotiating in China. It is important to negotiate with suppliers because it will help ensure that the goals and objectives of the partnership are clearly defined to both parties and the best deal is made.[21]

6.2.3 Value

Implementing a strategy that effectively utilizes blanket purchase orders across Nypro China could significantly decrease the amount of time and money that is spent processing purchase orders. Although it is difficult to quantify how much time would be saved for each blanket purchase order that is implemented it is clear that in the current purchasing system there is a significant amount of time spent processing purchase orders. If the quantity of purchase orders is reduced then buyers will have more time to focus their efforts on value-adding activities. Another benefit is that Nypro may be able to consolidate their supplier base and receive a quantity discount from vendors that they negotiate blanket purchase orders with. The benefits of implementing blanket purchase orders also extend to the vendors. For vendors they will benefit from a more consistent and potentially increased volume of business. This will allow for vendors to maintain better control over their production cycle and deliver savings in better performance or price.[22]

6.2.4 Limitations

This analysis of purchase order quantities does not take into account vendor redundancy; therefore some vendors will have higher purchase order quantities if they are added together. It is also important to note that this analysis is not complete, rather it should be considered as a starting point for future investigation. In the course of a seven week analysis it is difficult to

[21] (Vantage Partners, 2008)
[22] (U.S. General Services Administration, 2008)

gather enough information to successfully implement a blanket purchase order strategy; however the project team's work summarizes the information needed and provides a suggested methodology for moving forward.

6.3 Low Volume Vendors

The last kind of waste that the project team identified in their research stems from Nypro's use to too many low-volume vendors. The project team defines low-volume vendors as vendors that have infrequent, unplanned purchases that make up a low purchasing value. It is beneficial to investigate these vendors because they represent a potential cost savings through vendor consolidation.

6.3.1 Identify

In order to clearly identify that low-volume vendors is a problem for Nypro China consider Pareto analysis of MRO spending. Pareto analysis or 80-20 analysis is a method for quickly identifying what suppliers represent the majority of spending. As shown in Figure 13: Pareto Analysis there are 1023 suppliers for Nypro China, however only 144 of these suppliers make up 80 percent of the entire MRO buy for Nypro China. This means that 879 suppliers make up the remaining 20 percent of the MRO buy! This strongly suggests that there are many low-volume vendors throughout Nypro China. Figure 13: Pareto Analysis shows the Pareto analysis for each facility and all of the facilities combined.

Facility	Number of Vendors for 80% Spend	Total Number of Vendors
NTJ	39	236
NSZ	48	342
NGZ	31	244
NSU	26	201
ALL	144	1023

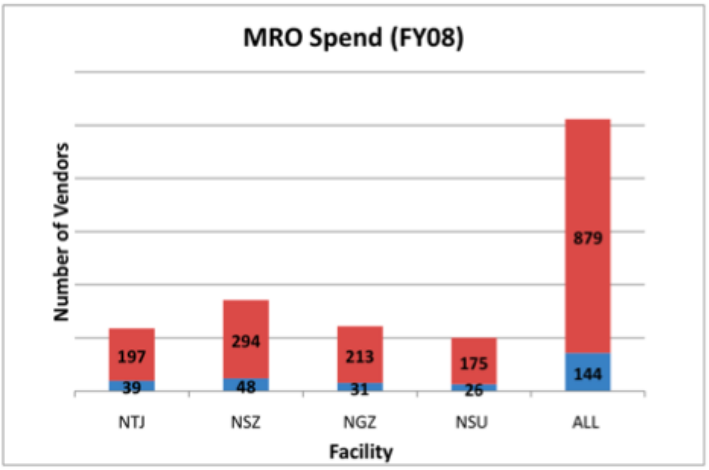

Figure 13: Pareto Analysis

In order to identify the kinds of suppliers that may include many low-volume vendors the project team defined "hot commodities." Hot commodities are level three classifications that have more than four vendors. This is based off the assumption that anything more than four suppliers for similar items is inefficient. This assumption is supported by the industry trend towards reducing the supply base. Across Nypro China the project team identified 40 hot commodities. The breakdown of these commodities is shown in Figure 14: Hot Commodities and the details of these commodities are included in Appendix E: Hot Commodity Analysis

Facility	Number of Hot Commodities
NTJ	12
NSZ	23
NGZ	5
NSU	No data
Total	40

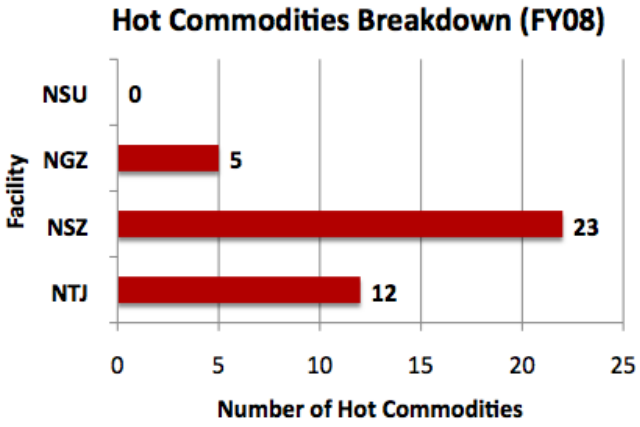

Figure 14: Hot Commodities

6.3.2 Recommendation

The project team recommends that the Nypro China supply chain team further investigates that existence of hot commodities across Nypro China. In order to have a complete range of data the hot commodities for Nypro Suzhou still need to be identified. Then, using the complete information the Nypro China supply chain team can further investigate the details of hot commodities and determine the optimal number of vendors for each commodity. After the optimal number of vendors for each commodity is determined Nypro needs to evaluate the suppliers in each of the hot commodities in order to make consolidations. The project team's proposed supplier evaluation model is one method that can be used for supplier evaluation.

6.3.3 Value

It is valuable to identify and eliminate the low-volume vendors throughout Nypro China because these vendors represent waste throughout the supply base. If Nypro can do more of its business with high-volume vendors they may be able to leverage their buying power to generate a cost savings.

6.3.4 Limitations

It is important to stress the significance of the major assumption that was made in order to identify the hot commodities for Nypro China. The project team assumed the anything more than four suppliers for similar items is inefficient. However, there are cases where it may be necessary for Nypro to have more than four suppliers for similar items. For example, it may be necessary for Nypro to have many different suppliers for molding machines because it is a very important, technical aspect of their operation. On the other hand, it may be wasteful for Nypro to have more than four suppliers for a commodity such as office stationary supplies. That is why it is important for the Nypro China team to further evaluate the optimal number of suppliers for commodity groups.

7 Findings Three – MRO Supplier Evaluation Model

Supplier evaluation is an important task because it is the base for supplier reduction and helps to structure a powerful supply chain.[23] Traditionally, vendor selection was based on picking the supplier with the best price, however today it is important to evaluate suppliers based off the their total cost which includes indirect supplier costs such as those associated with late delivery and poor quality.[24] The project team's proposed MRO supplier evaluation model was designed to average a multitude of supplier performance metrics to calculate a standardized rating that can be used to help determine which vendors to consolidate.

[23] (Kemp, MRO Today, 2002)
[24] (Filip Roodhooft, 2005)

7.1 Model Structure

The project team decided to use a weighted-point model to evaluate supplier performance. Essentially, implementing a weighted-point model involves selecting a number of criteria, determining different weights and selecting the supplier with the highest weighted total score.[25] In order to create a model that is broad enough to cover the many aspects of supplier performance the project team's proposed model has a two level criteria system. The two level system provides a more specific and informed ranking of supplier performance. The first level criteria are called the "major factors" and the level two criteria are "sub-factors" that make the major factors more measureable. The project teams suggested factors are shown in Figure 15: Major Factors and Sub Factors.

[25] (Wind, 1968)

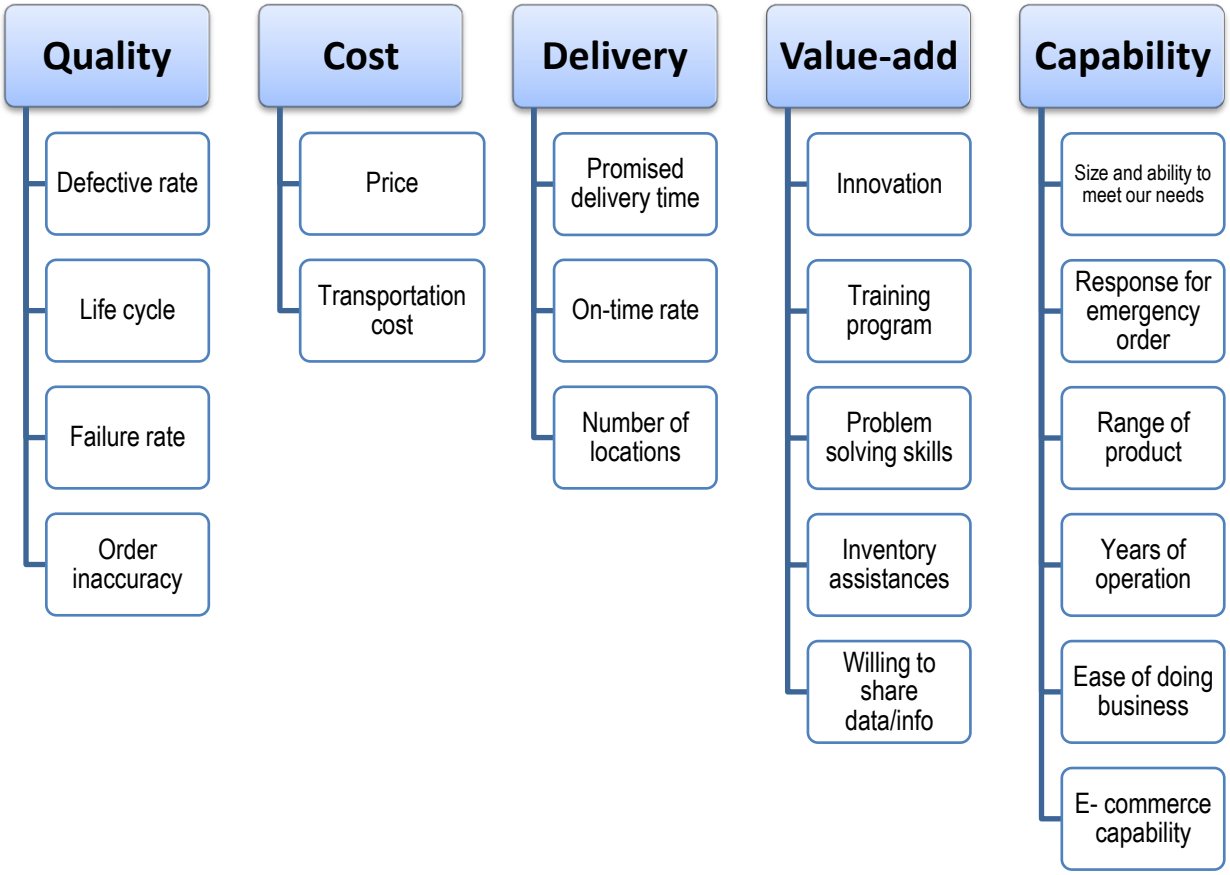

Figure 15: Major Factors and Sub Factors

7.2 Suggested Major Factors and Sub-Factor Definitions

Quality –

Defective rate (per year): the quantity of defective pieces over the total pieces the company received in a year

Failure rate (per year): the quantity of failure pieces over the total pieces the company received in a year

Life cycle: for products that can only be used once – use the mean time to failure (MTTF); for products that can be repaired several times and continue to operate – use the mean time before failure (MTBF).

Cost –

Price: the price of the material or service.

Transportation cost: included any transportation or freight cost that is not included in the price of the item.

Delivery –

Promised delivery time: recorded on purchase order and invoice.

On-time rate: times that the goods arrive on time over the total number of orders received.

Number of locations: count of locations.

Value-added –

Innovation: measured by number of patents.

Training program: marked 100 if have, 1 if not.

Problem solving skills: score problem solving skills from 1 – 100 based off willingness and ability to address specific problems.

Inventory assistances (VMI): marked 100 if have, 1 if not.

Ease of doing business: measured by time needed to set down a transaction.

Willing to share data/info: percentage of information shared.

Capability –

Size and ability to meet our needs: percentage of times that can meet our needs.

Response performance for emergency order: guaranteed delivery available marked 100 if have, 1 if not.

Range of products: number of needed commodities the vendor can provide.

Years of operation: number of years in operation.

Ease of doing business: measured by the P.O. number per year.

E-commerce capabilities: marked 100 if have, 1 if not.

7.3 Implementation

In order to implement this model there are five key steps that need to take place. These five steps are outlined in Figure 16: Supplier Evaluation Model Implementation.

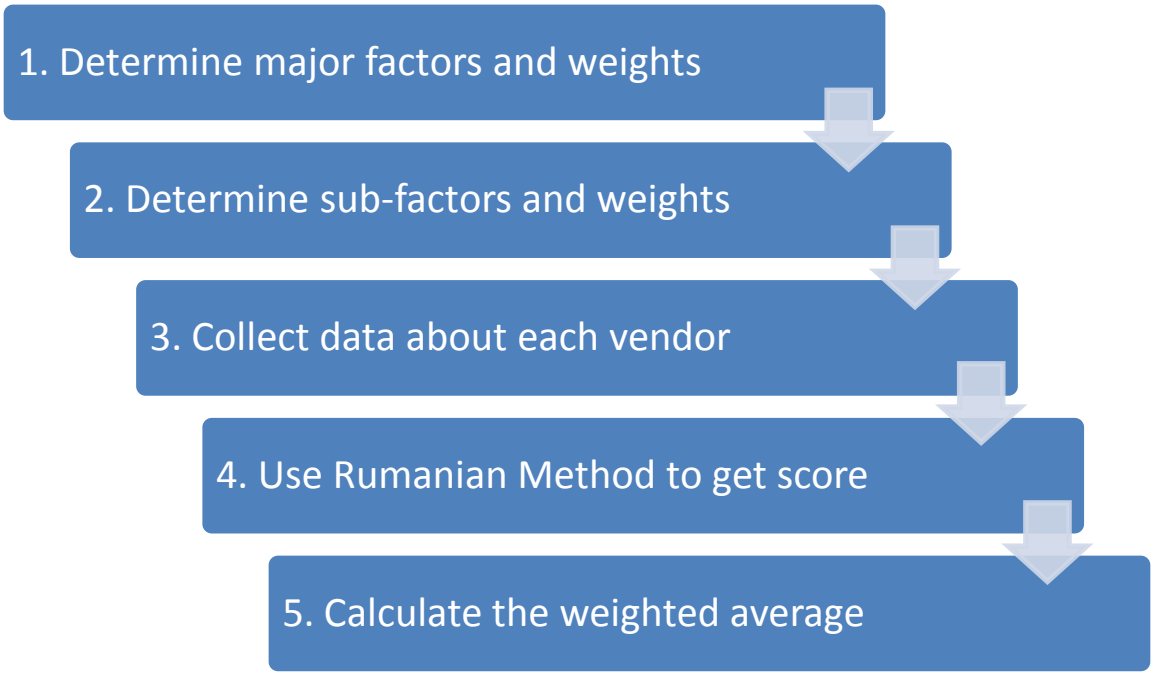

Figure 16: Supplier Evaluation Model Implementation

The first two steps in the implementation plan are relatively straightforward and are subjective. The project team has suggested several major factors and sub-factors along with a suggested weight. The proposed sub-factors and their weights are included in Appendix F: Proposed Factors and Weights**.**

The third step of the project team's proposed model implementation is to collect data about each of the vendors. This is a critical step in the implementation of this model because the effectiveness and value of the model relies on the accuracy and quality of the data that is

collected from each vendor. In order to collect this information the project team suggests that Nypro develops a comprehensive form that can be sent to suppliers to complete. Across the industry there is a form called a RFI of Request for Information which is an open enquiry that spans the market seeking broad data and understanding.[26] The project team has created a suggested RFI for Nypro to use to collect data about their suppliers. The project teams proposed RFI is included in Appendix G: Request for Information (RFI).

The data that is collected from the RFI form is referred to as "original data." Once the original data is received from the RFI form it needs to be changed to a standardized unit and range so it can be used to calculate a meaningful ranking. For example, "defective rate" scores range from 0 to 1, while life cycle can be several thousand minutes. Step four utilizes the Rumanian Method to convert all of the original data into scores that can be used in the model. The project team suggests that the Rumanian Method is used because it is objective and can be easily computerized.[27] Using the formula below, a program can be made to make the scoring process automated.

$$S_i = \begin{cases} \frac{99 \times (O_i - W)}{B - W} + 1, (B \neq W) \\ 0, (B = W) \end{cases}$$

B – Best original data

W – Worst original data

O_i – Vendor i's original data

S_i – Score of vendor i

[26] (Mhay, 2008)
[27] (Tan)

Using this scoring method the best vendor will receive a score of 100 and the worst vendor a score of 1, the remaining vendors will receive a score between 1 and 100 with higher scores representing the better vendors.

Finally, using the standardized data, the weighted average is calculated for all of the sub-factors and major factors to calculate total score. Vendors with a higher total score represent more qualified and capable vendors. To more clearly understand the last two steps in the supplier evaluation model consider the following example.

Original Data from RFI

Major Factor	Weight	Sub - Factors	Weight	Vendor 1	Vendor 2	Vendor 3	Vendor 4
Quality	0.3	Defective rate	0.1	1%	3%	2%	0%
		Life cycle	0.6	40	42	38	36
		Failure rate	0.2	3%	1%	2%	1%
		Order accuracy	0.1	0%	1%	0%	0%

Figure 17: Original Data

In Figure 17: Original Data the original data from the RFI form is shown for each vendor. The next step is to standardize this data by using the Rumanian Method as shown in Figure 18: Standardized Data.

Standardized Data by Rumanian Method

Major Factor	Weight	Sub - Factors	Weight	Vendor 1	Vendor 2	Vendor 3	Vendor 4
Quality	0.3	Defective rate	0.1	67	1	34	100
		Life cycle	0.6	67	100	34	1
		Failure rate	0.2	1	100	51	100
		Order accuracy	0.1	100	1	100	100

Figure 18: Standardized Data

Next, the standardized data is used to calculate the weighted average of the sub-factors to calculate the total score for the major factor – *quality*. See Figure 19: Weighted Average

Calculating the Weighted Average of Major Factors

Major Factor	Weight	Sub - Factors	Weight	Vendor 1	Vendor 2	Vendor 3	Vendor 4
Quality	0.3	Defective rate	0.1	67	1	34	100
		Life cycle	0.6	67	100	34	1
		Failure rate	0.2	1	100	51	100
		Order accuracy	0.1	100	1	100	100
		Total score of quality -		**57.1**	**80.2**	**43.9**	**40.6**

Figure 19: Weighted Average

57.1 = (0.1*67) + (0.6*67) + (0.2*1) + (0.1*100)

This process is repeated for every major factor and then the weighted average of the major factors is calculated to determine the final score. See Figure 20: Vendor Rating.

Calculating Overall Vendor Rating

Major Factor	Weight	Vendor 1	Vendor 2	Vendor 3	Vendor 4
Quality	0.3	57.1	80.2	43.9	40.6
Cost	0.25	40.8	50.7	81.3	48.2
Delivery	0.15	58.1	48.3	76.3	83.1
Value-add	0.15	60.5	81.3	42.2	58.1
Capability	0.15	45.1	76.4	67.2	78.9
Final Score		51.9	**67.9**	61.4	57.2
Ranking		4	**1**	2	3

Figure 20: Vendor Rating

67.9 = (0.3*80.2) + (0.25*67) + (0.15*81.3) + (0.15*76.4)

From this example one can tell that vendors 2 and 3 have this highest final score, so this suggests that they are the most qualified vendors.

7.4 Recommendations

The project team recommends that Nypro implements a supplier evaluation model that is similar the model proposed in this report. This standardized supplier evaluation process is one effective method for comparing similar suppliers who may not seem different until their total

score is calculated. The project team also recommends that Nypro implements some kind of RFI form to begin to collect more information about suppliers that can be used for supplier evaluation. Through the implementation of these suggestions Nypro will be able to perform a more effective and meaningful supplier evaluation. The project team recommends that over the long run Nypro begins to shift the majority of business to vendors with a high total score (as determined through supplier evaluation model). This is shown in Figure 21: MRO Relationships.

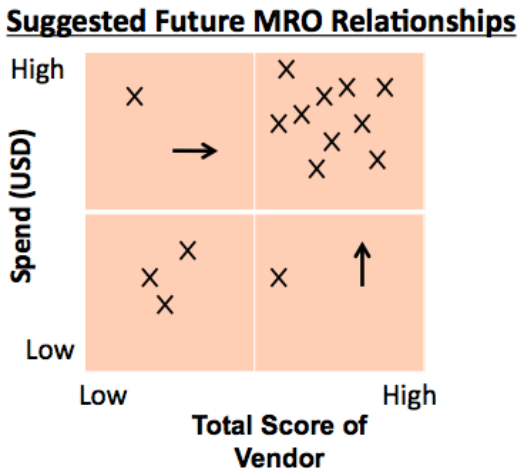

Figure 21: MRO Relationships

7.5 Limitations

The supplier evaluation model and RFI form that the project team has created should be used as starting points to creating a model and RFI form that is customized for the Nypro China operation. Due to time constraints on the project the project team based this model off observations and best practices. In a perfect situation this model and RFI form would be based off Nypro's specific needs and its creation would involve the input of several managers from various Nypro China departments.

8 Overall Recommendations

To review all of the recommendations the project team has divided the suggestions into short term and long term recommendations. Short term recommendations can be completed in less than six months, while long term recommendations take longer than half a year.

8.1 Short-term Recommendations

8.1.1 Create MRO Commodity Study Team

As Dr. Kemp suggests the first step to improving the MRO buy is to create a strategic MRO commodity study team.[28] The project team recommends that this team is diverse and cross-functional. The team should include members not only from purchasing, but from engineering, finance, and operations to make sure that no aspect of MRO evaluation is overlooked or neglected. Much of the preliminary analysis and data collection that this team would be responsible for has already been done by the project team. The goals of this team are long-term recommendations and include moving forward with MRO classification and supplier evaluation. These long-term recommendations are explained more in Goals for MRO Commodity Study Team.

8.1.2 Standardize the New Vendor Adoption Process

As suggested earlier in section 6.2, High Quantity of Purchase Orders, Nypro China should standardize the new vendor adoption process. This is a process that can be implemented immediately and its results are also immediate and significant. First, by standardizing this process this will stop the creation of duplicate vendors in the BPCS system. Secondly,

[28] (Kemp, MRO Today, 2004)

standardized processes across Nypro China will help to establish coordination at the regional level. This process will also allow Nypro China to collect more information about their suppliers which could be used to gain a competitive advantage through strategic supplier management.

8.1.3 Cleanse Vendor Data

The project team has identified 77 different vendor redundancies in the BPCS system which represents inaccurate information in the BPCS system. The project team recommends that Nypro updates these errors in the BPCS system immediately. This will create standardized vendor identifications in the BPCS system which will help Nypro China to leverage their buying power across the region. The project team also recommends that information in the BPCS system is checked for accuracy and updated periodically to keep contact information up to date.

8.1.4 Separate Direct Materials from MRO

The last short term recommendation proposed by the project team is to create a system to separate direct materials samples from the MRO spend. In the current system it is a time consuming process to identify which suppliers are providing MRO items and which ones are providing direct materials samples. By separating this spending from the MRO spending one will be able to quickly and easily distinguish the MRO spend from the direct materials samples spend. The project team has identified a quick fix to this problem – Create a dedicated direct materials samples vendor for each facility in the BPCS system. All of the direct materials samples should be purchased through one vendor name for each facility. For example all direct materials samples for Nypro Tianjin should be purchased under the vendor NTJ DIRECT SAMPLES. This recommendation is a simple fix that will effectively distinguish direct materials samples and MRO spending.

8.2 Long-term Recommendations

8.2.1 Goals for MRO Commodity Study Team

Although the creation of the MRO commodity study team is a short term goal the goals of this team are implemented over the long term. The first goal for the MRO commodity team should be to implement a standardized MRO classification system across Nypro China. The classification system proposed by the project team is a great starting point for future work however; before it is implemented it should be refined and expanded to make sure that it is perfect for the Nypro China operation. Also the classifications that the project team made should be reviewed at each facility to make sure that each supplier has the best classification.

The second goal for the MRO commodity study team should be to select major MRO commodities for analysis.[29] This team will be responsible for evaluating the needs of these commodities and collecting information about them at the regional level. Using this information the project team will be able to identify commodities that have the best chance of successful consolidation and cost savings.

The last suggested goal for the MRO commodity study team is to implement a strategy to collect more information about vendors for evaluation and consolidation. There are many ways to collect this information such as the RFI form proposed in Appendix G: Request for Information (RFI). Using this information Nypro China will be able to perform a comprehensive supplier evaluation and consolidate their supply base effectively.

[29] (Kemp, MRO Today, 2004; Kemp, MRO Today, 2004)

8.2.2 Vendor Evaluation Process

As explained in Findings Three – MRO Supplier Evaluation Model this is a important aspect to evaluating the effectiveness of a supply chain. The project team suggests that Nypro China expands upon the proposed supplier evaluation model and determines key vendors for consolidation and strategic relationship opportunities.

8.2.3 Map-Out Purchasing Processes

The project team also recommends that Nypro China looks into mapping out all of the current purchasing processes for each facility and creating a lean, six sigma, HVS project. By mapping out all of the purchasing processes for each facility the HVS team will be able to identify waste and inefficiencies in the current processes. Then by applying six sigma and lean thinking principles these processes can be optimized and standardized at the regional level. This will make processes easier to implement and will encourage communication and coordination at the regional level.

8.2.4 Monitor Usage

The last long term recommendation that the project team suggests is for Nypro China to begin to monitor MRO buying behaviors and patterns. There are many different software programs that are available to track and monitor inventory levels and spending. This kind of information is useful to an organization because it can be used to work with suppliers during negotiation to create better performance and price.

Nypro Clinton is an example of one Nypro facility which has already started to implement some of these strategies to improve their MRO operation. A case study of the Nypro Clinton facility is included in the following section, Nypro Clinton Case Study.

9 Nypro Clinton Case Study

The purpose of this case study was to understand the MRO purchasing process at Nypro Clinton and to understand how the MRO spend is managed at Nypro Clinton to provide to Nypro China a benchmark of what other Nypro facilities are doing.

At Nypro Clinton purchase orders for indirect materials originate from the engineers within their respective departments. When the department needs to order something they will complete a document that contains information about: the part numbers to be ordered, vendor identification number, quantities, and prices. It is up to the employee requesting the PO to get a quote for the items to be ordered and determine which vendor to use. Once they have completed the PO it is sent to a Central Store Technician and the PO is processed using the BPCS system. This system has an extensive database of vendor numbers and part numbers that have been utilized in the past. Nypro Clinton's purchasing group is in charge of maintaining the database of vendors. Once the Technician receives the PO they enter all of the information from the PO into BPCS and the BPCS system generates an official PO that is sent to both the requestor and the vendor via email or efax. Once the vendor receives the PO it is confirmed and the order is processed then the PO is matched with the invoice and packing slip to make sure the order is correctly paid.

Another important type of purchase order that is used at the Clinton facility is a blanket purchase order. At Nypro Clinton blanket purchase orders are capped at a certain dollar amount at the beginning of each period. Every order that is placed with a vendor using a blanket PO is listed under the same purchase order during the period. If the dollar amount established on the blanket PO is expected to be exceeded before the end of the period this amount can be augmented. At Nypro Clinton, each technician is in charge of a select number of blanket POs and

they are responsible for making sure that they are not exceeded and they also maintain a healthy relationship with representatives from these vendors.

The Nypro Clinton facility uses a standardized form called a supplier identification form or SIF to collect data about suppliers before they are entered into the BPCS system. The SIF form is required to be completed for every supplier before they can be registered into the BPCS system. The SIF form is comprehensive and collects information about the complete capabilities and qualifications of the supplier before they are entered into the system. This is a great practice because it makes supplier evaluation and consolidation an easier process because there is more information to analyze.

Inventory management is another important aspect of MRO management at Nypro Clinton. Central Store Technician Virgenmina Irizarry is in charge of controlling the inventory levels for two MRO repositories at the Clinton facility. One facility in her control has mainly office supplies, safety, janitorial supplies, and other miscellaneous MRO items. The other facility is located adjacent to the injection molding machines and includes parts that are vital to the maintenance, upkeep, and repair of these machines. Both of these MRO repositories are important to keep satisfactory inventories levels because if these parts or materials are not available the workflow is slowed and the downtime causes delays and lost profit.

The Clinton facility uses a powerful program called MP2 to track inventory levels, usage, and monitor buying behaviors and patterns. All of the items that are available at the MRO repositories are listed in the MP2 database by part number, quantity available, description, etc. Each repository has a sign-out sheet where employees record exactly what they are taking out of the inventory. At various points throughout the day Virgenmina checks the sign-out sheet and updates the inventories in the MP2 system. To assure that the MP2 system is keeping an accurate

inventory of the items in the repository once or twice a week Virgenmina also performs a manual count and scan of items that are held in the repository. The MP2 system also features a reporting system that generates a weekly report including information about the usage of each department. This report is sent out to all of the departments every week so they can keep track of their buying patterns and behaviors at various time periods.

10 Conclusions and Future Work

The work of the project team centralized and made a lot of information about the MRO spend for Nypro China available. In a very short period of time the project team was able to identify several possible areas where the MRO buy can be improved and provide a comprehensive methodology to move forward with these initiatives. The project team has provided several recommendations for Nypro China as they move forward with the overall goal of improving the MRO operation across the region. According to industry research, improving the MRO buy is a worthwhile initiative for many organizations. This is certainly the case for Nypro China – with an annual MRO spend of about 40 million United States dollars industry experts estimate that a 10 percent reduction in total MRO spending is attainable.[30] This represents a significant cost savings for Nypro China.

[30] (Kemp, MRO Today, 2003)

Appendix A: MRO Classification Definitions

Level One Classification Definitions

Level 1 Classification	Definition
Equipment and Spare Parts	All equipment and spare parts suppliers
Supporting Goods	Operating goods that support both production and general operation of the facility
Chemicals, Gases, Oils, Lubricants	Chemicals, gases, oils, lubricants that are used throughout the plant from molding machines to cleaning agents
Maintenance/Service Fees	Vendors that provide a maintenance service or other service
Direct Material Suppliers	Direct material sample suppliers - see report for more details
OTHER	Vendors with a special relationship with Nypro - see report for more details.

Total Level 1 Classifications - 6

Level Two Classification Definitions

Level 1 Classification	Level 2 Classification	Definition
Equipment and Spare Parts	Painting	All painting related equipment and spare parts
	Assembly	All assembly related equipment and spare parts
	Molding	All molding related equipment and spare parts
	Instruments	All instruments and related spare parts
	Printing	All printing related equipment and spare parts
	Tool Room	All tool room related equipment and spare parts
	Fixtures	All fixtures
	Transport	All transport related equipment and spare parts
	Multiple Departments	Various equipment and spare parts that are used in more than one department
Supporting Goods	General Consumable	Consumable goods that are used for general, everyday plant use
	Production Consumables	Consumable goods that are used in the production process
	Office Supplies	All office related supplies

	Welfare Supplies	Supplies that are used for employee satisfaction or benefit
	Renovations	Building renovations or remodeling
	Packaging Materials	All packaging related items
	Storage	All storage related items
	Building Security	Security system and supporting
Chemicals, Gases, Oils, Lubricants	Chemicals	Various chemicals used in plant
	Lubricants	Various lubricants used in plant
	Gases	Various gases used in plant
	Oils	Various oils used in plant
	Wax	Various waxes used in plant
Maintenance/Service Fees	Assembly	Assembly related maintenance and service vendors
	Painting	Painting related maintenance and service vendors
	Molding	Molding related maintenance and service vendors
	Tool Room	Tool Room related maintenance and service vendors
	Power Generator	Power Generator related maintenance and service vendors
	All Plant	Maintenance and service vendors that are used throughout the plant
Direct Material Suppliers	Direct Materials	Direct material samples related vendors
OTHER	OTHER VENDOR	Vendors with a special relationship with Nypro

Total Level 2 Classifications - 30

Appendix B: MRO Classification Guide

Seq.	Level 1	Level 2	Level 3
1	**Equipment and Spare Parts**	Painting	Drying Oven
			Dust Removal Machine and Related Accessories
			Painting Line
			Painting Machine
			PVD Painting
			Spray Guns and Related Accessories
			Spraying/Painting Robot
			UV Equipment
			Waste Recycling Machine
		Assembly	Auto Folding Machine
			Bunding Machine and Related Accessories
			Heat Pressing Machine
			Hot Stamping Machine
			Laser Printing Machine
			Metal Stamping and Related Accessories
			Other Accessories
			Protective Film Machine
			Seewoo Machine
			Ultrasonic Machine
		Molding	Auto Feeding Machine (Auto Loader)
			Chiller (Cooling Machine)
			Degating Machine
			Dehumidifier Machine
			Die Heater
			Dryer
			Foil Feeder
			Injection Molding Machine
			Molding Robots (Pick-up Robots)
			Molding Screws and Barrels
			Other Accessories
			Re-grinding Machine
			Resin Mixing Machine
			Temperature Controller
		Instruments	Measuring Instruments for Assembly

			Measuring Instruments for Clean Room
			Measuring Instruments for Painting
			Measuring Instruments for QC
			Testing Instruments
		Printing	Bar Code Printing Machine
			Label Printing Machine
			Pad Printing
			Product Printing
		Tool Room	Die Cut Tools
			Hot Runner and Related Accessories
			Injection Mold Tools
			Injection Molding (Tools) Maintenance
			Injection Molds
			Injection Molds Accessory (Pins, Springs, etc)
			Cutting/Milling Machine
			Die Accessories
			Assembly Line Transmission/Conveyors
		Fixtures	Assembly
			Molding
			Multiple Departments
			Painting
			Ultrasonic Machine Fixtures
		Transport	Cranes and Related Accessories
			Forklifts and Related Accessories
			Moving Platforms
		Multiple Departments	Air Compressor and Related Accessories
			Air Conditioning
			Anti Static Electronics
			Automation Accessories
			Deburring
			Electric Component Spare Parts (Motor, Transfuser, etc)
			General Maintenance Tools
			Power Generator
			Work Tables

2	**Supporting Goods**	General Consumable	Clean Room Accessories
			Electricity Accessories (Lighting, Wires, etc)
			Employee ID Cards
			Janitorial Supplies (trash bags, broom, etc)
			Employee Uniform
			Personal Use Goods (towels, tissue)
			Printing Labels and Forms
			Small Hardware Supplies
			Software
			Worker Protection Materials
		Production Consumables	Air Filters
			Waste Water Filter
			Anti-static Water for Painting
			Distilled Water for VM Painting
			Ink for Production
			Soldering Consumables for Assembly
		Office Supplies	Computers, Electronics, Cables
			Decorations (Signs)
			IT Consumable
			Office Furniture
			Office Stationary
		Welfare Supplies	Employee Break room
			Employee Canteen
			Employee Outing
		Renovations	Facility Expansions/Upgrades
		Packaging Materials	Anti-Static Bags
			Plastic Bags
			Plastic Trays
			Protective Tapes
			Protective Foam and Packing Materials
		Storage	Cardboard Cartons
			Hazardous Goods/Chemicals Storage
			Shelves
			Wooden Pallets

		Building Security	Caution Tape
			Fire Safety
			Power Safety
			Security System
3	**Chemicals, Gases, Oils, Lubricants**	Chemicals	Cleaning Agents
			Experimenting Solvent
			Molding Chemicals
			Quality Control
			Water Treatment
		Lubricants	Molding Machine Lubricants
			Multiple Departments
			Power Generator Lubricants
		Gases	Production Gases
		Oils	Heating Oil
			Injection Molding
			Painting
			Power Generator and IM
		Wax	Wax Floor Treatment
4	**Maintenance/Service Fees**	Assembly	Ultrasonic Machine Maintenance
		Painting	Cleaning Service
			PVD Painting
		Molding	Injection Molding Machine Maintenance
			Molding Machine Configuration
			Molding Parts Recycling
			Molding Robots (Pick-up Robots)
		Tool Room	Injection Molds (Tools) Maintenance
		Power Generator	Power Generator Repair/Maintenance Service
		All Plant	Air Compressor Maintenance Service

			Air Conditioning Service
			Clean Room Certification
			Consultant Service
			Environmental Control/Inspection
			Freight Costs
			General Plant Maintenance Services
			Internet Service Provider
			Machine Processing
			Motor Maintenance
			Plant Construction
			Plant Layout Modifications
			Rework Service
			Transport Maintenance Services
5	**Direct Material Suppliers**	Direct Materials	Assembly Samples
			Bunding Machine Samples
			Color Compounding Samples
			Die Cut Samples
			IM Samples
			Metal Samples
			Other Samples
			Packaging Samples
			Pad Printing Samples
			Painting Samples
			Pigments Samples
			Printing Samples
			Resin Samples
			Rubber Samples
			Supply Plating Samples
			VM Samples
6	**OTHER**	OTHER VENDOR	NGZ OTHER VENDOR
			NTJ OTHER VENDOR
			NYPRO HONG KONG
			NYPRO SU
			NYPRO TOOL SZ
			NYPRO TOOL TJ
	Total Level 1 Classifications - 6	Total Level 2 Classifications - 30	Total Level 3 Classifications- 165

Appendix C: Vendor Redundancies

Redundancy One

Different Name and Vendor Number Across Nypro China

Seq. Number	Vendor Name	NGZ	NSU	NSZ	NTJ
		Values Represent Vendor Numbers			
1	耐普罗机械（深圳）有限公司			71686	
	耐普罗塑胶五金制品（深圳）有	50064	73061		
2	NYPRO HONG KONG LTD		40001		
	NYPRO TOOL HONG KONG LTD	50107			
	NYPRO TOOL HONGKONG LTD		72924		30063
	NYPRO TOOL HONGKONG		40115		
3	Dell computer (china) Co., Ltd		70223		
	DELL计算机（中国）有限公司				30080
	戴尔（中国）有限公司			20085	
	戴尔计算机（中国）有限公司	50019			
4	南京昭凌精密机械有限公司			72929	
	南京昭陵精密机械有限公司				72548
5	深圳市先力超声波有限公司				71484
	深圳先力超声波有限公司			72789	

Redundancy Two

Same Name Different Vendor Numbers Across Nypro China

Seq. Number	Vendor Name	NGZ	NSU	NSZ	NTJ
		Values Represent Vendor Numbers			
1	亚光耐普罗精密注塑（天津）有	50062		20046	
2	耐普罗机械（苏州）有限公司		40395	70240	30455
3	ITW TRANS TECH			10156	30008
4	艾科斯辅助设备（苏州）有限公	73244	72722		
5	东莞市波记机械有限公司	70803		71991	30300
6	东莞市凤岗致业模具五金店	71638		71303	
7	东莞市新锋源模具贸易有限公司			73188	72752
8	飞比达电子元器件（东莞）有限	70167		70659	
9	广东泓利机器有限公司	71095		70444	
10	广州普利讯网络技术有限公司	70853		20150	
11	广州市辉泉喷码设备有限公司	70736		20076	

12	广州市汇邦聚合物有限公司	70758		20160	
13	广州市纪雅化工有限公司	50166		20165	
14	哈恩库博天津国际贸易有限公司		40228		30301
15	基恩士国际贸易（上海）有限公	72435		71053	
16	坚毅机械工程（高要）有限公司	71114			71610
17	均豪精密工业（苏州）有限公司		40127		72841
18	开德阜物流（上海）有限公司	72480	70924		
19	柳道万和（苏州）热流道系统有		72765		72856
20	马斯特模具（昆山）有限公司	73236		71100	
21	米思米（中国）精密机械贸易有	73505			71676
22	上海信好热流道科技有限公司			72546	72085
23	上海邑富贸易有限公司		70906		71802
24	深圳市理念注塑机配件商行	71553	71109		72253
25	深圳市龙岗区横岗锐格模具厂	72761		71156	72842
26	深圳市明利行机械有限公司		73389		73285
27	深圳市世标贸易有限公司	73191		72787	
28	深圳市思科铭科技有限公司	72354		71595	
29	深圳市智发电子贸易有限公司	71892		20006	72946
30	深圳泰德激光科技有限公司	72095			73373
31	深圳欣佰德精密模具有限公司	71050		72519	
32	圣维可福斯（广州）电子科技有	71827	72850		
33	史陶比尔（杭州）精密机械电子			72625	72112
34	天津津威电子设备有限公司		72833		72628
35	天津市山水商贸有限公司			72862	72308
36	天津中威科技发展有限公司		71498		70886
37	威猛工业自动化系统（上海）有	72823		72621	
38	伟迪捷（上海）喷码机有限公司		72792		72090
39	中山市三乡镇名科注塑机配件总			73476	72195
40	住重塑胶机械（上海）有限公司		71840		30363
41	深圳市洛高机电配件贸易商行	72472		71045	

Redundancy Three

Seq. Number	Vendor Name	NGZ	NSU	NSZ	NTJ
		Values Represent Vendor Numbers			
1	AKZO NOBEL COATING		73086/70657		

	(JIAXING)				
2	阿克苏诺贝尔涂料（东莞）有限	70306/70571			
3	东莞市佳鼎贸易有限公司		70286/70281		
4	明朗商务		71007/73107		
5	三井塑料贸易（上海）有限公司		60112/73050		
6	三星特种印刷器材有限公司		72771/70794		
7	深圳市宝安区乡镇极而峰静电器		71532/73126		
8	苏州风华精密塑料有限公司		72838/73165/72727		
9	苏州工业园区华杰物资有限公司		72809/40479		
10	苏州工业园区金田印刷涂层器材		73168/72852		
11	苏州利坤电子科技有限公司		71567/72723		
12	苏州利来特贸易有限公司		72254/72785		
13	苏州燃料有限公司		73153/72420		
14	苏州市爱宏化工科技有限公司		72496/73156		
15	苏州市大朋化学试剂有限公司		73082/70628		
16	苏州市高科精密模具有限公司		73197/73198		
17	苏州市吴中区木渎久佳诺精密模		72864/72865		
18	苏州永家物资有限公司		73112/71068		
19	武藏涂料(昆山）有限公司		73139/71935		
20	振达喷涂五金设备有限公司		70810/73097		

Redundancy Four

Different Name and Different Vendor Number at Same Facility

Seq. Number	Vendor Name	NGZ	NSU	NSZ	NTJ
		Values Represent Vendor Numbers			
1	米拉克龙贸易(上海）有限公	71778			
	FERROMATIK MILACRON MASCHINENB	72613			
2	深圳市龙岗区布吉镇宝升综合商			71251	
	阿特拉斯科普柯(上海)贸易			71995	
3	深圳市宝安区松岗丰裕喷涂设备			71886	
	东莞市黄江广聚模具配件店			73388	
4	陆河县建筑工程公司龙岗分公司			71440	
	东莞市鑫欣装饰工程有限公司			73227	
5	高要市坚毅威龙移印器材有限公		70411/60104		
	坚毅工程有限公司		40358		

6	广州市欧林家具有限公司	71000			
	广州市欧林装饰工程有限公司	72009			
7	深圳市标远鑫净化科技有限公司			72732	
	深圳市宝安区观澜亚当自动化机			72724	
8	深圳市福田区江红筛网商店			72803	
	深圳市龙岗区布吉沙湾永兴达五			71259	
9	南山区亚洋家私厂			72365	
	深圳市欧枫家具有限公司			72971	
10	深圳市思铭诚科技发展有限公司			20062	
	宏伟达机械工程（深圳）有限公			20063	
11	苏州市金鼎模钢有限公司		40139		
	苏州市中燃物资贸易有限公司		40123		

Appendix D: Purchase Order Quantity

NSZ, NTJ, and NGZ Combined

Level 1	Total Number of POs	Total Number of Vendors
Equipment and Spare Parts Total	4539	417
Supporting Goods Total	3270	209
Maintenance/Service Total	908	52
Chemicals, Gases, Oils, Lubricants Total	347	46
Direct Material Suppliers Total	342	92
OTHER Total	76	6

NSZ

Level 1	Total Number of POs	Total Number of Vendors
Equipment and Spare Parts Total	1928	161
Supporting Goods Total	1341	101
Chemicals, Gases, Oils, Lubricants Total	208	22
Maintenance/Service Total	150	30
OTHER Total	74	4
Direct Material Suppliers Total	63	24

NTJ

Level 1	Total Number of POs	Total Number of Vendors
Equipment and Spare Parts Total	2000	141
Supporting Goods Total	932	47
Maintenance/Service Total	720	13
Direct Material Suppliers Total	85	18
Chemicals, Gases, Oils, Lubricants Total	84	16
OTHER Total		1

NGZ

Level 1	Total Number of POs	Total Number of Vendors
Supporting Goods Total	997	61
Equipment and Spare Parts Total	611	115
Direct Material Suppliers Total	194	50
Chemicals, Gases, Oils, Lubricants Total	55	8
Maintenance/Service Total	38	9
OTHER Total	2	1

Appendix E: Hot Commodity Analysis

Facility	Hot Commodity (Level 3)	Quantity of Vendors (FY08)
NGZ	Measuring Instruments for QC	12
	Injection Molding Machine	27
	Molding Robots (Pick-up Robots)	6
	Computers, Electronics, Cables	8
	Employee Break room	6
NTJ	Metal Stamping and Related Accessories	8
	Assembly	5
	Molding	8
	Measuring Instruments for QC	7
	Injection Molding Machine	13
	Molding Screws and Barrels	7
	Other Accessories	6
	Painting Line	9
	Pad Printing	8
	Injection Mold Tools	6
	Injection Molding (Tools) Maintenance	5
	Worker Protection Materials	6
NSZ	Heat Pressing Machine	8
	Measuring Instruments for QC	11
	Testing Instruments	7
	Injection Molding Machine	15
	Molding Robots (Pick-up Robots)	14
	Temperature Controller	5
	Power Generator	5
	Spray Guns and Related Accessories	6
	Pad Printing	5
	Hot Runner and Related Accessories	5
	Injection Mold Tools	6
	Clean Room Accessories	7
	Electricity Accessories (Lighting, Wires, etc)	5
	Small Hardware Supplies	8
	Software	5
	Worker Protection Materials	8
	Office Furniture	9
	Facility Expansions/Upgrades	5
	Shelves	12
	Cleaning Agents	9
	Air Compressor Maintenance Service	5
	Air Conditioning Service	5
	Environmental Control/Inspection	5

Appendix F: Proposed Factors and Weights

Main Factor	Weight	Criterion	Weight
Quality	0.3	Defective rate	0.1
		life cycle(month)	0.6
		Failure rate	0.2
		Order inaccuracy	0.1
Cost	0.25	Price($/piece)	0.9
		Transport cost($)	0.1
Delivery	0.15	Promised delivery time	0.5
		On-time rate	0.3
		Number of location	0.2
Value-add	0.15	Innovation	0.1
		Training program	0.1
		Problem solving skills	0.4
		Inventory assistances	0.2
		Willing to share data/info	0.2
Capability	0.15	Size and ability to meet our needs	0.3
		Response performance for emergency order	0.2
		Range of product	0.2
		Years of operation	0.1
		Ease of doing business	0.1
		E-commerce capabilities(times/month)	0.1

Appendix G: Request for Information (RFI)

Supplier Name		Nypro vendor number
Contact Information		
Physical Address		Postal Code
Contact Name	Phone Number	Fax
E-mail Address		

Question list

1. How many years have your company operated for?

2. What kind of products does your company provide?
(a list of products and quotation attached)

3. What kind of added-services can your company provide (for free)?
   a) Training program
   b) Change a new one if something wrong with the product in *one year*(or___)
   c) Maintenance service in *three year* (or ___)
   d) Face-lifting of the product for new functions

4. What kind of culture does your company hold?

5. Which aspect of the product is your company dedicated to currently?
   a) Cost
   b) Quality
   c) Creativity
   d) Selling
   e) Service

6. How many patents does your company have?

7. Can you hold inventory for customs and how many?

8. How often does your company use e-commerce?
   a) Never
   b) Once in several months
   c) 1 – 4 times a month
   d) 4 – 30 times a month
   e) Everyday

9. How many branches does your company have? Who and where are they?

	Name	Location
Branch 1		
Branch 2		
……		

10. What's your opinion about Nypro as your customer?

11. What kind of relationship do you think is most suitable between your company and Nypro?

12. What's your company's policy about discount?

Nypro will really appreciate you to finish this question list and send it back to the following address:

Any questions, please contact:

Reference List

Arabe, K. C. (2001, January 18). *ThomasNet IndustrialNewsRoom*. Retrieved May 2008, 5 , from MRO Purchasing Goes Electronic: http://news.thomasnet.com/IMT/archives/2001/01/mro_purchasing.html

Barry, J. (1996, June 22). *Access my Library*. Retrieved May 5, 2008, from A development model for effective MRO procurement (maintenance, repair and operating): http://www.accessmylibrary.com/coms2/summary_0286-9388415_ITM?email=mikefitz@wpi.edu&library=

Carter, J. S. (2002, October). *Policy and Procedure for the use of Blanket Purchase Orders.* Retrieved August 17, 2008, from Miami Government: www.miamigov.com/procurement/docs/policies/blanketpoprocedures.pdf

Filip Roodhooft, J. K. (2005). Vendor selection and evaluation An activity based costing approach. *European Journal of Operational Research* , 97-98.

Gordon, S. R. (2006, May). *Institute for Supply Management.* Retrieved August 14, 2008, from www.ism.ws/files/Pubs/Proceedings/FFGordon.pdf

Kemp, D. R. (2002, June). *MRO Today*. Retrieved August 17, 2008, from Traditional Evaluation Models: www.mrotoday.com/mro/archives/mro%20coach/kemp/kempJJ2002.htm

Kemp, D. R. (2003, January). *MRO Today*. Retrieved August 19, 2008, from A value-enhancing initiative : www.mrotoday.com/mro/archives/mro%20coach/kemp/kempD02J03.htm

Kemp, D. R. (2004, May). *MRO Today*. Retrieved 8 11, 2008, from Improving the MRO Buy: www.mrotoday.com/mro/archives/mro%20coach/images/kemp_on04.pdf

Kemp, D. R. (2004, July). *MRO Today*. Retrieved August 19, 2008, from Management by commoditiy : www.mrotoday.com/mro/archives/mro%coach/Kemp/kempJJ04.htm

Mente, B. L. (1994). *Chinese Etiquette & Ethics In Business.* Chicago: NTC Business Books.

Mhay, S. (2008). *The Negotiation Experts*. Retrieved August 18, 2008, from Request for... Procurement Process Terms: www.negotiations.com/articles/procurement-terms/

SAP. (n.d.). *SAP Help*. Retrieved August 19, 2008, from direct material (EBP): www.help.sap.com/saphelp_srm30/helpdata/en/f6/1bc7fe7773d411a4950060b03c3b0e/content.htm

Sollish, F. (2005). *Purchasing and Supply Manager's Guide to the C.P.M Exam.* Alameda: Sybex Incorporated.

Tan, Y. System Engineering.

U.S. General Services Administration. (2008, May 8). *GSA*. Retrieved August 17, 2008, from Benefits and Advantages of Using Blanket Purchase Agreements (BPAs): http://www.gsa.gov/Portal/gsa/ep/contentView.do?programId=10013&channelId=-13462&ooid=8101&contentId=21336&pageTypeId=8199&contentType=GSA_BASIC&programPage=%2Fep%2Fprogram%2FgsaBasic.jsp&P=FX7

Vantage Partners. (2008). *vantagepartners*. Retrieved August 17, 2008, from Developing a Supplier Negotiation and Relationship Management Process and Toolkit: www.vantagepartners.com/consulting/successstory.cfm?id=8

Wind, Y. a. (1968). The determinants of vendor selection: The evaluation function approach. *Journal of Purchasing and Supply Management* , 29-41.