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A Comparative Study of Procurement Management in China's Petrochemical Companies

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A Comparative Study of Procurement Management in China's Petrochemical Companies

A Major Qualifying Project Report:

Submitted to the Faculty

Of the

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This report represents the work of one or more WPI undergraduate students submitted to the faculty as evidence of completion of a degree requirement. WPI routinely publishes these reports on its website without editorial or peer review.

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Abstract

This project studies and compares the procurement and supplier management methods of two petrochemical companies in China, BASF-YPC and YPC. To help understand the practices of these companies, literature was searched to identify relevant best practices in the areas of purchasing strategies, supplier selection, and supplier performance evaluation. The practices of the companies were compared with each other, and with the identified best practices, from which some areas for improvement were identified, and possible suggestions were offered to the companies.

Acknowledgements

The BASF-YPC and YPC 2009 MQP project team would like to thank BASF-YPC and YPC for their time, and providing us with information. Special thanks to Mr. Xu Nanqiang and Mr. Zhou Jian of BASF-YPC for meeting with the team in person on multiple instances. The team would also like to thank Mr. Zhang Jian of YPC for meeting with the team on several occasions even with his company's late entry into the project.

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Executive Summary

In this project, the procurement methods and supplier management of two important petrochemical companies in China were studied. A comparative study between BASF-YPC and YPC was performed on these topics to gain a greater understanding of how these two companies differ in the way they operate, and how their different backgrounds affect their operations. This study was also meant to give the project team a greater appreciation of management procedures in the China region and how they differ from those in the US. BASF-YPC and YPC were chosen specifically because of their different backgrounds, and for their different perspectives on regional and global businesses in China.

BASF-YPC is a 50/50 joint venture between BASF of Germany and YPC of China. BASF is a global leader in petrochemicals, and it provides customers with a series of high-performance products. These include various chemicals, plastic materials, agricultural products, as well as crude oil and natural gas. The company has operations in 39 countries with more than 350 establishments. It entered this joint venture with YPC to learn from YPC's regional experience and gain an edge in doing business in the China region.

YPC is a wholly owned subsidiary of China Petroleum and Chemical Corporation (Sinopec). Sinopec is the second largest petrochemical company in China and it engages in oil exploration and development. It also produces and sells petrochemical products. One of the major areas where YPC intends to benefit from this merger is to learn from the good management practices of BASF.

Although BASF-YPC is a 50/50 joint venture, the company is more influenced by BASF's corporate structure and culture than YPC's; as a result BASF-YPC uses more BASF strategies. YPC being a subsidiary of Sinopec uses and is influenced significantly by its parent company but uses very little influence in the joint venture. It is in this regard that this project was initiated to study how the two companies do things differently, focusing on procurement and supplier management. While studying their procedures, the team attempted to identify areas in both companies' practices that could be improved and areas where further study could greatly benefit the companies.

From these comparisons, the team found that although both companies are engaged in similar businesses and are both located in China, they have more differences than similarities. Due to BASF's influence in the joint venture, BASF-YPC follows more international standards and best practices than YPC, which runs its operations taking into consideration more regional and local factors. YPC is mostly influenced by its parent company Sinopec, which has as a major stakeholder the Chinese government. As a result it operates with less foreign influence.

By the completion of the project, the team found some areas in YPC's procurement practices that could be improved and offered suggestions to the management. On the other hand BASF-YPC's procurement department exhibited very good procurement methods and supplier management practices such that the project team found almost no weak areas to offer suggestions for improvement.

1 Introduction

Purchasing in any business is a very critical process that requires attention and continuous evaluation. The contribution it makes is as equally important as those made by manufacturing, marketing and engineering to the pursuit of a company's strategic objectives. Firm's that pay attention to procurement realize the impact it has on total quality, cost, delivery, technology, and total customer satisfaction.

As companies look for ways of improving customer value and performance, many have identified purchasing and supply management as key areas that affect the total cost of a firm's operations. Manufacturers spend an average of about \$55 cents out of every dollar of revenue on goods and services, which makes purchasing an area for significant cost savings (Monczka, Trent, & Handfield, 2005). Procurement plays an important role in the efficiency of any production or manufacturing plant by ensuring that all raw materials, parts, and components necessary for the smooth operation of the facilities are readily available when needed. (Jeeva A. , 2008)

There are many challenges that face procurement departments in their struggle to ensure the smooth operation of their companies through making available the right kind of parts or services when needed while maintaining cost effectiveness. According to Dr. Jeeva these challenges include: "Discontinuation of critical parts and components, new sources of supply, uncertainties in the environment, quality, capacity and capability of suppliers, supply configuration, corporate social responsibility, greening, and contractual obligations (Jeeva A. , 2008, p. 1)."

Due to the growth in complexity of procurement procedures, effective strategies will become necessary for companies to remain successful in reducing costs through procurement, improve efficiency and performance, and ensure that raw materials, and parts and components are always available for use (Jeeva A. , 2008).

Such demand on procurement requires purchasing departments to shift from the traditional tactical or clerically oriented activities to strategies that focus on effective supply management. "The challenge for strategic procurement professionals is to go beyond the 'low hanging fruit' and make improvements that systematically impact the Procurement process."

(Baron, 2002, p. 1). This can be done effectively with strategic supply management. “Strategic supply management involves developing the strategies, approaches and methods for realizing a competitive advantage and improvement from the procurement and sourcing process particularly through direct involvement and interaction with suppliers” (Monczka, Trent, & Handfield, 2005, p. xxi)

The present procurement practices of BYC and YPC vary in several ways. BYC’s procurement department is responsible for all procurements done in the company. The department is in charge of the acquisition of both direct and indirect materials and these two branches are not separated. Instead the company has divided procurement into three segments: service procurement, technical procurement and raw materials procurement. The company also uses a special strategy called Procurement Verbund Team (PVT) which focuses on the utilization of cross functional teams to make all significant procurement decisions.

YPC on the other hand follows procurement practices of its parent company Sinopec. The company’s production department is in charge of all raw materials and the purchasing department which is called YPC Material and Equipment Department (YPCME) is mainly responsible for MRO procurement for the company. YPC does not do all its procurement as an independent company. Often times YPC’s purchases are made by Sinopec or are influenced by them.

This project compares the procurement strategies and methods, as well as supplier management strategies of BASF-YPC and YPC. The goal of this project was to study procurement management, supplier selection, and supplier performance evaluation in the environment of China, and to enhance understanding and knowledge in these areas. Four objectives were created to facilitate this goal. The first objective was to understand and compare each company’s practices. The next was to attain a firm understanding of best practices that could apply to the companies. Following this the project team used data and information obtained from these two companies to identify areas of contrasts, similarities, strengths, weaknesses, and potential areas for improvement while comparing their practices with best practices.. . Finally the team suggested possible solutions to the identified areas and made recommendations to the companies.

2 Company Profiles

2.1 Profile of BASF-YPC

BASF-YPC Company Limited (BYC) is a large scale petrochemical 50:50 joint venture between BASF and Sinopec, with a total investment amounting to USD 2.9 billion. Like its Parent companies BASF-YPC (BYC) focuses on petrochemical refining and chemical products. Some of the products the company deals with are:

- Paints & Coatings / Superabsorbent Polymers / Fibers & Textiles/ Paper Coatings
- Solvents / Adhesives / Ink / Plasticizers / Fuel Additives / Plastics
- Film & Shrink Wrap / Antifreeze / Polyester
- Thermoplastics
- Pharmaceuticals / Food Preservatives
- Leather Processing / Downstream Chemicals / Pesticides
- Chemical Catalysts (BASF-YPC Co.Ltd., 2009)

2.1.1 Petrochemical Site in Nanjing

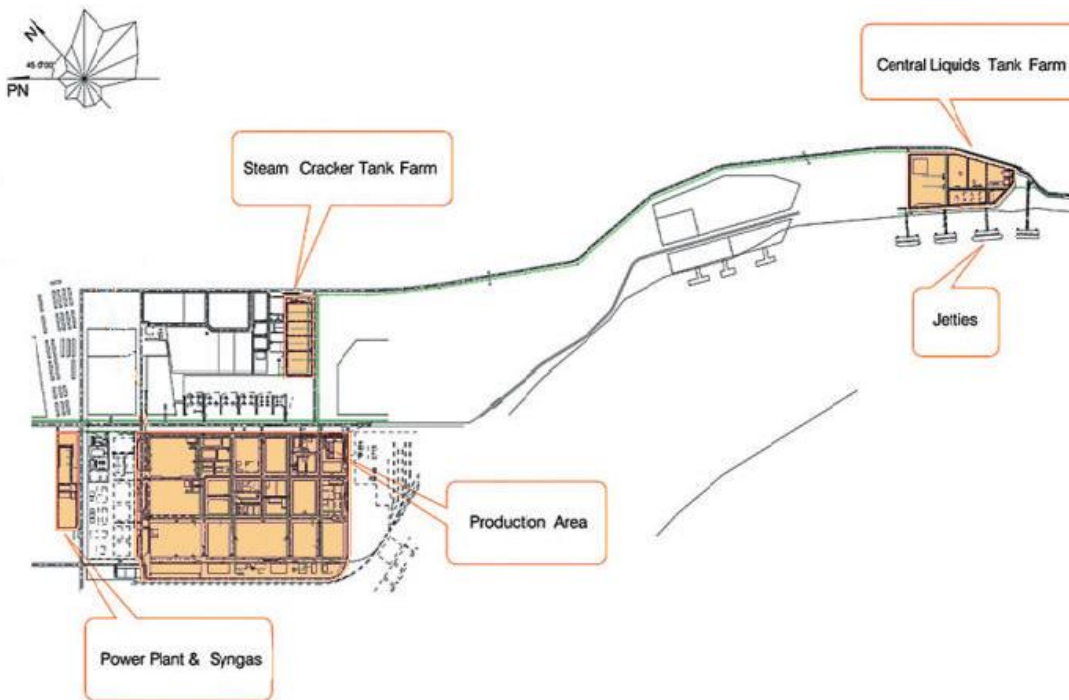


Figure 2.1 BASF-YPC's Petrochemical Site in Nanjing

2.1.2 Products & Services

Table 2.1 List of Products offered by BASF-YPC

Acrylic Acid & Esters	Cracker & Aromatics	Oxo-Alcohols & Intermediates	EG & LDPE/EVA
<ul style="list-style-type: none">•Crude acrylic acid (CAA)•Glacial acrylic acid (GAA)•Methylacrylate (MA)•Ethylacrylate (EA)•n-Butylacrylate•2-Ethylhexyl acrylate (2-EHA)	<ul style="list-style-type: none">•Polymer Grade Ethylene•Polymer Grade Propylene•Benzene•Toluene•Mixed Xylenes	<ul style="list-style-type: none">•n-Butanol•i-Butanol•2-Ethyl hexanol•Propionaldehyde•Formic Acid•Propionic Acid•Monomethylamine anhydrous•Dimethylamine anhydrous•Trimethylamine anhydrous•Monomethylamine (aqueous solution)•Dimethylamine (aqueous solution)•Trimethylamine (aqueous solution)•Dimethylformamide (DMF)	<ul style="list-style-type: none">•Low Density Polyethylene (LDPE)•Ethylene Vinyl Acetate Copolymer Resin (EVA)•Ethylene Glycol (MEG)•Diethylene Glycol (DEG)•Triethylene Glycol (TEG)

(BASF-YPC Co.Ltd.)

2.1.3 Organizational Structure

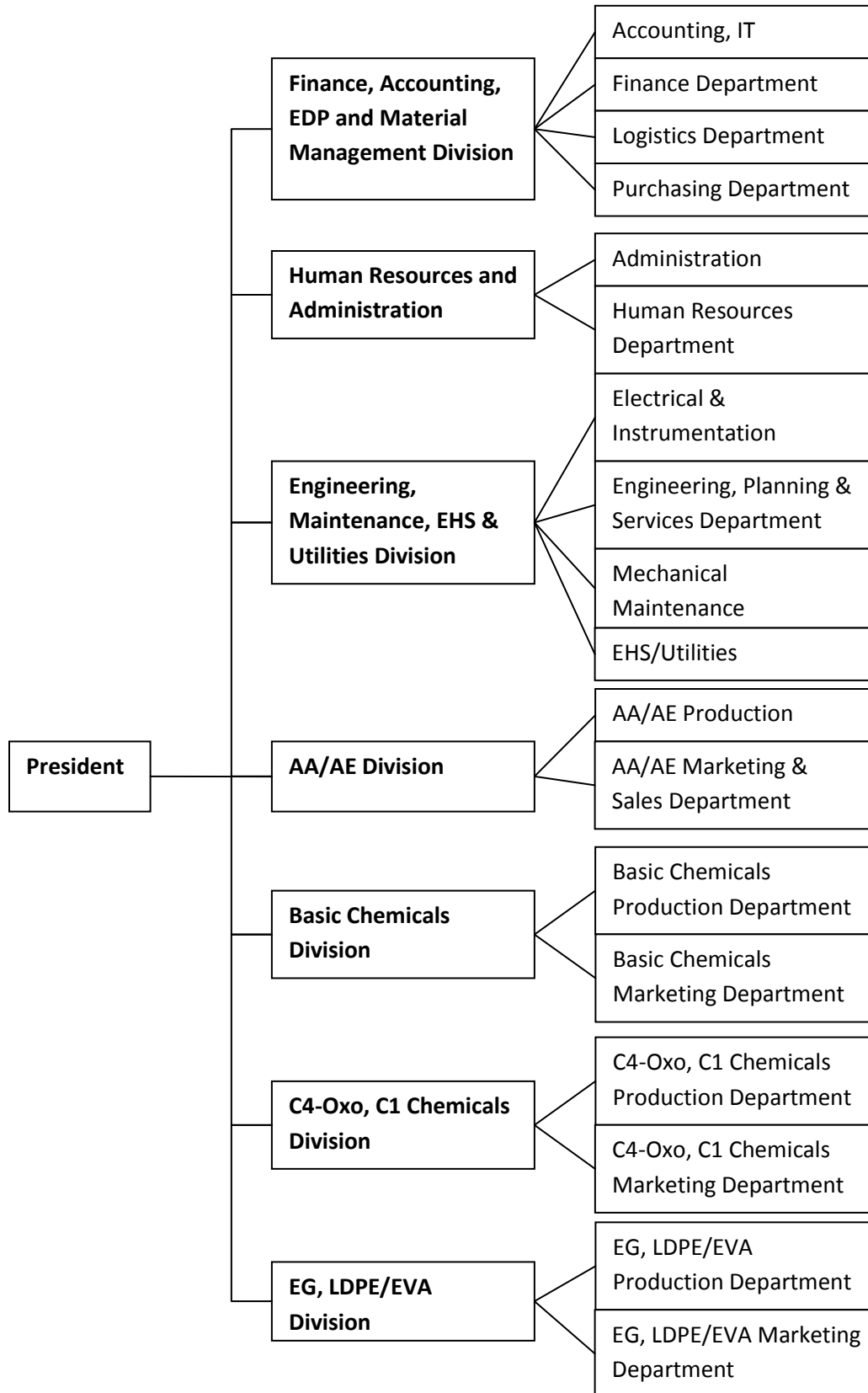


Figure 2.2. Organizational Structure of BASF-YPC

(BASF-YPC Co.Ltd., 2009)

2.2 Profile of YPC

2.2.1 Introduction

Yangzi Petrochemical Company limited (YPC) is located in Nanjing, Jiangsu Province, China. It is a wholly-owned subsidiary company of China Petroleum & Chemical Corporation (Sinopec). The company processes about 8,000,000 tons of crude oil per year, 650,000 tons of ethylene per year, and 1.4 million tons of aromatics per year as the core of its 43 sets of large-scale petro-chemical production plants. YPC's annual production capacity is over 700 million tons split into 5 primary categories: polyolefin plastics, polyester raw materials, rubber raw materials, basic organic chemical raw materials and finished oil products. The products can be widely used in light industry such as textiles, electronics, food, automotive, aviation, as well as the modernization of agriculture and other fields. The annual sales of YPC is more than 400 billion Chinese Yuan. In response to globalization and market competition, Yangzi Petrochemical has invested 6.3 billion RMB and has established seven joint ventures in recent years. (YPC)

2.2.2 Organizational Structure

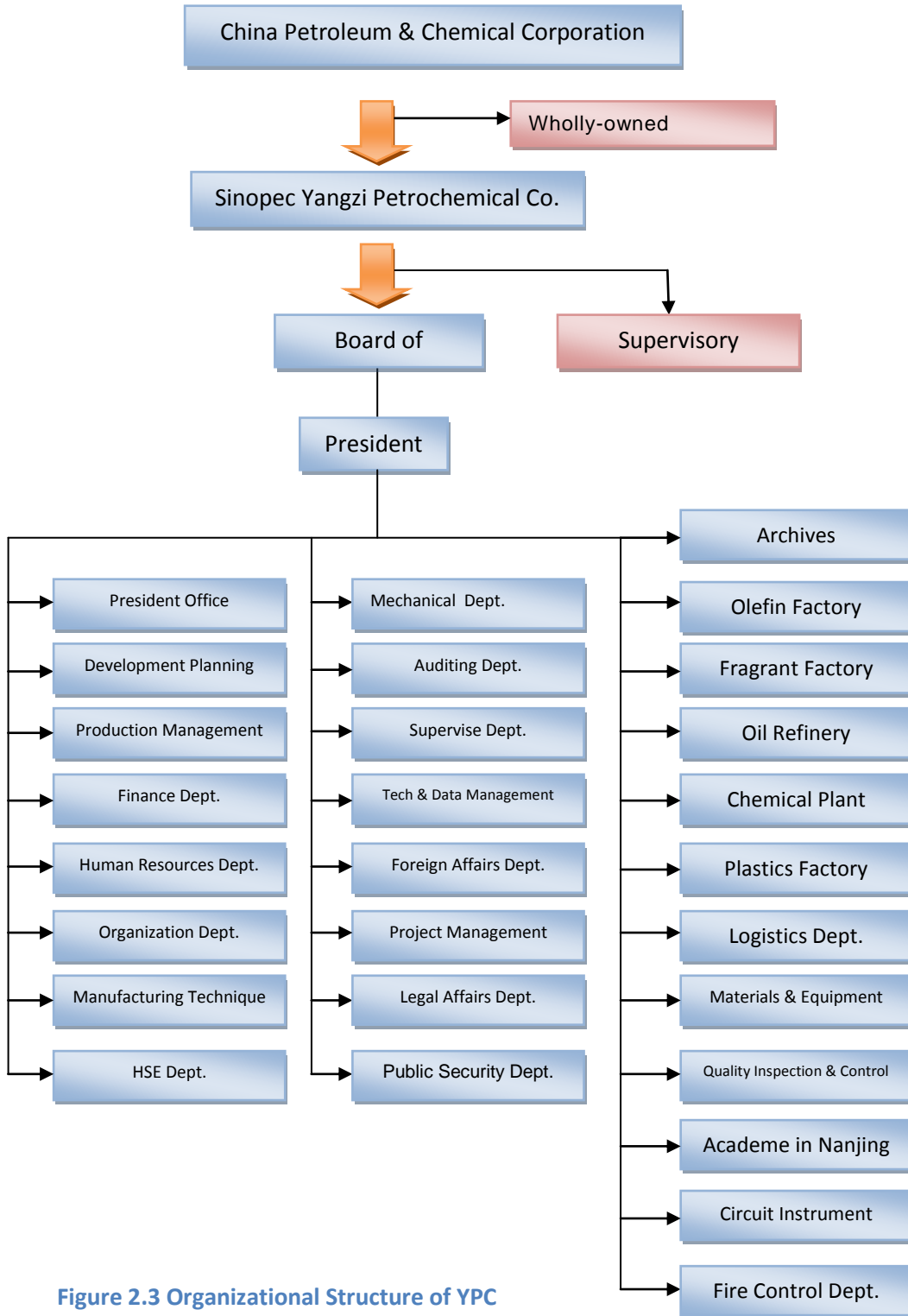


Figure 2.3 Organizational Structure of YPC

2.2.3 Products & Services

Table 2.2 Products and Services of YPC

Basic organic chemical raw materials	Polyester raw materials	Refined oil products	Polyolefin plastic
<ul style="list-style-type: none">• Ethylene for industrial use• Propylene for industrial use• Butadiene for industrial use• Diethylene glycol for industrial use• Three ethylene glycol• Cracking RAFFINATE four carbon• Other chemicals	<ul style="list-style-type: none">• Purified terephthalic acid for industrial use• Ethylene glycol for industrial use	<ul style="list-style-type: none">• Slurry• Motor Gasoline• 3, jet fuel• Light diesel oil, automotive diesel city• Fuel oil	<ul style="list-style-type: none">• High-density polyethylene• Low density polyethylene• Polypropylene resin• Other plastic products

(YPC, 2009)

2.3 Profile of BASF

2.3.1 Introduction

BASF is headquartered in Ludwigshafen, Germany. It has more than 350 businesses in 39 countries. And in Germany it has more than 60 manufacturers, who are located in Ludwigshafen, Munster, Hamburg, Stuttgart, Mannheim, Würzburg, Cologne and other cities. BASF has its own coal, oil and gas resources. BASF's businesses in foreign countries are mostly in Europe. In addition, it has branches in the United States, Japan, Argentina, India, Singapore, Egypt and China. Over the past few years, BASF has focused on the development of integration in the petrochemical industry.

BASF is a leading chemical company that provides customers with a series of high-performance products, including chemicals, plastic materials, agricultural products as well as crude oil and natural gas.

2.3.2 Organizational Structure

Corporate Management and Control



Figure 2.4 Corporate Management Structure

- Corporate Governance: management and supervision of company activities
- Board of Executive Directors and Supervisory Board jointly responsible for the direction of the company
 - Board of Executive Directors manages company operations
 - Supervisory Board oversees and advises Board of Executive Directors

2.4 Profile of Sinopec

2.4.1 Introduction

China Petroleum & Chemical Corporation (Sinopec Corp.) is a publicly listed company, trading on both domestic and international stock markets. As its name indicates, Sinopec is engaged in oil and gas exploration and production, as well as the production and distribution of oil and chemical products. The company is vertically integrated with well-defined upstream and downstream operations, prominent core businesses, and an established marketing and distribution network in mainland China. Over the past few years, Sinopec Corp. has earned a number of impressive rankings in China's business market. It is China's largest producer and distributor of oil products (both wholesale and retail of gasoline, diesel, and jet fuel), the number one producer and supplier of major petrochemical products (including petrochemical intermediates, synthetic resin, synthetic fiber monomers and polymers, synthetic fiber and chemical fertilizer), and the second largest crude oil producer (Sinopec).

Sinopec has signed and renewed strategic relationships with 23 domestic and 10 international suppliers, Economic Observer reported (A Chinese newspaper). The suppliers include steel manufacturers, coal and crude oil suppliers and large equipment providers. Domestic firms Baosteel, Angang, Shenhua Energy, and China Aerospace Science and Technology Corp were among the companies that signed new deals. Cooperation with these strategic suppliers will serve Sinopec's next round of expansion over the next three years, including oil explorations, refining and building a natural gas pipeline, said Sinopec director Wang Tianpu.

2.4.2 Organizational Structure

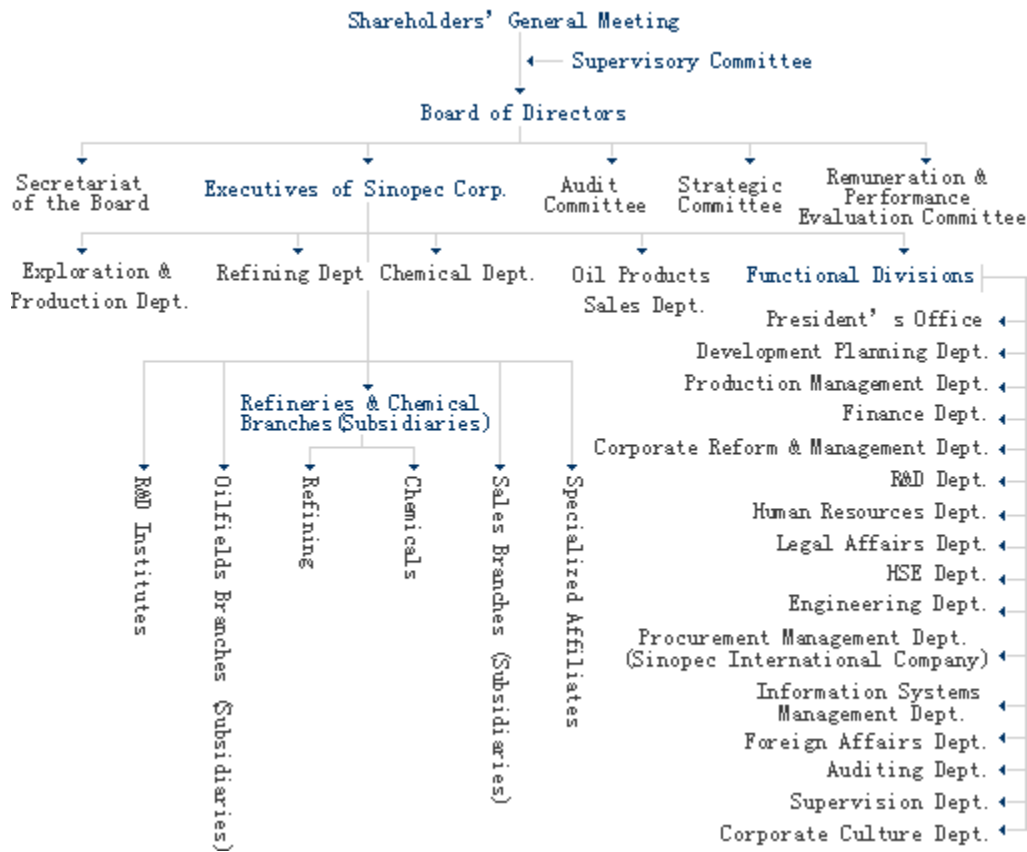


Figure 2.5 Organizational Structure

(Sinopec)

2.4.3 Products & Services

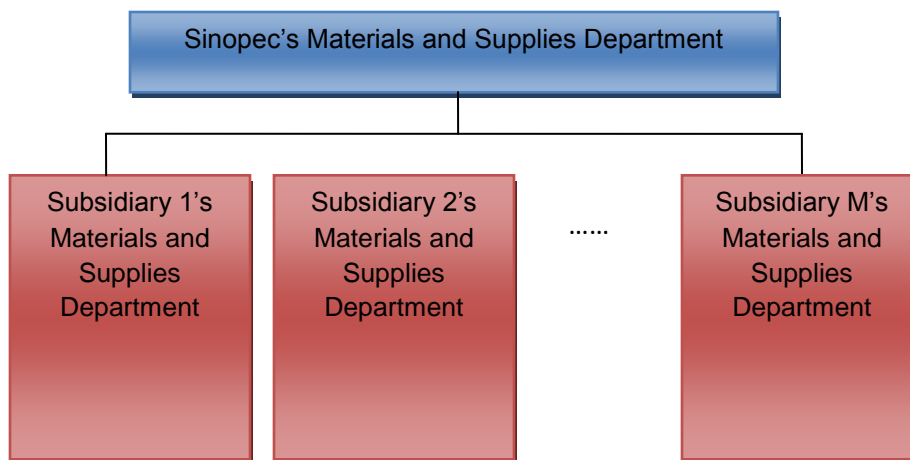
Table 2.3 Products and Services of Sinopec

Automotive Lubricants	Marine Lubricants	Industrial Lubricants	Greases	Special Synthetic Lubricants
<ul style="list-style-type: none"> Gasoline Engine Oil Diesel Engine Oil General Engine Oil Motorcycle Oil Gas Engine Oil Railway Engine Oil Automotive Gear Oil Transmission Fluid Engine Coolant Brake Fluid Others 	<ul style="list-style-type: none"> Engine Oils-Crosshead Diesel Engine Oils-Trunk Piston Outboard Engine Oil 	<ul style="list-style-type: none"> Industrial Gear Oil Hydraulic Oil Compressor Oil Refrigeration Compressor Oil Turbine Oil Transformer Oil Others 	<ul style="list-style-type: none"> General Purpose Grease Grease for Metallurgical Industry Bearing Grease Grease for Electric Tool 	<ul style="list-style-type: none"> High and Low Temperature Bearing Grease Special Lube For Metallurgical Industry Special Grease For Automobile Components Synthetic High Temperature Chain Oil Special Lube-Sealant

(Sinopec)

2.4.4 Materials Management System

For the Department of Materials and Supplies, Sinopec has adopted a hybrid system of centralized management and decentralized control.



The Organizational Structure of Sinopec's Materials and Supply Department

Figure 2.6 Organizational Structure of Sinopec's Materials and Supply Department

It is seen from the chart above that the MS Department (Materials and Supply Dept.) plays an integral role in Sinopec's supply chain, linking its large supply base of over 20,000 members to the production facilities. Additionally, due to the huge procurement volumes and expenses incurred every year, the MS Department contributes significantly to the entire enterprise's efforts in cost reduction and quality improvement (Zhao & Zeng, 2007).

Since Sinopec is an enterprise that is largely dependent on purchasing, it has paid a great deal of attention to effective sourcing strategy design and improvement. Over the years, the MS Department has gained extensive experiences in purchasing practices for various material and commodity groups. Sourcing methods have generally fallen into the following three major models:

- (1) Direct integrated purchase by the MS Department: the MS Department first centrally integrates the needs from all subsidiary firms, makes the actual purchases, and then allocates the acquired materials to each Subsidiary's respective departments. This approach is typically completed via the e-commerce websites of the vendors.
- (2) Integrated purchase managed by the MS Department: the MS Department takes responsibility to make group purchase decisions, such as identifying possible vendors and determining the price ranges (especially the upper limit). Each subsidiary company then selects the most appropriate vendor based on product specifications, price preference, location, credit, and other factors.
- (3) Individual purchase by each subsidiary company: the subsidiary company makes purchasing decisions independent of the central MS Department.

(Zhao & Zeng, 2007)

3 Literature Review

3.1 Supply Chain Management

For the operations of any business to run smoothly, the flow of materials to and from key locations must be carefully managed. This includes resources that go into intermediary products, resources that go directly into the final product, resources that contribute to the everyday running of the company, and getting the product to intermediary and final customers. While a single company may not have direct control over all of these operations, it is key for the company's success that it regulates as much of this process as possible, whether through intermediaries and outsourcing or in-house management. Supply chain management is a combination of these activities, "Managing the modern supply chain has become a job that involves specialists in manufacturing, purchasing, and distribution (The 21st Century Supply Chain, 2004).

3.1.1 Aspects of Exemplary Supply Chain Management

In his seminal article, "The Triple-A Supply Chain," written for the Harvard Business Review (Lee, 2004) asserts that companies frequently confuse the most efficient supply chain as the optimal one for their situation. While this is not always the case, the optimal supply chain, Lee claims, is one that combines the three A's: Agility, Adaptability and Alignment (Lee, 2004). Historically, it has been observed that when business is doing well, it implies that companies have focused on maximizing the speed of their supply chains, and when business is doing poorly, it is an indication they have focused on cutting costs. However, the most efficient and cost-effective supply chains do not necessarily gain a sustainable advantage over their rivals. A disadvantage of supply chains that focus on low cost and high speed is that they are unable to adjust to unexpected changes in supply and demand, having devoted their optimization to economies of scale (Gilmore, 2009), which results in massive swings in the amount of inventory and lost profits (Lee, 2004). It is therefore important for companies to combine all three "A's" as Lee points out, in order to operate in a well-balanced business environment.

Agility is defined as the ability to adjust and respond efficiently to sudden unexpected changes in markets. This can be done by utilizing contingency plans, developing crisis management teams, developing a dependable logistics system or partner, building inventory buffers of inexpensive key components, developing collaborative relationships with suppliers,

and promoting the information flow between the company and its suppliers and customers (Lee, 2004).

Adaptability is defined as the ability of a supply chain to meet and adapt to long-term structural shifts in the markets it serves and utilizes. It is also the ability of a company to meet shifts in company strategy (Gilmore, 2009). This can involve modifying supply networks and strategies, modifying products, modifying technologies, monitoring economies around the globe for new supply bases and markets, utilizing intermediaries to develop new suppliers and logistics infrastructures, evaluating the needs of the end consumers, creating flexible product designs, and determining where the company's products stand in the technology and product life cycles (Lee, 2004).

Alignment is defined as the ability of a company to align the goals of all of its supply chains with the company's goal. This way, all efforts to improve the bottom-line of each component of the supply chain is in line with improving the performance of the supply chain, and collaboration is encouraged. This can involve creating incentives like profit sharing and risk sharing, defining roles, tasks, and responsibilities for suppliers and customers, and exchanging information and knowledge freely with vendors (Lee, 2004). Through these methods, the suppliers will have a vested stake in the purchasing and the company's success (Gilmore, 2009).

3.1.2 Challenges in the Optimization of a Supply Chain

In 2001, Whirlpool's North American branch had a product availability of around 87%, lagging far behind many of its competitors. To turn this around, Reuben E. Slone and Paul Dittman developed a battle plan which included new information technology, new processes, new roles, and new talents. In this process, accurate and timely information was key, as well as the selling of their plan to all those involved (Slone, 2004).

Slone and Dittman began with new research on the topic of consumer needs, and from this, they discovered 27 different dimensions upon which Whirlpool's performance was being judged. They then compared this to their largest competitors and cross-industry information. From this information, they determined how much it would cost to become the leader in each dimension and then what medium- and low-level investments they could perform. Next, areas where small investments yielded high returns were identified as beneficial options. Similarly,

areas where large investments would yield low returns were eliminated as possibilities. To further develop the plan, several meetings were held with key individuals. Competitive analysis was essential to getting the impact of the plan across to everyone. Finally, fresh talent was added to the company from companies with strong supply chains and highly competitive supply-chain-focused MBA programs (Slone, 2004).

Talent in the company was fostered with incentives for expertise enhancement even outside of promotions, and partnerships with Michigan State University and the American Production and Inventory Control Society (APICS). Within the company, a Six Sigma black belt was utilized to enhance the solution development process. From industry and academia, an expert advisory board was developed to benefit the upper management of the project. Lean techniques were applied, as well as using different types of inventory to balance the demands of other types of inventory in terms of costs. For example, the smallest-volume Stock Keeping Units (SKUs) can be taken out of inventory to operate on a pure pull basis, while high-volume SKUs can be given extra buffer so that they are never out of stock (Slone, 2004).

As a result of these changes, product availability increased to over 93% by 2003 and 95% in 2004. Day's finished goods in inventory dropped from 32.8% to 26%. Total cost productivity from freight and warehousing changed from 4% to 7.2%. Working capital was lowered by almost \$100 million and supply chain costs reduced by almost \$20 million. The total payback on the original investment was less than 2 years (Slone, 2004). Different corporations take different approaches at optimizing their supply chain base just as Whirlpool did.

Exxon Mobil Corporation was recognized by Hackett Best Practices, a division of Answerthink Inc., for its best practices in procurement in 2002 (Business Wire, 2002). These practices were classified under the categories of operating efficiency and effectiveness. They utilized global implementation of standardized processes and procedures, which allowed them to leverage their size and expenditures to optimize their relationships with their suppliers.

3.2 Procurement

Of the many fields involved in supply chain management, procurement is one of the major areas. It is here that a company gets the resources it needs to run.

Procurement itself can be broken up into three major divisions by the intended use of the resource: raw material and production goods, maintenance, repair and operating (MRO) supplies, and capital goods and services. Of the three, MRO is most frequently understated, but is an area that can make or break a company's competitive advantage. According to Tuck (2002), improper procurement management leads to three possible outcomes: running out of parts, having too much inventory, and failing to aggregate spend and leverage procurement, capitalizing on volume discounts and low-cost suppliers.

The largest obstacle in procurement today is the large amount of data involved. There are “thousands of discrete items sourced from dozens of suppliers... multiple plants across the country and around the world” (Tuck, 2002, p. 1).

3.2.1 General Procurement

Direct vs. Indirect Procurement

Industrial procurement of materials, such as those for manufacturing plants, can be classified as direct or indirect, with direct procurement referring to production-related goods and indirect procurement referring to non-production-related goods. In the past, companies have viewed the two classes of purchasing separately and have applied different strategies in the handling of these activities. Direct items such as raw materials, which go into the production of goods and services and come out as the end product, have always had more consideration than indirect materials, which still make a significant impact on overall production costs, even though they have no connection with the finished product (NRX, Making Information Relevant; MRO Supply Chain Excellence, 2008).

Since the 1980s, companies have devoted much time in research and development, which have resulted in many innovative methods in logistics and capacity planning as well as inventory control and management. These discoveries have enabled industries to use IT systems to support their logistics replenishment in more effective ways than in the past. Systems such as Materials Requirement Planning (MRP) have given companies the flexibility to respond to the constantly changing customer requirements, while maintaining production processes that are cost-effective and competitive in the global market (Gebauer & Segev, 2000).

Indirect Procurement (MRO)

One of the most commonly used terms in any production or manufacturing industry is “MRO”. Maintenance, repair, and operations (MRO) are part of daily activities that production industries partake in, and therefore, procurement of any necessary item for the use of these activities is crucial to the smooth operations of the industry. Although the materials and services that are termed MRO do not go directly into the end products of the manufacturing or production process, they are necessary to realize profitable end products (Setech Inc. "What is MRO", 2008).

The Strategic Importance of Procurement

One way of making procurement more effective is maximizing the use of available technologies. In an MRO Buying Report article in 2001, Albert Keal, director of purchasing operations, powertrain/components, and indirect materials at the Harley Davidson Motor Co in Milwaukee, Wisconsin, noted that the use of technology will play a tremendous role in procurement by reducing lead-times and transaction costs, and providing purchasing with capability to leverage high volumes (Purchasing Magazine, 2001).

Using technology strategically is necessary to reinforce and enhance procurement. A very effective procurement strategy will improve operational integrity, which is crucial for improved manufacturing uptime and productivity. Furthermore, a successful procurement plan will drive down production cost and improve overall end-product quality.

3.2.2 Reorganizing Procurement

- Increasing supplier contracts has the advantage of increasing cooperative purchasing power. Companies often generate cost savings by re-negotiating long-term contracts with their suppliers.
- Proper monitoring of both direct and indirect purchases provides companies with better information on spending patterns. Knowing spending trends on items helps to identify areas of possible cost savings.
- Reduction of what is often an enormous number of suppliers allows companies to get rid of the not so needed suppliers and establish better connections with the ones that are most needed. When this happens, better supply contracts are negotiated, price reductions are possible, and improved relations and services are expected (Gebauer & Segev, 2000).

Electronic Procurement

As part of reorganizing procurement strategies, more firms are increasing their use of technology to help ensure better purchasing operations. To realize the full benefits of these emerging technologies, certain decisions must be made. The scope of the project must be determined at the start. In addition to the scope, other necessary decisions include “vendor selection and choosing, a business model for catalog content and supplier management, as well as the degree of integration with ERP and other systems” (Gebauer & Segev, 2000, p. 112).

Scope

Two components determine the scope of electronic procurement: the “range of products and services that it covers, and the functionality it provides” (Gebauer & Segev, 2000, p. 112). However, not all goods and services can be supported by electronic procurement solutions. Goods and services can be categorized into the level of complexity, which are considered as the risk it poses to the user company and the strategic importance of such goods. In other words, it is the level of profitability that such products could potentially bring to the company. The following variables can be used to categorize goods and services into these two groups: delivery terms, the number of available suppliers, the pace of technological change, and the complexity of logistics.

“Low hanging fruit” is a term used to describe “standardized items that do not require much information and explanation, that allow for digital handling, and involve high transaction volume and high degree of distribution, and for which the transparency of the supplier market is low” (Gebauer & Segev, 2000, p. 112). There are several steps that are involved in designing an electronic purchasing process, and a decision must be made about which steps to include in the process. Examples of these include an information phase, negotiation, and settlement, including payment and after-sales activities.

Vendor Selection

The vendor selection process, like the scope, has several dimensions that determine an effective vendor choice. The best packages by vendors, though dedicated to a small range of products, are able to compete with established market players that offer services over a broader

range of products. Most vendors try to provide software to be used for procurement, as well as offer additional services that are mostly aimed at strategically collaborating with partners to offer attractive services. These additional capabilities can also be considered for selection.

Catalog content and supplier management: Internal vs. external solutions

As seen in Table 3.1, one important way of ensuring a smooth indirect electronic purchasing is to use a multi-vendor catalog showing items and services of different supplier companies.

Table 3.1 Existing Vendor Selection Methods. Adapted from (Gebauer & Segev, 2000, p. 114)

Feature	Best-of-breed/sole solution providers	Established vendors of comprehensive solutions (ERP)
Focus vs. Vision	Focus on limited range of products concentration on core competencies No constraints by previously defined IT architectures and underlying business models	Need to support broad range of products and large number of installations can limit ability to focus Integration of applications into a larger whole – helps realize a broader vision
Flexibility vs. Experience	Small customer base allows flexibility and responsiveness to customer needs Robust software development concepts, experience User friendliness	Robust software development concepts, experience Took time to match requirements regarding ease of use and intuition
User friendliness	Friendly user-interfaces as major success factor	
Brand name	Uncertain future – early stages of financing, tight competition expected Established brand names, large customer bases	Established brand names, large customer bases, market power
Implementation efforts and real-time integration	Stand alone solutions not always available – need to install backend systems and databases and establish additional links and interfaces Real-time integration not always available	Backend systems and front end applications from one source. Number of additional links limited

Integration with Other applications

Electronic procurement solutions require products that can be integrated into a firm's existing software system. Some vendors offer packages that can be easily linked with existing application systems, while others do not offer these types of products. Therefore, depending on the need of the company, such inquiries might be necessary before a vendor is chosen. Electronic procurement is one solution to changing indirect purchasing strategies. However, it cannot stand on its own because it has to be integrated into existing systems (Gebauer & Segev, 2000)

Outsourcing

Outsourcing is a strategy that some companies have adopted in an attempt to reorganize their procurement. A benefit of outsourcing that many companies have experienced is cost savings. Outsourcing requires sound strategies to ensure that the best providers meeting the particular needs of a company are selected. Some considerations that will assist companies in their decision include the number of personnel that would service the facility, the distance between the supply point and the company, which is how long it will take for ordered parts to be delivered, availability of the outsourcing personnel, expected turnaround time, accessibility of outsourcing personnel, whether or not they will always be available to management and internal users when needed, the necessary procedures for ordering goods and services, automation efforts that the provider is or will be involved in, in terms of both providing services and payments and provisions made for emergency situations (Brown, 1999).

Benefits and Challenges of Outsourcing:

Many companies view outsourcing as one of the easiest ways of reducing purchasing costs. However, outsourcing has challenges, too. It is therefore important for decision makers to analyze both sides of the option before a decision is made.

One challenge that prospective outsourcers must be aware of is the potential for initial costs that can occur in the initial contract stages. Many outsourcing firms expect to be able to access local companies' inventory levels and processes so that they can better analyze and manage them. They prefer to have a computer link to their customers' systems. If this link is not

in place, it is necessary to determine which party is responsible for installing this link (Brown, 1999).

There are other hidden costs that need to be discussed in depth between the provider and the customer with any outsourcing contract. For example, if a particular service provided by the firm requires continuous attention and expenditure, the contract should be negotiated such that these additional costs would be borne by the firm as part of the deal. Additionally, companies should avoid a scenario where the supplier would start charging added fees for future services provided after the contract has been signed and is in progress (Brown, 1999).

Customers must be able to examine the processes that potential suppliers will use to track inventory levels. Since different companies have different systems of tracking inventory levels, this must be discussed in detail as part of the contract terms. Another contract issue includes the length of contracts. Customers have several options as to how to negotiate and establish contract terms with their suppliers. Some suppliers have a minimum number of years that they expect contracts to last. However, customers can opt to compromise and renew the contract annually.

Among the mentioned contract issues is the issue of pricing. Pricing should be negotiated such that it could be reviewed regularly. It is necessary that for non-standard items, detailed terms of the contract establish pricing. These items include those that are not used regularly, but fall into the cost and usage of the MRO category. Another issue that must be addressed in the contract is turnaround time. For example, if the customer expects a 24-hour turnaround for all supplies, this should be included in the contract terms. This will eliminate any delay in replenishment, which otherwise would prolong lead times (Brown, 1999).

3.2.3 Procurement by Petrochemical Industries

Petroleum company operations can be divided into two types: upstream and downstream activities. Upstream activities can be classified as the first phase of the petrochemical industry's processes, which includes exploration, production, and procurement of crude oil, or other forms of hydrocarbon raw materials. Downstream activities are all the activities that take place after the raw material has been procured. These activities include all the processes that the raw materials

are subject to until the final product is delivered to the consumer. Some downstream activities are refining, transportation, and sales of petrochemical products such as fuels, oils, lubricants, and other petroleum-based chemicals. Because of the instability of the oil market, it is very important that petroleum companies operate effectively in order to be able to recover all costs, even when oil prices continuously follow a downward trend (Gebauer & Segev, 2000)

Like any other growing industry, competition exists in the petroleum industry. In addition, due to complex regulations in this sector, it is required that the petroleum companies make substantial efforts to assure quality and compliance. New products must be developed constantly or quality standards must improve on a continuous basis. This incurs marketing expenses, which are often very substantial. Because of their size, many petroleum industries have a strong purchasing power, which sometimes is not utilized to their benefit. For the most part, purchasing is centralized, which leads to complex processes and large administrative overhead.

Direct procurement in petroleum industries, which includes crude oil, natural gas, and any other raw material, is handled by specialized departments rather than by a centralized purchasing department. This accounts for approximately 30% to 40% of revenues. Since direct procurement is undertaken by specialized departments, central purchasing departments are mostly left with the purchasing of indirect procurement, such as materials and services. This procurement accounts for approximately 14% to 16% of revenues.

Indirect procurement can include simple supplies in the area of maintenance, repair, and operations (MRO), such as valves, pipes and fittings, controllers and gages, office supplies, and computer equipment. It can also include complex equipment for exploration, drilling, and refining, and for particular services such as pumping, drilling, and maintenance services.

Certain activities in the petroleum industry tend to be difficult because of the size of the organizational structure of these companies. Some important tasks, such as sourcing, ordering, supplier management, and the monitoring purchasing patterns, are normally difficult, especially service procurements. For the most part, transactions are complex and are both nationally and internationally dispersed. Because of this, petroleum industries require systems to assist in

effective communication in procurement and limit the difficulty that can cause procurement processes to become cumbersome and expensive (Gebauer & Segev, 2000)

3.2.4 Procurement Optimization

Optimizing procurement and supply chain helps industries make gains by reducing total operation costs and improving efficiencies. Costs can also be saved on materials and inventory management. One factor that industries must note is the importance of ensuring that needed parts for any asset can be easily found. This will eliminate unnecessary time spent in searching for parts. Such time savings will directly increase labor productivity, plant reliability, and availability (NRX, Making Information Relevant; MRO Supply Chain Excellence, 2008).

According to Stimson (2002, p.1), “companies that invest in performance management outperform other companies in multiple financial measures.” Procurement performance optimization can be divided into six components: leadership, strategy, and governance; organization structure and centers of excellence; cross-enterprise integration and commodity teams; procurement resource management and development; stakeholder relationship management and communication; and metrics.

Leadership Strategy and Governance

About 65% of CEOs view procurement as important, while only 45% view current procurement practices to be effective. The gap between CEOs’ perception of the significance between importance and effectiveness must be filled by procurement officers. Excellent procurement leaders are described as visionary, ethical and fair, analytical, results-focused, relationship-oriented, people who have resolve, strategic thinkers, innovators, big thinkers, and change agents.

It is important for procurement leaders to understand the supply chain process in its entirety. An effective leader must integrate themselves into company operations and adopt a strategic plan to add value throughout the process. They must also be clear communicators and able to solicit the CEOs’ support to drive change for their company. Procurement leaders must see to it that all the necessary questions about procurement performance are asked. These questions must be strategic and based on direction, execution, and enablement (Stimson, 2002).

Organizational Structure & Centers of Excellence

MRO can be organized by like commodities, internal customers, or expertise - a combination of all three is also possible. However, each organization style has advantages and disadvantages, as seen in Table 3.2.

Table 3.2 Advantages and Disadvantages of like commodities. Source (Stimson, 2002, p. 2)

Advantages	Disadvantages
<ul style="list-style-type: none"> • Consolidate and therefore can leverage enterprise-wide volume and concentrate the supply base – top two ways to leverage volume and save money • Buyers can develop deep industry, commodity, and supplier expertise • Speak with one, consistent voice to Suppliers • Difficult for suppliers to play one internal customer off another • Manage business-to-business relationships at the enterprise level 	<ul style="list-style-type: none"> • Work across internal customers and therefore are less aligned • Some internal customers may have to “take one for the team” to get the overall best enterprise value • Internal customers are still held accountable for own Profit and Loss (P&Ls), e.g., by Strategic Business Units (SBU) and therefore resist cross-SBU activity • Local users feel removed from the supplier selection and management process and look to somebody else to solve supplier, supply, quality, and other problems

Advantages and disadvantages must be compared in order to choose the most appropriate method for the procurement. The procedure to select the best solution normally consists of two approaches: top-down and bottom-up. The top-down approach examines two workshops: “select, rank, and weigh structure evaluation factors and score structure options based on the factors.” The bottom-up approach “analyzes processes, tasks, and times in order to build ‘jobs’ in the new, top-down organization structure or shell” (Stimson, 2002, p. 2).

Cross-Enterprise Integration & Commodity Teams

A strategic sourcing best practice involves cross functional sourcing teams and utilizes value indexing. Once purchases are separated and divided, cross enterprise teams are formed to prioritize strategic sourcing. To proceed, these teams profile the commodities from both the internal supply and external industry perspective to determine a total cost of ownership (TOC) and develop a category strategy. Once all of this is completed, a supplier selection decision matrix can then be developed (Stimson, 2002).

Certain factors and weights make up the decision matrix. These factors include “net landed cost, quality, service / responsiveness, technology / innovation, manufacturing capability, continuous improvement, partnership / strategic fit, importance of buyer to supplier, supplier diversity, and globalization / localization” (Stimson, 2002, p. 2). These factors are considered first level, and a second level of factors describes in detail the first level. For example, net landed cost in level one will include all of the costs associated with a particular item, from its unit cost to freight charges and payment terms (Stimson, 2002).

A scoring conversion table then becomes necessary for all of the factors, both qualitative and quantitative, to help teams rate suppliers the same way. When the factors for scoring are identified, the teams can then issue requests for information (RFIs) and requests for proposals (RFPs). When responses for RFIs are received, suppliers can be scored using the factors and are either eliminated based on their information or are “short listed” to be included in the bid list for RFPs.

When responses for RFPs are received, suppliers are scored based on the developed scoring conversion table and ranked. The ranks are entered into the selection decision matrix to determine which suppliers have the best value to offer. This process is known as value indexing. An example is shown in Table 3.3.

Table 3.3 Value indexing matrix example (Stimson, 2002, p. 2)

Decision Factor	Guideline Weight	Identified Weight	Vendor A		Vendor B		Vendor C		Vendor D	
			Rank	Value	Rank	Value	Rank	Value	Rank	Value
Net Landed Cost	15-25%	22%	1	0.22	2	0.44	4	0.88	3	0.66
Quality	15-25%	20%	3	0.60	2	0.40	4	0.80	1	0.20
Service / Responsiveness	5-15%	12%	3	0.36	4	0.48	1	0.12	2	0.24
Technology / Innovation	5-15%	10%	3	0.30	1	0.10	2	0.20	4	0.40
Manufacturing Capability	5-15%	10%	1	0.10	2	0.20	3	0.30	4	0.40
Continuous Improvement	5-15%	9%	2	0.18	3	0.27	1	0.09	4	0.36
Partnership / Strategic Fit	5-15%	7%	1	0.07	3	0.21	2	0.14	4	0.28
Importance of Client to Supplier	3-5%	4%	4	0.16	3	0.12	1	0.04	2	0.08
Supplier Diversity	3-5%	3%	0	0.00	0	0.00	0	0.00	0	0.00
Globalization / Localization	3-5%	3%	1	0.03	2	0.06	3	0.09	4	0.12
Totals:		100%		2.02		2.28		2.66		2.74

In the value index matrix, a rank of 1 is considered the best, indicating that that vendor has the lowest value in the decision factor. For example, as seen in Table 3.3, Vendor A offers the best value, since its overall value is the lowest at 2.02. Vendor B offers the second best value at 2.28, and so forth.

For the cross enterprise teams to be successful, all members must understand and be committed to the team’s goals and objectives. The team must win the support of upper management, there should be open, clearly stated action plans, and open communication between team members aimed toward achieving a common goal. Three key roles will help to ensure the success of the team’s efforts: a leader, facilitator, and a benefits and measures professional.

The team leader is the liaison between sponsors and management, as well as any relevant committees. The leader is responsible for the team’s performance and the recognition of all team members for rewards, when necessary. The facilitator is responsible for organizing all team meetings and follow-ups with members regarding action plans. Finally, a benefits and measures professional will be in charge of establishing performance measures. The professional will determine the baseline measure (As-Is) and lead the team to achieve and set goals (To-Be) by putting in place a tracking and reporting process. The professional will also confer with the finance department on results and benefits (Stimson, 2002).

Stakeholder Relationship Management & Communication

For any venture to be successful, it is important that all stakeholders contribute to the efforts in achieving any set goals. In the same way, procurement has stakeholders, and re-

organization requires the opinion of all stakeholders. The stakeholders are the suppliers, the internal customers, and the procurement employees, and it is very necessary that all parties are involved in any decision-making process. It is beneficial to use a third party to obtain some information from these stakeholders about their point of view and any additional input, which can be used to assess some transformation concerns that may arise.

Some concerns, such as risks associated with transforming procurement that will emerge include execution risk, supply risk, demand risk, agility risk, and sustainability risk. For example, the “supply risk” can be explained as all the risk associated with the supply of materials in an attempt to consolidate the supply base. Communication between stakeholders is another important factor that has to be considered in the process of transformation (Stimson, 2002).

Metrics

Metrics tend to be one of the most important factors that are used in making decisions about change and transformations. Research by CAPS indicates that metrics by two of the stakeholders in procurement, CEOs, and CPOs (Chief Procurement Officers), differ. In their research, CAPS determined the top 6 procurement measures reported by these two groups, as shown in Table 3.4 below.

Table 3.4 Difference in metrics for CEOs and CPOs (Stimson, 2002, p. 6)

CEOs’ Top Procurement Measures	CPOs’ Top Procurement Measures
1. Quality of purchased items	1 Price negotiations resulting in savings
2. Key supplier problems that could affect supply	2 Use of leverage through combining volumes
3. Supplier delivery performance	3 Past delivery performance
4. Internal customer satisfaction	4 Monitoring of delivery performance
5. Purchase Inventory dollars	5 Requirement supplier has credible quality program and stress continual improvement
6. Purchase cost savings	6 Department budget vs. actual expenditures

CPOs prefers to track just the cost savings, but it is important to have a balanced set of metrics. Table 3.5 shows some examples of a balanced set of metrics.

Table 3.5 Examples of MRO balance metrics scorecard (Stimson, 2002, p. 6)

<p style="text-align: center;">Customer</p> <ul style="list-style-type: none"> • Consumer complaints related to purchased materials and services • Internal customer satisfaction • Use of cross-functional teams in selecting and evaluating suppliers • Supplier satisfaction 	<p style="text-align: center;">Financial</p> <ul style="list-style-type: none"> • Measurable cost savings • Pricing trends vs. published indices • Total cost of ownership (TCO) • Cost per transaction • Procurement budget management
<p style="text-align: center;">Internal Business Processes</p> <ul style="list-style-type: none"> • # suppliers accounting for 90% of spend (supplier concentration) • % compliance with preferred suppliers • Lead time from requisition to order • Average value of purchase order 	<p style="text-align: center;">Learning and Growth</p> <ul style="list-style-type: none"> • Training / development time and \$ • Professional certifications • Sharing of best practices • Employee satisfaction • Employee turnover

3.3 International Purchasing

International purchasing is when an organization progresses from domestic buying to purchasing around the world. The process combines all the complexities of domestic purchasing with the complexities and variations of different nations, along with international regulations and standards (Monczka, Trent, & Handfield, 2005).

Advantages and Disadvantages

The advantages and disadvantages of international purchasing can be summarized as greater opportunities and greater complexities, respectively. With international purchasing, there are three main areas that differ from domestic purchasing: an increased variety of materials available, a greater variety of price availability, and a larger variety in quantity availability (Branch, 2002). Along with this wider set of options comes a greater level of complexity in all transactions. There are greater variations in governmental, legal, cultural, and social standards which have to be reconciled. In addition, there are international associations which also have to be satisfied, especially if corporations wish to maintain any one of various international certifications. As a result of its multinational nature, international purchasing requires

professional personnel who have the business acumen and technical knowledge, and will be able to deal with the many challenges that come with the process (Branch, 2002).

The International Challenge

The challenges of international procurement can be illuminated by comparing the differences between international purchasing procedures and domestic procedures. Unlike the latter, international procurement procedures include dealing with unknown potential sources of suppliers and the possibility of additional documentation that is required for international purchasing. These uncertainties are some of the challenges that confront organizations dealing with worldwide sourcing. Other challenges include changing from shorter lead times to managing longer lead times. Accurate forecasts associated with extended lead times becomes a critical issue that must be acknowledged and handled accordingly. Delivery dates have to be managed carefully, taking into consideration possible transit or customs delays. International purchasing also introduces other political, financial, or logistic risks (Monczka, Trent, & Handfield, 2005).

Intercultural Corporate Executive Differences

In a recent explorative article by Daewoo Park and Hema A. Krishnan (Park & Krishnan, 2001), differences and similarities in the supply chain management preferences of executives were identified. Through a comparison of practices in US and Korean firms, this article focused on determining which supply chain management practices may be universal versus which may be determined by the home nation of the company. Citing previous research as well as their own, the authors noted the greater general collaboration between Asian companies and their suppliers in comparison with US firms, yet each country's practices remain unique. Their research data supported this observation (Park & Krishnan, 2001). As a result, it is important for companies to consider regional and other cultural differences when trying to optimize their organizations and the rest of their supply chains.

Shifting Socio-Economic Factors

Different factors determine when or where companies place importance on outsourcing. Varying economic periods such as recessions forced companies to reconsider their supply chains and become more aware of emerging markets and other opportunities for either new sales or cost reductions in the production of their products or services. These trends are more obvious in

markets that tend to be more dynamic. In Asia, the Chinese market demonstrates such ability to make certain adjustments even in poor economic times.

Although China's economy was growing at an annual rate of approximately 6% at the start of the current year, 2009, it could increase to 8% according to a Goldman Sachs forecast. So far, robust consumer spending, combined with government-funded infrastructure spending and loose bank lending, has been the counter-balance to falling exports. Such infrastructure is designed to open up western China and introduce more labor by gaining access to the regional population. While it is unlikely that trade with America will return to its former state, a more complex market will emerge, with production rearranging itself towards the most cost-effective solution. It is likely that some focused regional logistics operations will continue to benefit China. However, the large global logistics providers are most likely to be able to reach new markets and benefit from the global restructuring (Chinese Economic Growth Points to New Opportunities in Global Logistics, 2009).

Purchasing Trends

In an analysis of research into the future of purchasing and supply management, researchers found that the nature of purchasing is quickly changing. Outsourcing, sustainable development objectives, and improved business-to-business relationships have changed the role of purchasing and supplying to be much broader and more critical than they once were. In this changing environment, it has become increasingly important to keep up to date with the most efficient purchasing methods.

Purchasing is shifting from clerical to strategic with the implementation of technologies to facilitate the clerical side of purchasing. This leaves purchasing professionals available to work on strategic tasks, such as evaluating the need for outsourcing and forming long-term business relationships. There is also evidence that purchasing departments that work in teams accomplish goals faster. This is especially true for cross-functional teams where purchasing professionals can benefit from professionals with skills in project management, operations, and those with inter-personal skills (Zheng, Knight, Harland, & James, 2007).

3.4 Supplier Management

3.4.1 Supplier Selection and Performance Evaluation

Supplier Selection Overview

The initial supplier selection and evaluation process has become an important business decision. The increasing number of long-term relationships between supplier and purchaser has caused the selection of the correct supplier to be a critical step in reducing costs. Although there is no best way to perform every supplier selection process, the goal remains the same: minimize risk while maximizing overall value. An example of a general supplier selection process is as follows: recognize the need for supplier selection, identify key sourcing requirements, determine the sourcing strategy, identify potential supply sources, limit suppliers in the selection pool, determine the method of supplier evaluation, and select the supplier and reach agreement. Following these steps ensures a greater chance of establishing cost-effective supplier relationships.

Supplier Risk factors

Poorly managed supplier risk is threatening the availability of critical supplies and services in many companies. A prevailing problem with supply management professionals is that they manage supplier risk on a tactical or reactive basis, without clearly identifying potential risks. Two key aspects that may lead to the supplier risk are the procurement staff and the organization of the supply chain.

A potential problem with a company's procurement is the lack of procurement professionals within the company. The procurement department is likely to make mistakes without a skilled staff, such as placing too much value on the initial cost of an item, which can undervalue factors such as supplier relationships and total cost of ownership. Qualified professionals are increasingly important because procurement is a systematic process and requires risk assessment and a mitigation strategy to reduce costly errors that may arise from preventable problems with suppliers.

The organization of the supply chain and some supply strategies may reduce initial costs, but increase supplier risk. For example, lean supply chains or the just-in-time strategies can sometimes increase the risk of stock outs and manufacturing disruptions due to dependence on

fewer suppliers or frequent deliveries. Many of the best practices or strategies can also increase supplier risk, such as outsourcing strategies, which can cause the procurement process to become less visible and less controllable. Also, supply base optimization may increase the likelihood of dual-or-sole sourced suppliers relying on a single sub-tier supplier.

When managing supplier risk, it is necessary to clearly identify items that are critical to production in the supply chain. Comprehensive review of all suppliers will determine which suppliers provide these critical supplies. To mitigate these risks, the company should secure a backup supplier, establish a contingency plan for a supplier emergency, and review the financial information of each critical supplier. Assessment and prioritization of the supplier risk will help focus the resources of the company to the highest areas of risk.

There are four main steps to manage the supplier risk. First, obtain executive management commitment to the risk management effort. Second, establish cross-functional teams to assess and address supply chain vulnerability. Thirdly, establish key metrics to ensure tailored supplier risk management, such as single supplier dependence, availability of alternate sources, and utilization of long-term contracts. Finally, develop a comprehensive mitigation plan to reduce risk. (Gabbard, 2008)

Management Selection Data

In supplier management, there are a few key areas where the technology or protocols are in need of improvement for better business efficiency and stability. These include an alert system for risk avoidance, systems, protocols, or other resources for the continual monitoring of negotiated contracts, and a repository for historic data and performance information for companies. This last point is especially important, since only 12% of buyers will transact without ratings (Yacura & Charpie), as shown below. It was also found that 89% of buyers surveyed would pay 5% more in a transaction rating if the seller were available. (Original Source: MIT Sloan Survey on Branding and Ratings, May 2000)

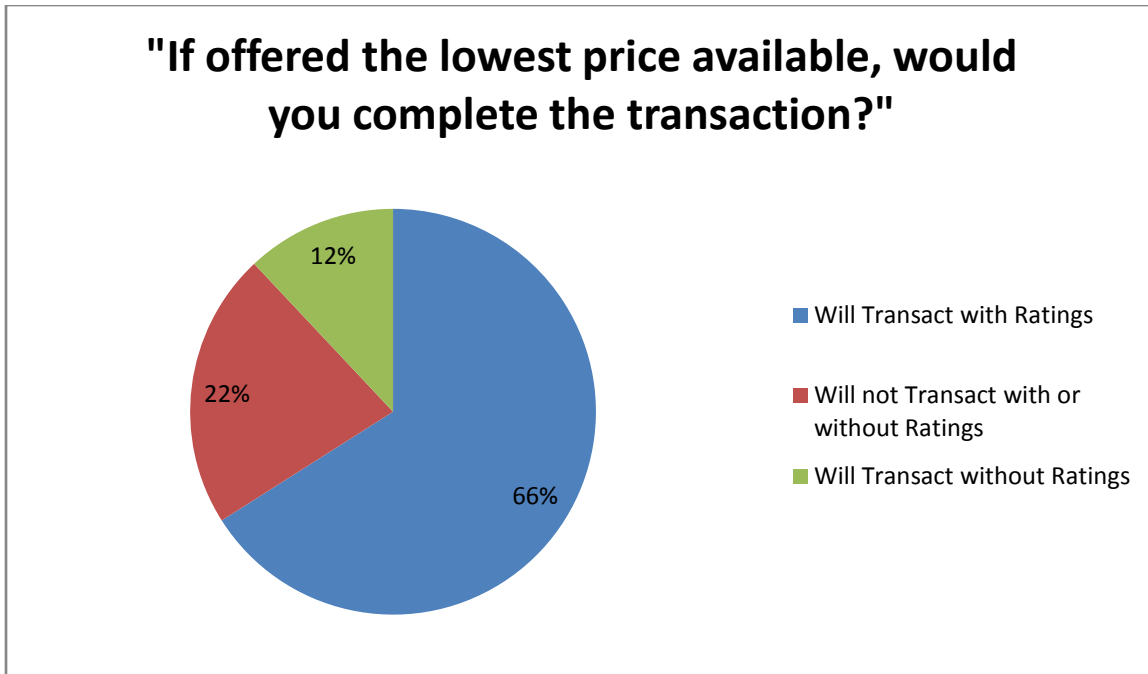


Figure 3.1 Percentage of buyers who will transact with and without ratings

Supplier Evaluation Overview

Supplier Evaluation can help identify poor quality suppliers and allows for effective optimization of the supply base of a company. Many companies perform evaluations on their suppliers using the criteria of cost, quality, and delivery. Many companies, however, find that these three criteria alone are often not enough to evaluate suppliers of critical goods. Some other factors that could be evaluated include management capability, employee capabilities, cost structure, total quality performance, process and technological capability, environmental regulation compliance, financial stability, production scheduling and control systems, e-commerce capability, supplier's sourcing strategies and techniques, and long-term relationship potential. The criteria that are necessary to evaluate will vary based on the purchaser's business requirements and the supplier being evaluated.

Total Cost of Ownership

On average, 30-35% of spending at manufacturing organizations is spent on non-core suppliers. (Baron) There are several tools available to identify areas of waste in non-core suppliers. Total Cost of Ownership (TCO) one of these tools, is an assessment of all costs associated with the ownership of an item, including purchasing price, maintenance, and any other

costs that might be incurred by owning the item. TCO can be divided into three groups: incurred costs, performance factors, and policy factors.

Incurring costs are associated with direct costs of acquiring the item or service, such as the price paid for the item and freight costs. These costs are generally the highest visibility. This is generally one of the highest costs associated with a product or service, and many times a company will primarily consider the incurred cost in its purchasing decision. Only considering incurred costs can often lead to paying more than required due to the hidden costs of performance and policy.

Performance factors are costs caused by problems with the product or service, such as late delivery or maintenance. These types of costs are less visible and are generally not factored into the purchasing decision in traditional purchasing. These costs can drastically increase if there is a problem with the product or service, it arrives late, or if it requires constant maintenance.

Policy factors are factors or constraints such as tax, regulatory, or social requirements. An example of this would be using only recyclable products. These factors, although generally considered, are often not factored into the cost of a product.

TCO is an effective tool because many times companies only consider the incurred costs of the product. Often, however, performance factors and policy factors account for a substantial amount of the total cost and are not included in the purchasing decision. If a company takes these factors into account when selecting and evaluating a vendor, they may be able to avoid these hidden costs.

Some key metrics that should be considered when evaluating the TCO of a product or service are the delivery, quality, cost, order accuracy, customer support, and business relations with the supplier providing it. If a company is weak in one of these areas, it can significantly increase the TCO of a product. Another factor to consider is the supplier's ability to predict future needs, which can be difficult to determine, but can pave the way for much lower TCO by potentially reducing unforeseen costs. (Baron)

Supplier Intelligence

Supplier Intelligence (SI) is becoming more important in the changing world of MRO and supply chain management. In general, Supplier Intelligence is the monitoring of suppliers, but there are many facets to this such as the market, economic, and financial data on the supplier and the supplier's suppliers. This data is swiftly changing from an advantage to a necessity for survival as increasing numbers of companies are using this information to optimize their decision making.

SI is necessary because critical parts and equipment must be available or manufacturing could come to a halt, directly cutting into the company's profits. A company must always be ready with these critical parts in case a supplier fails. Ensuring that critical supplies will always be available at a predictable cost is one of the primary goals of SI.

Business and market intelligence concerning suppliers is important to the supplier decision making process. Business intelligence may include information such as key performance indicators, spend, demand, performance, finance, and quality. Similarly, market intelligence may include markets, industries, goods and commodities, finance, suppliers, competitors, and technologies. This section of a company's SI should have as much information on the company as possible, including advantages and disadvantages of decisions made by the supplier.

An economic and financial review should be performed on suppliers as well. Economic factors can affect all of the businesses in the area and can include inflation, employment, exports, imports, GDP, GNP, balance of payments, current deficit, and government and private sector influence. Financial health is a key indicator of the longevity of a firm and its data, which includes liquidity, activity, debt, profitability, and market ratios. With both economic and financial data, the reasons for a seemingly poor analysis must be considered and weighed in order to fully understand its financial condition.

The potential for a supplier to be acquired by another company is a very important factor. If a supplier is acquired, renegotiation procurement staff must reevaluate their strategies and potentially find new suppliers or renegotiate contracts. Some trends that influence a supplier's

likelihood of being acquired are customer sentiments, product life cycles, new product development, technological advances, and cost drivers.

Competition, as well as political and economic factors, affect the suppliers' suppliers and should be included in the SI review. The data affecting competition includes labor trends, unemployment, and cost of fuel and land. The data affecting the political landscape includes political stability, tax environment, infrastructure (roads, rail, telecommunications), and technology development. Economic factors include population growth, propensity for natural disasters, healthcare, and terrorism.

The product life cycle directly affects relationships with suppliers. A supplier who provides an item that must be replaced every week is much different than one who provides an item every ten years. Also, it must be ensured that the product required will be available for the extent that the company needs it.

Cost drivers, future market requirements, and the potential for long term relationships must also be included in the SI analysis. Cost drivers include information on the supplier's supply base, the lowest acquisition cost, lower total costs, higher competition, and how often a company obtains new suppliers. Future market requirements relate to how likely a supplier is to accommodate the company as it moves towards the future, and require new products Information such as supplier capacity and demand forecasts are required for this. Long term relationships are one of the keys for companies improving supply chain; a strong relationship can be mutually beneficial and reduce risks.

With this wealth of potential data that can be included in SI, a company must evaluate the tradeoffs they are willing to make to generate an SI analysis. A budget is necessary to plan how much information a company can afford to collect. This information on suppliers and their performance can serve as a valuable tool. It can be used to determine the best supplier, as well as strengthen a position when negotiating with them (Jeeva, 2008).

3.4.2 Supplier Relationships

Like all relationships, supplier-client relationships can vary depending on many variables. These variables include information sharing, risk sharing, resource sharing, and many others. As

a result, the spectrum of supplier relationships varies greatly from the casual relationship, where the primary interaction is via individual transactions, to the highly involved, where strategic alliances come into play and information sharing and collaboration are essential. (Kauffman & Crimi, 2000)

In order to achieve the greatest value from a supplier, a relationship-based purchasing culture should be fostered. Many companies are still performing transactional-based purchasing from their suppliers. In a transactional-based purchase, each group is attempting to obtain the best deal for themselves and provide the minimal amount of resources for the maximum gain. This method, while often leading to the lowest initial price, is inflexible and can cause poor performance in the supply chain. A relationship-based purchasing system involves strategic alliances and communication, often resulting in flexibility and creative solutions for each group's problems. A functional strategic relationship usually involves shared risks as well as shared rewards, making success a shared goal between the two companies (Beck).

Executives can achieve this by involving their suppliers in their reengineering plans to make the suppliers change some of their operations to meet the demands of the customers. It is in the interest of the suppliers to make an effort of meeting these requests because in recent days, many companies are moving towards consolidation. If suppliers are not willing to meet the demands of customers, buyers may want to remove such suppliers from their vendor lists and concentrate on the few that have improved their supply chain processes (Morgan, 2004)

The primary risk factors when dealing with a supplier are the dependency of the supplier on the client for demand, the dependency of the client on the supplier for their product, and the stability of the supplier (Yacura & Charpie). The dependency of the supplier on the client, and the dependency of the client on the supplier clearly illustrate the importance of good supplier relationship management. Since a supplier can, potentially, depend on a few clients for some or all of their business, a client must be careful to communicate clearly when there are significant changes in the quantity of business needed. In this manner, the supplier has time to adjust to those needs and transition safely with lower risk of bankruptcy. Here, the client benefits from greater supplier stability and thus, lower risk. This is especially important for suppliers of key components to a client's business. Likewise, information must flow in the other direction for variations in supply capacity so that the client can plan accordingly, finding additional sources,

adding production in house, or potentially supporting the supplier in the expansion of their facilities through use of the client's resources in exchange for special status or deals with the supplier. Here, the supplier benefits directly from continuously adequate supply levels and indirectly from potential kickbacks from the supplier and potentially greater supplier efficiency.

The viability of a supplier currently can depend on many factors. Some key indicators include how many years the business has been in existence, the company's current and past financial condition, whether or not the company is ISO 9000 registered and past performance in terms of quality and delivery performance (Yacura & Charpie).

3.4.3 Supplier Improvement

Introduction

To meet the demands of its customers, Grainger Inc., located in Lake Forest, Ohio, considered some of the demands that were important to buyers (Avery, 2004). Companies making purchases need these critical items to keep their businesses running and therefore, it is important for procurement officers to be able to place an order in multiple ways. Grainger updated its system such that its customers can place orders by phone, via the internet, or through a contractor stopping by at one of their multiple branches. When a customer contacts Grainger with a request, a customer service agent uses powerful search engine tools to navigate to a product solution in seconds. "We want to avoid having to tell customers that we will get back to them later or that we will have a solution for them next week" (Avery, 2004, p. 9). It is assumed that about 40% of the cost of purchasing is attributed to processing costs, which implies that actual cost of item is 60% of the total cost (Avery, 2004)

Knowing that the costs of processing comprises much of procurement spending, buyers must find all possible means of reducing this cost, which will result in direct savings on procurement. Doing this may require taking a second look at distributors and their commitment to facilitating the company's needs.

Supply Base Optimization

"Supply base optimization, also known as supply base rationalization, is the process of identifying how many and which suppliers a purchaser will maintain" (p. 275). This process

often involves eliminating suppliers who are not able to meet the supplier performance objectives of the purchasing company in the present or in the future (Robert Monczka, 2005).

Supply base optimization is a process where the purchasing company continuously makes the effort of eliminating marginal suppliers and those suppliers from whom few purchases are made. This step is normally the first phase of the optimization process. Subsequent phases include companies replacing good suppliers with better suppliers and having a supplier performance measurement system in place to track and measure the performance of all suppliers. This will enable the selection of the best performing supplies in order to establish stronger business relationships with them (Robert Monczka, 2005).

The main goal of optimizing a supply base is to increase cost reduction, quality, delivery, and information sharing between sellers and buyers. Advantages of this process include buying from world-class suppliers, the use of full service suppliers, reduction of supply base risk, lower supplier base maintenance costs, lower total product cost, and the ability to pursue complex purchasing strategies. When buying from world-class suppliers, instead of being responsible for thousands of suppliers, purchasing can concentrate on only a few core world-class qualified suppliers. With the use of full service suppliers, suppliers in an optimized supply base are often larger and are capable of providing a range of services. Purchasers making use of such suppliers can expect services in the form of access to the suppliers' engineering, design, testing, production, service, and tooling capabilities. Reduction of supply base risk is advantageous because risk in the supply base does not only mean supply interruption. Poor supplier quality, poor delivery performance, or paying too high a price for purchased items are all risks that can be managed more effectively if a fewer number of suppliers are maintained.

Lower supplier base maintenance costs results from maintaining a manageable number of suppliers, which enhances effective communication between suppliers and buyers. Buyers are more able to effectively communicate problems associated with purchases. These activities have associated costs, such as time, effort, and potential miscommunication. The probability of incurring a higher cost with 5,000 suppliers is greater than that of 500 suppliers. Supply base optimization provides the opportunity to achieve lower total product costs by awarding larger

volumes to fewer suppliers. It is much easier to pursue very complex strategies with fewer suppliers due to the increased two-way interaction between supplier and buyer, making the ability to pursue complex purchasing strategies vital to the company. Such strategies include supplier development, early supplier design involvement, and development of cost-based pricing agreements (Robert Monczka, 2005).

Process Improvement Program

A supplier evaluation (SE) is an effective tool used to target problems with a company's supply chain, but does not necessarily lead to solving these problems. A process must be in place to develop and implement viable solutions to problems discovered during SE. Combined with SE, the process improvement program (PIP), is an effective method of managing the costs and risks associated with supplier performance.

The SE&PIP process is a ten step program that was created to incorporate all four parts of the Plan-Do-Check-Act (PDCA) process, as seen in Figure 3.1 below.

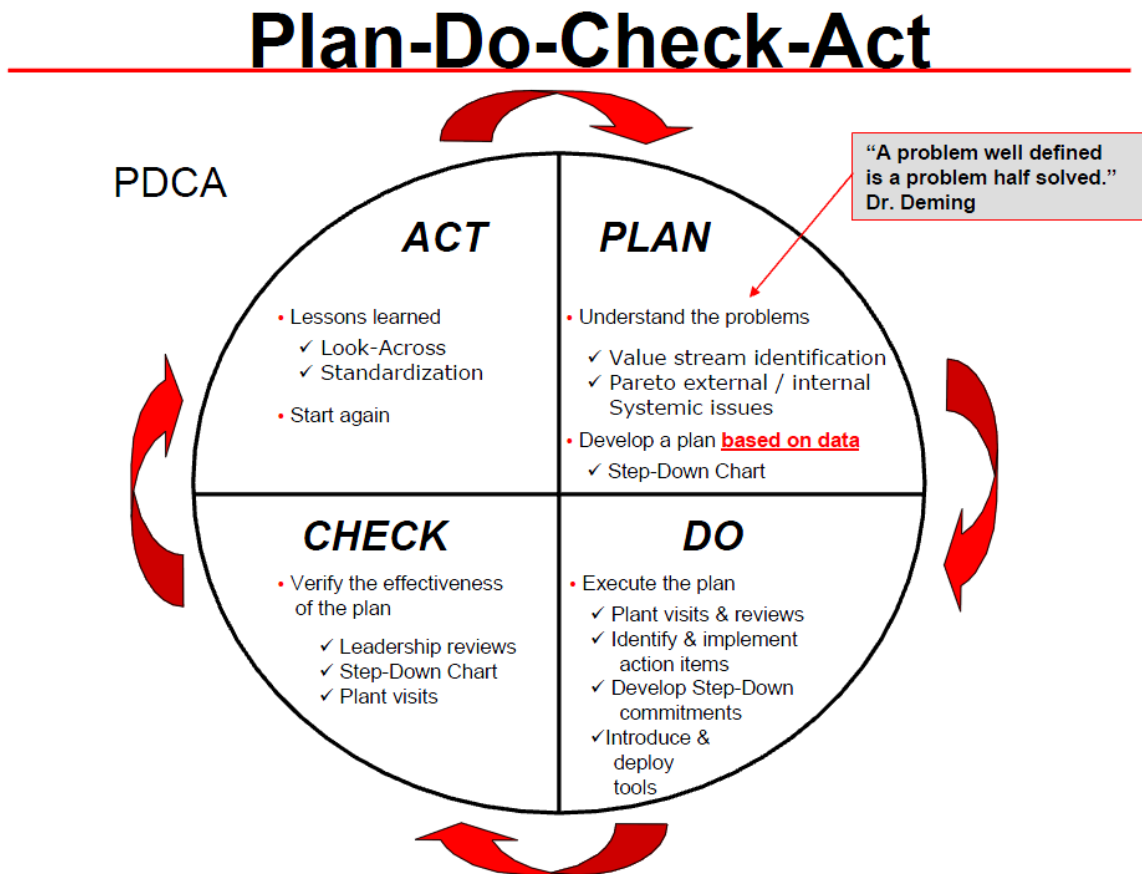


Figure 3.2 Plan-Do-Check-Act Diagram (Rodeghier, Stegner, Chang, & Kemp, 2007)

The first step in the SE&PIP process is a pledge of commitment by the company. This is important because this program can be expensive, and without the full commitment of the entire company and top management, it will not succeed. Next, a carefully selected project leadership team is selected. This team must have excellent management, follow-through, and creative thinking skills, because the lack of a high-quality team can lead the project to failure.

After the commitment is made and the team is assembled, an initial plan of action must be created and communicated to the company and core suppliers. This stage will require significant planning and work. Attention must be paid to the visibility of the evaluations and metrics to be used in evaluating the suppliers. Once the plan is developed, it is launched on a small scale by evaluating a small group of suppliers. Once problems are identified, an improvement plan for each supplier should be created.

The next step in the process is gaining the supplier's commitment to follow through with the improvement plan. Without this step, improvement in the supply chain is jeopardized.. After the supplier is committed to improving its supply, follow up-meetings will be held to evaluate progress. Before expanding the program to more suppliers, leadership reviews should be conducted to ensure that the program is being completed on schedule and correctly.

The last two steps of the program involve expanding the program to the entire supplier base and building supply chain ownership. This is the final goal of the process, and companies that reach it can save on average 10-25% on their purchasing. Companies must continuously monitor the process to ensure the program does not deteriorate. (Rodeghier, Stegner, Chang, & Kemp, 2007)

The Use of Cross Functional teams

In order to enhance their competition position and to benefit from different viewpoints, organizations today increasingly rely on cross-functional teams. A cross-functional team is a group of people with different functional expertise working toward a common goal. Cross-functional teams often function as self-directed teams responding to broad directives. Decision-making within a team is generally democratic, but often is led by a manager, coach, or team leader. (cross-functional team)

Three attributes contribute to successful cross-functional teams: task-orientation, interdependence, and democracy. A successful cross-functional team should be focused on team

objectives and adhere to company policies. Interdependence between team members is defined as the foundation of teamwork and cooperation. Individual capabilities and roles within the group are the two elements in evaluating interdependence. The success of the team is based on motivated communication and cooperation, and thus democracy in a cross-functional team is founded in empowerment, communication and team morale. (Jin, Qian, & Miao, 2007)

Nevertheless, there are difficulties in cross-functional collaboration and decision making, and such difficulties have been documented in research areas other than sourcing. Those problems can be structured into sourcing decision-making processes concerning three different areas: functional interdependency, strategy complications, and misaligned functional goals. Functional interdependency indicates that the lack of holistic vision makes the decision process difficult, information dependency makes deadlines difficult to meet, the lack of designed system-support makes calculations and synergy effects difficult, and the use of ad hoc decisions that are not well-founded. It has been found that process-design-related problems have emerged due to a process that is not properly structured. Strategy complications arise if unclear strategies are implemented or inconsistent basic data for decision-making contributes to decisions that are not well-founded. If misaligned functional goals are implemented, functional imbalance creates functional advantaged and disadvantages, forced path dependency makes functions move ahead without all necessary information present, and difficult timing of functional needs makes the processes unbalanced (Moses & Ahlstrom, 2008).

Strategic Sourcing

‘Strategic Sourcing’ is defined as “a periodic event that includes the identification and selection of initial commercial arrangements with a selected supplier that either creates or resets a relationship.” (Kauffman & Crimi, 2000) This benefits an organization through an improved ability to achieve strategic goals and an improved contribution from purchasing outcomes. However, the transition from a traditional procurement program to a strategic sourcing program involves many changes. The process, as shown below in figure 3.2, starts with establishing the precedence for the change and ends with the monitoring of the final implementation. (Kauffman & Crimi, 2000)

In the ‘identify strategically important items’ stage, it may be useful to use an ABC analysis for items. “A” items would be those strategically most important and that involve a

large quantity or dollar value. As a result, suppliers of these items would most likely be good choices for strategic relationships. “B” items would be less important and likely lower volume or cost, but still important enough that some sort of continuing relationship with the suppliers is desirable. Finally, “C” items would be the least important strategically, and their suppliers would be the least likely candidates for strategic relationships. However, it is key throughout this process that value added services are sought, especially where they could be economically beneficial (Kauffman & Crimi, 2000).



Figure 3.3 Strategic Sourcing (Kauffman & Crimi, 2000)

Strategic Sourcing Methodology

The 'develop an overall strategic sourcing plan' stage can be further broken down into an eleven step process, as shown below in Figure A. This stage begins with the collection and analysis of spend data, which is utilized in the determination of a baseline. Customer requirements are then determined to ensure that the sourcing strategy will meet the company's needs and the company will be able to satisfy the end user's demand. Market analysis then follows to identify potential opportunities. From this data, the development of product and service group strategies is initiated. Suppliers are then evaluated and profiled prior to selection. After, selection agreements are negotiated and the planning of the implementation of the relationship starts. The installation of reporting systems then occurs to ensure clear communication between the client and supplier. Finally, the results of the system are measured, including supplier performance, which can then be managed (Kauffman & Crimi, 2000).



Figure 3.4 Strategic Sourcing Methodology (Kauffman & Crimi, 2000)

3.4.4 Supplier Contract Management

Supplier Contract Overview

Dr. Rene G. Rendon defines contract management as the very first step which identifies business needs that can be best met by procuring from outside of an organization (Rendon, 2007). In procurement planning, outsourcing analysis is recommended to assess the contract risks and conduct market research to identify prospective suppliers.

The next step is solicitation planning, in which documents needed to support the solicitation are prepared. Cross-functional teams can be used in this process to develop solicitation and identify contract risks. In the process of solicitation, organizations obtain information on prospective sellers to determine how their needs can be met.

Source selection begins when bids and proposals are received and evaluation criteria can be applied to select a supplier. It includes negotiations between the seller and the buyer on any relevant aspects of contracted effort. Using a formal source selection organization with trained and experienced teams, along with a weighting system to prioritize the evaluation criteria is recommended as the best practice in source selection.

The major goal of contract administration is to ensure that each party's performance meets the contractual requirements. To achieve this, an organization can use a formal administration methodology with cross-functional team members competent in contractor performance measurement.

In the last process, contract closeout, it should be verified that all administrative matters are concluded on the physically complete contract. As best practice, a formal team should be established using a contract closeout checklist and documenting contracting lessons learned and effective practices. (Rendon, 2007)

Framework Agreement/Contract

A framework agreement is an agreement with suppliers. The purpose of this agreement is to establish the terms governing contracts awarded during a given period, particularly in regard to price and quantity. In other words, a framework agreement is a general term for agreements with providers which establish terms and conditions under which specific purchases (call-offs) can be made throughout the term of the agreement. (OGC Guidance on Framework Agreements in the new procurement Regulations, 2006) Actually, there are two types of framework agreements covered by the classic directive. Although the classic directive refers exclusively to "framework agreements", the provisions actually relate to two different situations: framework agreements that establish all terms and those that do not. Purely for explanatory purposes, the first kind may be termed framework contracts and the second framework agreements *stricto sensu*. It should be stressed that the use of this terminology is not obligatory for implementing

the directive. It is also useful to recall that framework agreements that establish all of the terms (framework contracts) are “traditional” public contracts and consequently, their use was possible under the old classic directives, provided that they were concluded in accordance with the procedural provisions of these directives. (Flahefr, 2006)

It is important to consider whether a framework agreement, as defined above, is the right approach for the particular goods, works, or services to be purchased. This is a value for money judgment for the contracting authority or authorities concerned, taking account of the kinds of purchases involved and the ability to specify such purchases with sufficient precision upfront. In particular, the framework should be capable of establishing a pricing mechanism. However, this does not mean actual prices should always be fixed, but rather that there should be a mechanism that will be applied to pricing particular requirements during the period of the framework. It should also be possible to establish the scope and types of goods and/or services that will need to be called-off. There should not be any objection to upgrading the product, service, or work required so long as it remains within the scope of the original specification (OGC Guidance on Framework Agreements in the new procurement Regulations, 2006).

Framework agreements can be concluded with a single provider or with several providers, for the same goods, works, or services. When using several providers it is a best practice to use at least three providers that there are sufficient candidates satisfying the selection criteria and which have submitted compliant bids meeting the award criteria. The agreement will establish the terms which will apply under the framework, including delivery timescales and daily or hourly rates (OGC Guidance on Framework Agreements in the new procurement Regulations, 2006).

A framework agreement sets out the terms which will apply to any work done, such as terms dealing with copyright, confidentiality, limitation of liability, etc. It does not commit the parties to the carrying out of any particular piece of work, but sets out the terms that will apply if the parties do subsequently agree that some work will be done. If and when any particular piece of work is agreed to be done, the nature of the work can be agreed upon by a simple letter or email or even-though this is more risky- just by word of mouth. There are several advantages of using a framework agreement in this way. The wording of the framework agreement can be agreed upon between the supplier and the customer, and it can be signed during the initial stages

of the business relationship when there is time for both parties to consult their lawyers. There is no need to wait until both sides are ready to commit themselves, since the framework agreement simply sets out the terms which will apply if and when the parties decide to commit themselves to a particular piece of work. After the framework agreement has been signed, from a legal perspective, each time the parties agree that a particular piece of work is to be done, a separate oral contract will come into existence for that particular piece of work. This avoids the problem of the customer being viewed as having a power of “direction and control” which would exist under the first option above. Under a framework agreement, the customer is simply requesting and supplier is simply agreeing or disagreeing every time there is work to be done. If the customer should ask for something outside of the supplier’s field of expertise, they are free to decline and equally free to negotiate a higher rate if they decide that to carry out the work. (Antell, 2001)

4 Methodology

4.1 Methodology Framework

Due to the limited project specific information before the first company visit, the specifics of the methodology of the project could not be determined. As a result a few general methodologies were considered for the project process and the narrowing and refining of the problem statement. These were the Operations Research Approach, the DMAIC, and the DMADV process.

The Operations Research Approach for problem solving consists of a seven step methodology. The seven steps are: Orientation, Problem Definition, Data Collection, Model Formulation, Solution, Model Validation and Output Analysis, and Implementation. A potential problem with using this framework was the uncertainty of whether modeling would be applicable for the project. As a result this approach was held in consideration along with the others until more data could be collected concerning the scope and specific focus of the project.

The DMAIC Process is frequently used to improve an existing business process. It consists of 5 steps as the acronym implies. These steps are Define, Measure, Analyze, Improve, and Control, as shown in the diagram below.

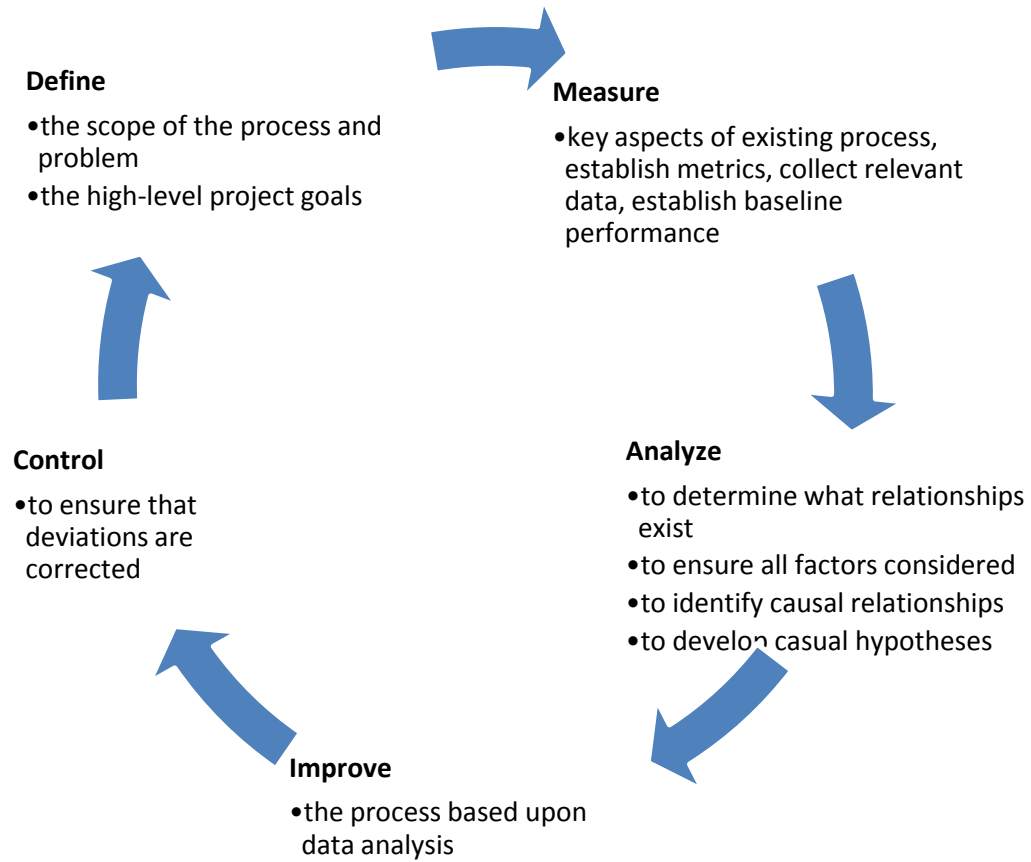


Figure 4.1. DMAIC Process (Monczka, Trent, & Handfield, 2005)

In addition, if new information is gathered that would change the project in the process can be reset to an earlier step. Just as in the case of the Operations Research Approach, the team could not be sure whether the process would be able to reach the control phase, due to the early uncertainty in the focus and scope of the project, and therefore was held in consideration until more data could be collected.

The DMADV process is also known as Design For Six Sigma (DFSS). DMADV is another 5 step process which consists of the following steps: Define, Measure, Analyze, Design, and Verify. DMADV is frequently utilized for designing new processes and products and was chosen for consideration for this reason, though again due to the early uncertainty about the project, it could not be determined whether this process would be applicable to the project. As shown below the process starts with the Define step where the goals of the process or product are defined clearly and checked to make sure that the goals are consistent with customer demand.

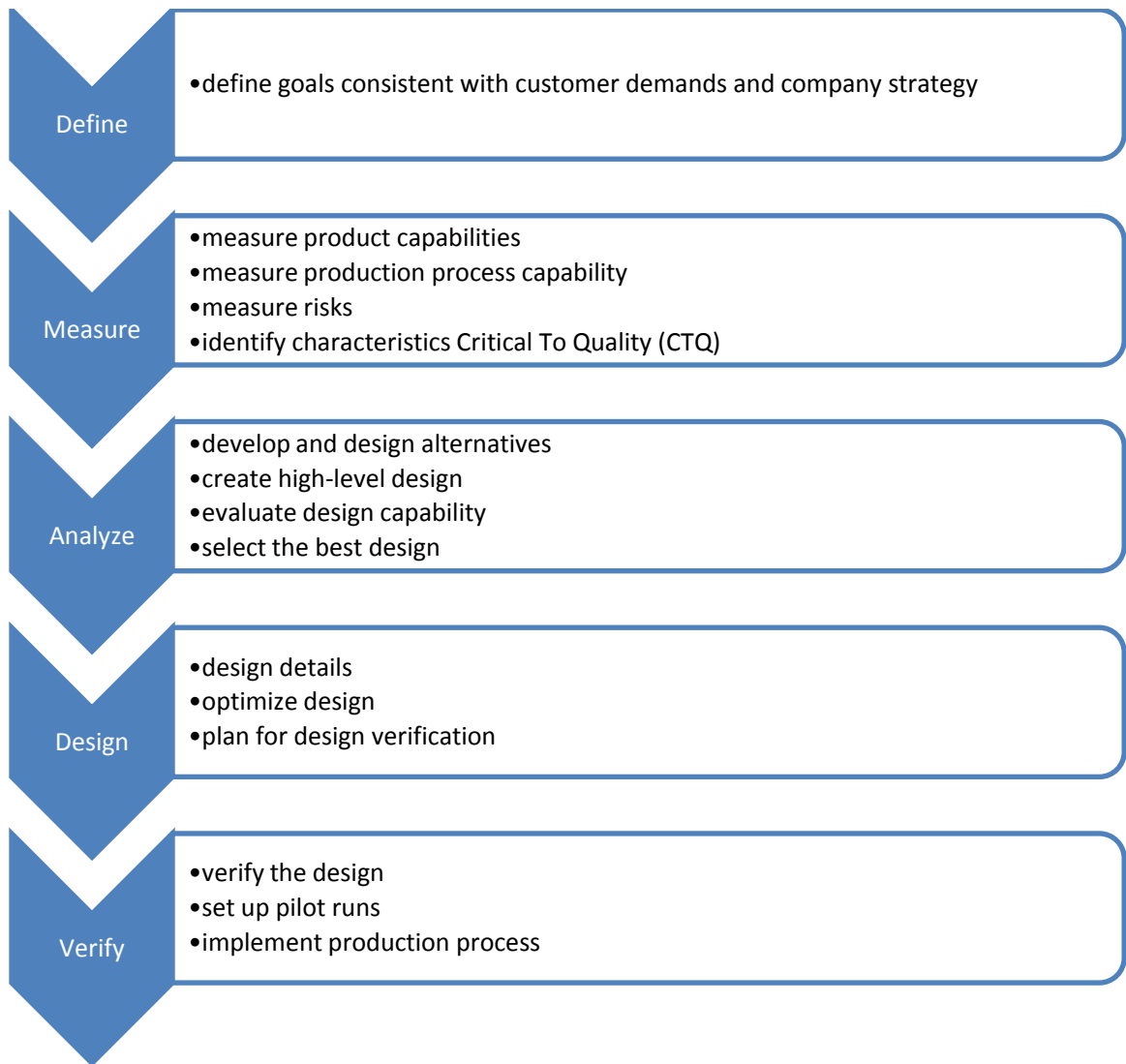


Figure 4.2 DMADV Process (Tech-FAQ, 2009)

The process then goes on to identify critical characteristics and risks in the Measure step. In the Analyze step the information from the Define and Measure steps are used to develop initial designs which can then be evaluated for capability. The Design step then works out the design details, prepares for design verification, and optimizes of the design. Finally in the Verify step the design is tested utilizing simulations, prototypes, pilot runs, and/ or other processes. This step only ends with the final implementation of the production of the process or product. Just as in the DMAIC process, if new information is gathered that would change the project in any step the process can be reset to an earlier step.

Since little information was available about the project specifics it could not be determined which of the above would be better for this project until after the first company visit. As a result both the DMADV process and a combination of the DMAIC and the Operations Research Approach processes were held in consideration till further details could be obtained. This combination was chosen since the DMADV process is more applicable for the scenario where a new process would need to be developed and the fusion process is more applicable for the scenario where an existing process would need to be optimized. The DMAIC process was also chosen for the project definition and refining process as well as the initial background research and data collection.

4.2 Background Research and Initial Data Collection

Before more significant data could be collected, it was necessary to develop a better idea of the project through background research and early contact with BASF-YPC. Procurement and supplier management were specific areas where further study was required. Specific areas where more information was needed included: procurement and supplier management with a focus on the petroleum industry, and company profiles, as well as others.

Once this scope of the research was defined, several techniques were then utilized to gather the data. These included: electronic database searches through WPI and SEU's library services, finding sources through professional supplier management websites, and various search engine searches. The database searches included topic specific searches for existing information and previous research as well as searches for industry and regional information.

With this information on hand the first with BASF-YPC was arranged and preparations for the visit were initiated. In preparation for the meeting, discussion points and specific questions were developed. The first step was for individual group members to brainstorm ideas for questions, discussion topics, and documents wanted from the company. The group then came together to share and discuss the questions, discussion topics, and requested documents. After the discussion the group consolidated the lists of questions, topics for discussion, and requested documents, eliminating poor questions and refining the remaining questions. Portions of these lists were then reviewed by professors. Once the final wording was done in English, the lists were then translated into Chinese with careful consideration of the meaning and point of each question or discussion point. Most of these were then sent as an attachment in an email to the

company prior to the meeting. Some questions were thought to be more effective if they were simply brought up at the meeting. This full process can be seen outlined below.

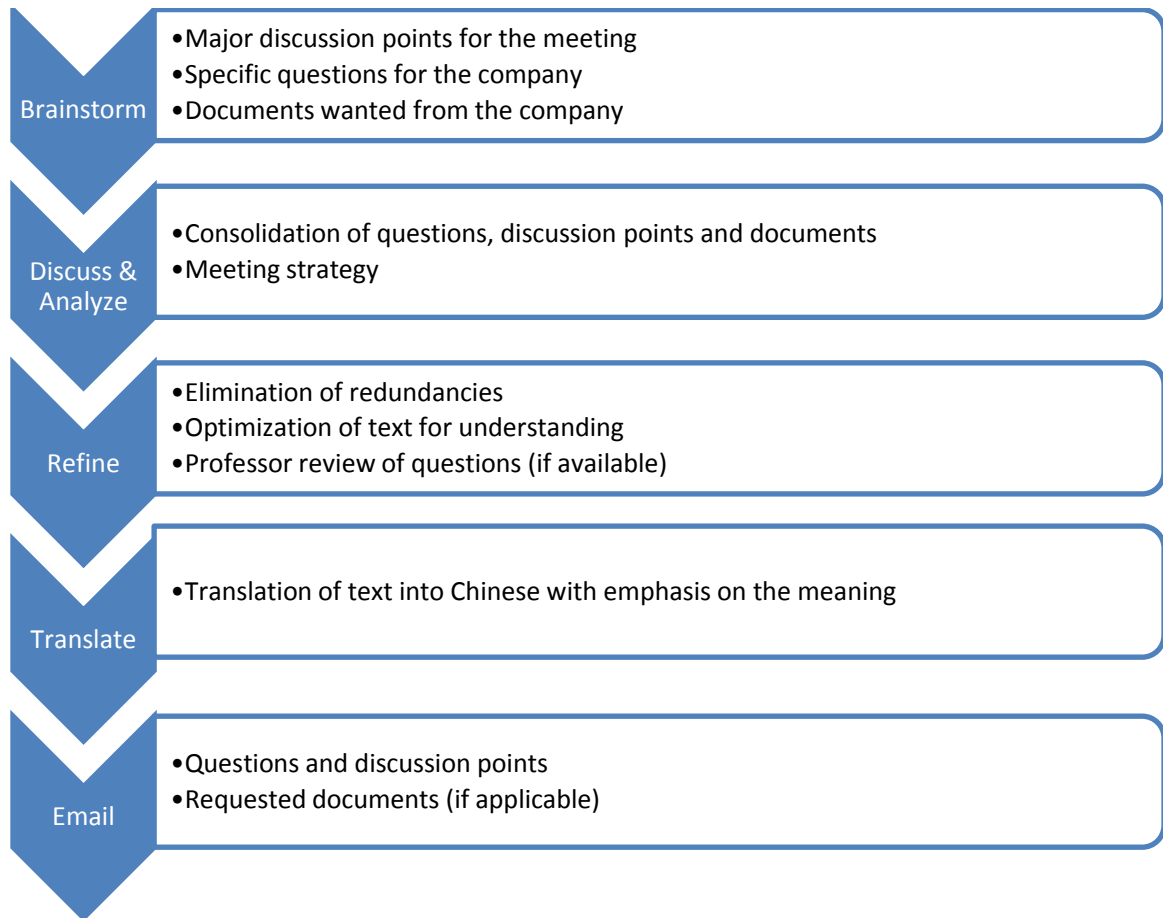


Figure 4.2 Data collection techniques

4.3 Project Reframing

After the first company visit it was evident that the project scope and focus needed to be changed and that the team would need to be more strategic to get information from BASF-YPC. Due to the confidentiality concerns of the company, there would be little information sharing with the group making a project solely focusing on BASF-YPC nearly impossible. To develop the new project definition, scope, and goals the team went to the DMAIC process. Here the process to be improved was the project framework. This would not be the only use of the DMAIC process in the project. This initial usage of the process would eventually form the majority of the Define stage for the rest of the project. However, at this point in the project this was not clear. As a result this mini-cycle of the DMAIC process stands here as an example of

how the team utilized standard and organized approaches at all levels in the project, especially when there was uncertainty.

Define and Measure

Here the problem was the redefinition of the project, and the data available for the Measure step was the information from the first company visit. After considering the available options, the possibility of involving another company was brought up and through group consensus it was decided that YPC would be approached for involvement in the study.

Analyze

After YPC's acceptance of our offer, more types of studies were accessible for use in the reframing of the project. Most significant among those discussed were various types of comparative studies, the possibility of completely shifting the project focus on to YPC, and the possibility of creating case studies.

To choose from the above possibilities, a group discussion format was adopted in which individuals were given time to form their own opinions and rationales for their choice(s). Shortly after this the group came together to discuss the future of the project and come to a consensus on the project direction.

Improve and Control

Once the consensus was found the team went about the rewriting of the project statement, definition, goals, and scope. Once there was a new draft of the project statement, definition, goals, and scope this was made available for review by the advising professors. With their recommendations taken into account, the project then progressed according to the new plan.

While the project continued and as new information was obtained from both BASF-YPC and YPC the project statement, definition, goals, and scope would continue to refine, though not as significantly.

4.4 Data Collection Strategies

The team quickly developed two new strategies for gathering information from BASF-YPC and YPC using the new project definition and goals and recent experiences with the companies as guidelines.

BASF-YPC

A challenge with obtaining information from BASF-YPC was their confidentiality procedures. The company was not able to offer any electronic or hard copies for the group to work with and analyze. It became clear that communication via telephone or internet would not be an efficient means of data collection. As a result, the group would have to rely solely on notes taken in meetings and a strategy of asking questions to handle this situation was developed. Questions would be asked which would bring up documents with key information. Due to the relatively large size of the project group it was possible that some could copy down the document while others copied down the manager's responses and still others focused on questioning the manager with these roles shifting as need be (ex. Questions brought up from information recently shown could be asked by anyone and the other roles would shift accordingly). To make the meetings as efficient as possible, the group often focused on collecting as much information as possible, and then studying it for comprehension later. Proceedings meetings were also recorded with an audio recorder and compared with the written notes (See appendix D).

The choice of whom to meet with was made clear after the second meeting with BASF-YPC. At the first meeting the language barrier greatly hampered the interaction of the team with the Chinese speaking manager, as only half the team could fully understand what was happening throughout the meeting. At the second meeting the team was able to meet with an English speaking manager with relevant knowledge pertaining to the project. The greater interaction with the second manager and the ability of all the team members to participate in the meeting greatly enhanced the effectiveness of the meetings. As a result, all further meetings with BASF-YPC management were arranged to be with the English speaking manager.

For the remainder of the paper, the term "data" and "information" are used almost interchangeably in the context of BASF-YPC. This is because neither of the terms completely describes what the team could obtain from the company, though "data" is slightly more accurate.

YPC

Unlike BASF-YPC, YPC was more open with their information sharing with the project group. The primary challenge with YPC was the language barrier, since the YPC manager only spoke Chinese. To overcome this problem the team adopted a two stage strategy at first which was later refined.

In the initial strategy the WPI and SEU students would pair up and the SEU student would help the WPI students follow the meeting. This had the advantage of maintaining meeting flow but the disadvantage that the SEU students would have to multitask both translating and participating in the meeting themselves.

Later the strategy evolved to include breaks in the meeting where the SEU students would inform the WPI students what had transpired during the meeting. This soon further evolved into scheduled breaks in the meeting with discussion among the entire SEU-WPI team and little if any summarization outside of the breaks and the WPI students utilizing the time to digest the information gathered.

Additionally, since YPC was actually willing to provide the team with documents, it was necessary for the team to do follow up work after and outside of meeting situations. This included the two primary activities of translating documents and contacting YPC via phone for additional data or clarification (see appendix F).

Translation of the documents was handled by the members of the team fluent in Mandarin (the official Chinese Language). One obstacle for the translation was translating technical terms and retaining the original meaning, not just the direct translation of the words. This later point occasionally became an issue when different members of the team would translate the same work in a different manner and there needed to be clarification of the original meaning. In most cases this was resolved through group discussion or phone calls to the company to further clarify the points in contention.

Telephone calls and emails were also utilized to get further data from YPC. Initially, telephone calls and emails were simply used for the arrangement of meetings with YPC. However, later when it became apparent that YPC was willing to share data with the team, the

team started to ask for clarifications, data, and documents through these communication methods (See appendix E).

Through these methods the interactions of the project team and the companies were improved to enhanced the data collection projcess and impove its efficiency.

4.5 Data Analysis

Since this involved many on going processes and the team was relatively large, there were frequently multiple steps in the analysis process simultaneuously. For example: while data previously obtaned was being analyzed, more data was being obtained. From these areas additional information that was needed would be identified. As a result, the entire process could not be described sequentially and could only be described categorically.

The major sections of the data analysis consisted of compilation of data collected at company visits, direct comparison of the two companies, comparison of the companies versus a benchmark, and the development of suggestions for the companies.

The development of suggestions for the companies was further broken down into the following steps: identification of areas for improvement, the development of potential suggestions, the evaluation of the applicability of the suggestions, and the refinement of the said suggestions.

Compilation of Data

Due to the large amount of data obtained directly from meeting notes, and the existence of a language challenge, the compilation of data was a key step in the analysis process. This process allowed for the identification of discrepancies and areas where further inquiry was necessary. This stage also ensured that the whole team had the same correct and current information.

For BASF-YPC the data compilation process consisted of checking the recorded meeting minutes with the individual notes of team members. This allowed for the identification and remediation of gaps and some errors in the minutes. Gaps or potential errors in the data collected were noted for clarification at later meetings. Copies of diagrams and other visuals shown at the meetings were also created, while still fresh in the minds of team members.

For YPC the data compilation process was a bit more complex, starting with the translation of documents and the audio recordings of meeting minutes into English. These were then checked by other group members and with group members' notes. Though this part of the data collection and analysis process was more complicated, it also enhanced the understanding of the entire group, through review of the work shortly after the meetings. It further enhanced the process when translation issues would foster specific discussion of the material and illuminate points for clarification.

Through these processes, the group ensured that data collected was of good quality, and accurate and identified areas for further research. This step also facilitated the next step, which was the Direct Company Comparison.

Direct Company Comparison

With the data compiled, areas of similarity and differences were then identified and good candidates for direct comparison between BASF-YPC and YPC were chosen. The team decided to compare how the purchasing departments of the two companies did things similarly or differently. To help the team make fair comparisons, it compared how each company went about accomplishing a task the team chose. For example for supplier selection, the team compared how each company goes about evaluating and selecting suppliers. Areas where they followed similar processes were noted as well as areas where they differed. With these areas in mind, the presentation of such data was then considered, and it was decided that a summary form of presenting the data would be chosen with emphasis on key comparison areas.

Creation of Best Practices Checklist

Due to the limitations on gathering hard data from both companies, it was determined that the creation of a best practices checklist might be most helpful for the team to have as benchmarks for comparisons. . These best practices were taken from well known published sources found through the initial background research and subsequent follow up research. The research techniques utilized include: research database searches, searches on professional organization websites, and the utilization of various texts available to the team. These practices were then compiled into three lists for the three major categories of the study: procurement, supplier selection and evaluation, and supplier performance evaluation.

Comparison with the Best Practices Checklist

To compare the companies with the checklist it was decided that a tabular form would be utilized. This format was chosen so that the best practices could be directly compared with the actual practices of the companies. With the best practices list, the data collected from the company visits was then searched for relevant areas and summaries of each company's practices were developed and placed in the table.

Development of Suggestions for the Companies

With the comparisons completed, areas of strengths and weaknesses, as well differences and similarities compared to best practices were identified in each company. The team then prioritized the areas of the companies that could be improved and made suggestions to help such improvements, using the best practice list as a reference. The prioritization was done taking into considerations factors like political, social, and economic that affected the companies, and the ease of implementing the proposed solutions.

5 Findings and Discussions

5.1 Project Constraints

This project like all MQPs and especially off-campus MQPs faced several constraints. Unlike many on-campus MQPs, off-campus MQPs face the additional time, resource, and risk constraints. Although time is a constraint on every process, greatly restricted time can create more constraints. . While on-campus MQPs can take up to three terms, the off-campus MQP faces the challenge of project completion in two terms, of which only during the second term can data be collected and analyzed from direct sources. Furthermore, the resources available to off-campus MQP teams are more frequently restricted than they are for on-campus MQP teams.

The BASF-YPC team faced two major constraints that put a strain on the successful completion of the project. The first major constraint was the redefinition of the project topic. The original project topic which was supposed to be “MRO Spend Analysis” for BASF-YPC had to be changed after the team’s first visit to the company. This was mainly due to the sponsor’s unwillingness to share data with the team due to confidentiality concerns. After the first visit the team had to brainstorm with the project advisor to decide on a new project topic. At this brainstorming session it was decided that the project topic should be changed to “A Comparative Analysis of Procurement Management for Petrochemical Corporations in China: BASF-YPC and YPC.” This meant that a second company, YPC had to be added to the project sponsors.

YPC was chosen because it was confirmed from one of the SEU professors that they would be willing to give information to the team. Throughout the team’s meetings with BASF-YPC, no data was given to the team in any form. All the data and information used in the project were gathered from interviews and discussions at meetings. Although the managers at BASF-YPC were willing to talk to the team, not all questions received answers, and almost all answers did not have any data to support them.

The second major constraint was a language challenge. This constraint was faced on the part of YPC, which was added as the second project sponsor. Although the manager at YPC was willing to provide data and information in hard copies as well as electronic copies, he could not communicate in English, and no one in the department could help in this regard. All

communications with him had to be a two way translation process, and all documents he provided had to be translated. This added to the time constraint which had already set in as a result of the change in topic, and also made it necessary to have more follow-up questions because of the difficulty in communication; this retarded the team's progress at times.

Irrespective of all constraints, the team did its best in finding means to overcome them, and executing the project within the given time frame. The team depended mostly on its Chinese partners for obtaining all the information that could be provided.

5.2 Procurement Strategies

As organizations go through different processes and reengineering to improve performance and add value, purchasing is seen by many as one area that savings can be made while at the same time achieving high efficiencies. Most companies have been taking their procurement departments through strategic restructuring to ensure that the most cost effective and well organized methods are used. Although BYC and YPC are affiliates they have very different purchasing structures.

5.2.1 BYC's Procurement System

BYC's purchasing department is divided into three segments, Normal Purchasing (NP), TP (Technical Purchasing) and SP (Service Purchasing). Normal Purchasing (NP) is the segment responsible for all the direct procurement for production. The Technical Procurement (TP) segment deals with all the purchases of equipment and material that is not raw material. The Service Procurement (SP) segment mainly focuses on supporting activities such as catering, medical care, insurance and repair and maintenance.

Normal Procurement (NP) of BYC is about 95% of all procurement done by the purchasing department due to the nature of the company's continual production. In 2008 the segment spent about 30 billion Chinese RMB on raw materials, Technical procurement was about 300 million RMB and spending on service procurement was about 2 billion Chinese RMB. BYC maintains about 100 suppliers for raw materials. The company chooses a major supplier from this supplier base for each raw material that they purchase, and tries to have about two or three more suppliers on standby to be used in case the major supplier fails. This strategy is mostly used for Normal Purchasing with a focus on continuous supply of raw material for

continuous production without necessarily worrying about the cost of the material as is the case for Technical and Service procurements.

Technical Procurement (TP) is divided into about 21 segments and 170 sub segments. Some of the 21 segments are:

- Construction services
- DCS/Instrumentation
- Electrical equipment and supplies
- Engineering services
- Environmental and safety service, safety services, safety equipment and supplies
- Fabricated equipment
- Facility management, advertising, transportation on site
- Installation services
- IT/CT services and equipment
- Laboratory equipment
- Machinery
- Office equipment and supplies

Purchasing for each of these sections is achieved using different strategies. Various groups from different departments and backgrounds work together for a common goal. BYC uses about 600 suppliers to satisfy its demands in this segment.

The Service Procurement (SP) deals with all the non technical procurement and also deals other procurements that are still technically related but do not fall directly under the Technical Procurement segment. These include: engineering service, installation, construction, facility management, and packaging material.

BASF-YPC General Procurement Process

Roles and Responsibilities

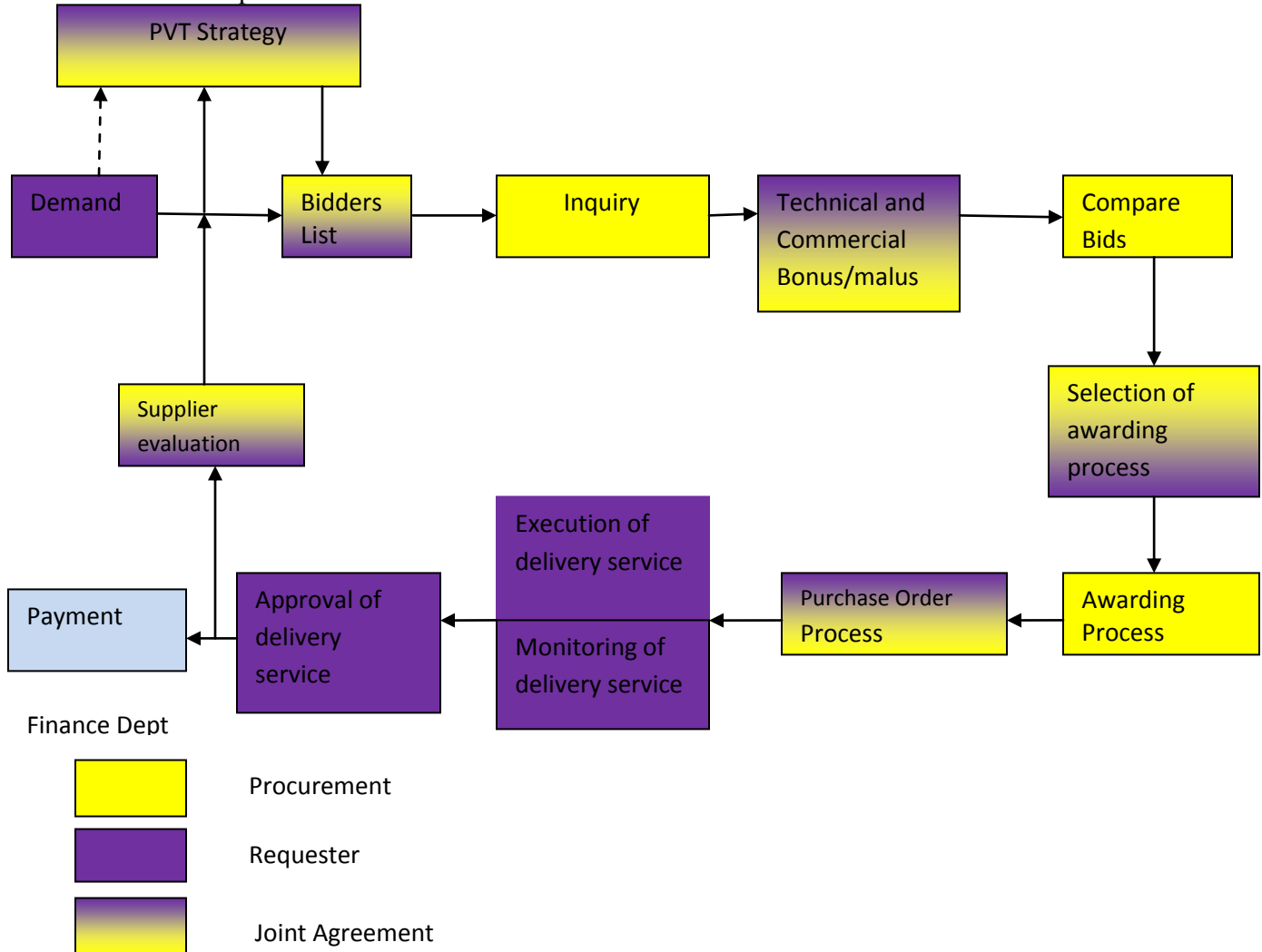


Figure 5.1 BYC's General Procurement Process

As shown in the above process, BYC involves other departments in its procurement process such that both the requesting department and the purchasing department come together to make some key decisions regarding the item's purchase. The requesting department is solely responsible for generating the demand, executing and monitoring the delivery and approving the delivery service. The purchasing department inquires about the item after receiving the demand, compares bids and awards the contract. The rest of the process is completed jointly by both departments. Among these are some important steps as the selection of awarding process and the evaluation process. Traditionally these are the sole responsibilities of the procurement staff, but BYC makes use of a cross-functional team for that.

BYC's Unique Strategy

BYC's procurement department does all procurement for the company, both direct and indirect procurement is handled by the department. The company does its best to have a competitive edge by making use of its PV strategy in every aspect of the procurement process. The company divides procurement into two main branches: PV (strategic) and site (Operational) Procurement.

The PV branch is the part that is made up of teams that have members from both commercial and technical communities. The teams also have global and regional members, as well as virtual organizations that work together with them. Their goal is to develop global and regional procurement strategies and to coordinate global and regional sourcing activities.

The site procurement is when the actual procurement takes place. However, all site purchases, equipment and services are made in line with strategic decisions made by the PV teams. The site procurement is to provide steady and reliable supply of goods and services. Costs of purchases made are based on the total cost of ownership and not just the purchase price of an item. All procurement decisions made follow the company's guidelines including ethical and sustainable development.

Demand Bundling	Increase Competition	Best Practices and Innovation	Standardization	Process Optimization
Aggregate products into larger volumes	Constantly modify supplier portfolio	Exchange know how on suppliers markets, products and services,	Harmonize goods, services, packaging	Streamline process along supply chain
Within company and between companies	Manage supplier list by reducing the number, increasing the number, changing an existing supplier with a competitive one or changing the origin of a supplier	Introduce goods of acceptable quality	Standardize to reduce stock, reduce transportation cost, increase potential for bundling, and have less variety and to reduce engineering efforts	Reduce Purchasing costs
Bundle to achieve value and have better price negotiating power	Make or buy decision	Exchange information about prices and or conditions and adjust them to benefit company, example, Payment conditions, INCOTERMS		Focus on each step of the supply chain, example, buy directly from manufacturer instead of distributor,
				Reduce inventory costs by using systems such as VMI. JIT.

Figure 5.2 BYC's PV strategies

5.2.2 YPC's Procurement System

Unlike BYC's purchasing department, YPC's Material and Equipment Department (YPCME) is responsible for all procurements except raw materials.. Procurement made by YPCME is about 30% of total procurement by the company; the rest of the procurement is mainly raw material which is purchased by the production and operation department. YPC does not independently control its entire procurement process as BYC does. Its procurement process is integrated with its parent company Sinopec's procurement system. There are three forms of procurement methods used by YPC namely direct procurement, instructed procurement and procurement by YPC as a subsidiary of Sinopec.

(Direct) Integrated Procurement is mainly done by Sinopec as the parent company. With this method the headquarters contracts with selected suppliers for some general items that Sinopec itself and all its subsidiaries use. Once these contracts are signed, Sinopec integrates demands from all its subsidiaries and purchases together. This category of suppliers includes all international suppliers that the company buys from.

Instructed procurement which is the second form is almost like the direct procurement, except that with this method Sinopec contracts with several suppliers that are qualified by the company to do business with them. When these contracts are established, the subsidiaries can then choose certain suppliers recommended by Sinopec that they prefer to use and establish longer business relationships with them. With the instructed procurement, the subsidiaries are required to purchase from these recommended suppliers.

Procurement by YPC itself as a subsidiary is the last method where each subsidiary can make purchases by themselves with or without influence by Sinopec. However, as a subsidiary company, YPC uses the material classification code system of Sinopec for all its purchases.

The material classification code system is used in both Sinopec and its subsidiaries. The materials are classified into 52 categories mainly based on the natural attribute, and for one material there is only one code representing it. Except for those 52 categories, there are another two categories which are only used in ERP and e-commercial system, namely Category 90 and Category 91. Category 90 is about service materials in activities as transportation, storage, load, customs declaration, etc, to make adjustment to the e-purchasing demand. Category 91 is about

waste defective materials to meet sales and financial business demand. Sinopec uses this code system to standardize the demand information from its subsidiaries, especially in the direct procurement and instructed procurement.

Procurement Process for YPC

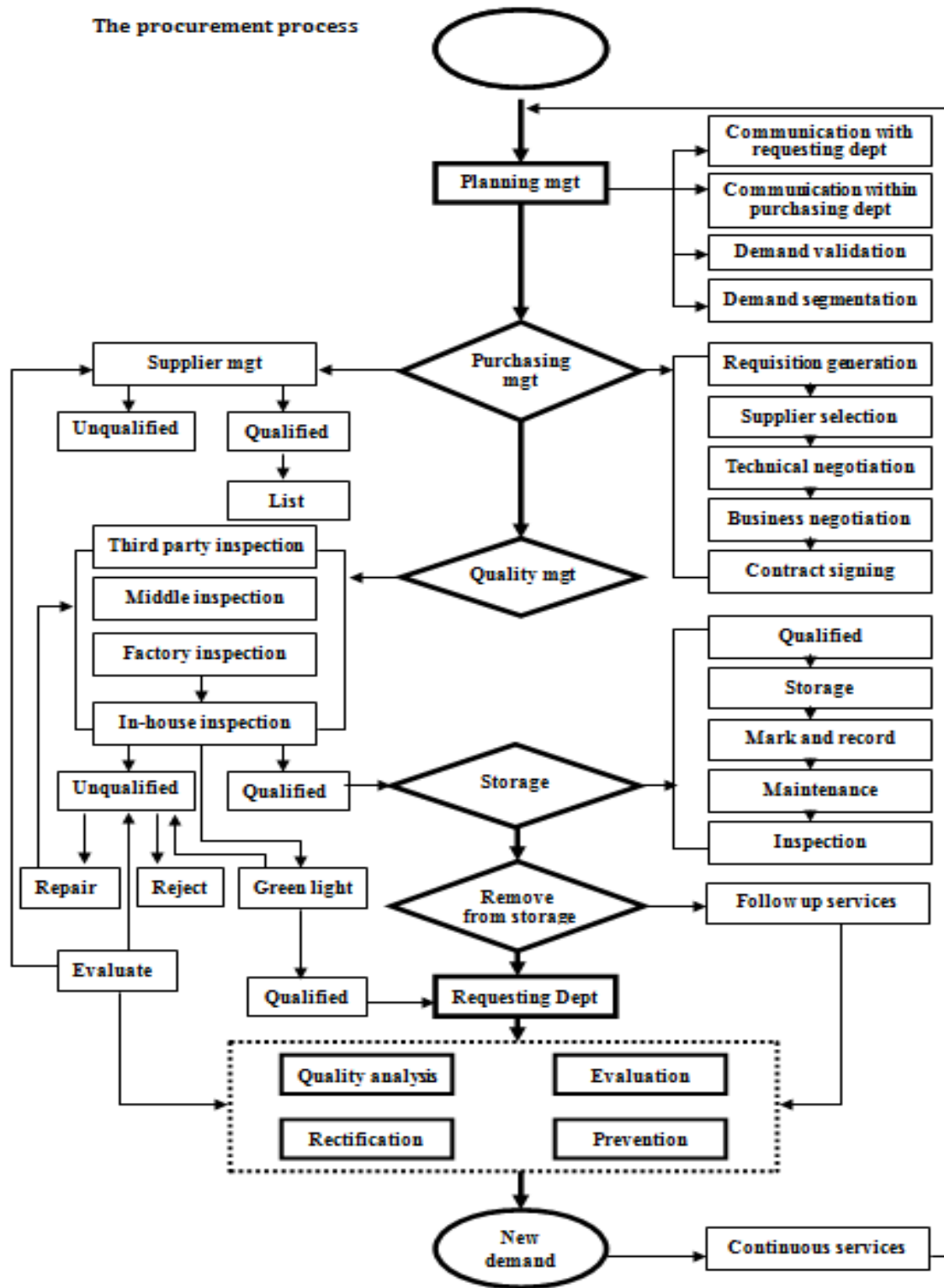


Figure 5.3 General Procurement Process of YPC

From the process above, it can be seen that YPC's purchasing department has divisions within the department that takes care of all requisitions once a demand comes from a requesting department. YPCME's purchasing department has 5 main parts to its purchasing process; planning management, purchasing management, quality management, storage and supplier management. For planning management, YPCME communicates with the requesting department and within the department itself to validate the demand. The purchasing management section and the supplier management section are responsible for supplier evaluation and selection to meet the requested demand. . The quality management staff is responsible for inspecting and approving the quality of the product. The inspection is done in three forms; third party inspection, middle inspection, and factory and in-house inspection. For storage, YPCME does some basic work on storage and follow-up services as quality analysis, evaluation, rectification and prevention after products have been removed from storage.

5.2.3 Purchasing Integration for Competitive Advantage

Different people, groups, and departments within an organization can work together to achieve common goals for the organization. Such goals could be reduction of product cost, improving the quality and delivery of a product, and the innovation of a new product. Integration is one area that organizations can realize their objectives and goals. This is true in every aspect of an organization's procedures including purchasing. It is imperative for organizations to adopt procurement strategies that will give them a competitive advantage in the industry. Procurement integration is practiced by a lot of companies in order to gain this competitive advantage (Robert Monczka, 2005).

Integrated Procurement by BYC and YPC

BYC uses integration as one of its core strategies in its procurement process. The company uses demand bundling in most of its purchases. With this approach a team will bundle all of the demands of an item by the entire company, and use the large volume to increase negotiation leverage. There is bundling within different departments of the company as well as other affiliate branches worldwide. Demand bundling is one of BYC's 5 procurement strategies to maintain a competitive edge. The company tries to maintain effective communication and linkages between departments and its sister and parent companies. Bundling is done for similar or different products and services to achieve better leverage for price negotiations.

YPC uses a different integration approach but also does this for the same reason as BYC. YPC's first step to achieving this goal was consolidating all the procurement that is not raw material. Prior to purchasing integration, every department within the organization was involved with purchasing their own materials and supporting products. YPC found this to be ineffective and wasteful, and since got the materials and equipment department (YPCME) to handle all these purchases. According to MR. Mr. Zhang, the YPCME department manager, this change has impacted the company's procurement system effectively. Another method that the company uses to increase integration is purchasing done by its parent company Sinopec. As YPC's headquarters Sinopec does over 50% of all purchases for its subsidiaries. This approach is to allow the Material and Supply department of Sinopec to integrate all the demands from their subsidiaries into a large volume purchase. The large volume purchase gives the company the advantage to negotiate better prices.

Cross Functional Teams

Communication, coordination and collaboration in organizations are some basic important steps in achieving overall company ideals and objectives. The use of cross-functional teams in realizing these steps is increasingly becoming popular in firms. Such teams are also becoming more and more important as firms pursue leading edge purchasing strategies and practices. Cross-functional teams consist of personnel from different functions in an organization, with different expertise, and from different backgrounds put together to achieve a common goal. The tasks of these teams vary and are more defined by the company's goals and objectives (Robert Monczka, 2005).

BYC's Procurement department makes use of cross-functional teams as one of its core strategies. Such teams at BYC are popularly known as PVTs, Procurement Verbund Teams. "Verbund" is a German word that means "to combine." BYC uses such teams in all of its purchasing practices, a practice that was adopted from one of its parent companies BASF. The PV teams were formed to eliminate some of the potential differences in opinions that existed prior to their formation. For example, if engineering generates a demand for an Item, they will be much concerned with getting the best quality without worrying so much about the cost. The purchasing department however wants to make sure they get the best deal possible to save the company money; these differences could create some conflicts in opinion.

A potential conflict in preference is what the PVT strategy used by BYC is supposed to address. With this strategy different department's work together to satisfy their procurement needs. They are cross-functional/regional teams that combine both the technical and procurement communities. They come from different Departments such as Maintenance, Engineering, and other major stakeholders. Members of the teams are made up of people from different backgrounds and regions around the globe; from the Americas, Europe, Asia and Africa.

The task of each team is to define the PV strategy, Increase coverage of the company's practices and define better ways of managing the company's suppliers. The team is to ensure that the company's technique of bundling is carried on effectively. They are responsible for making all the contacts that will ensure that purchasing is able to bundle demand within the company and between companies. Each PV team tries to utilize experts in each field in order to apply specific knowledge to improve procurement.

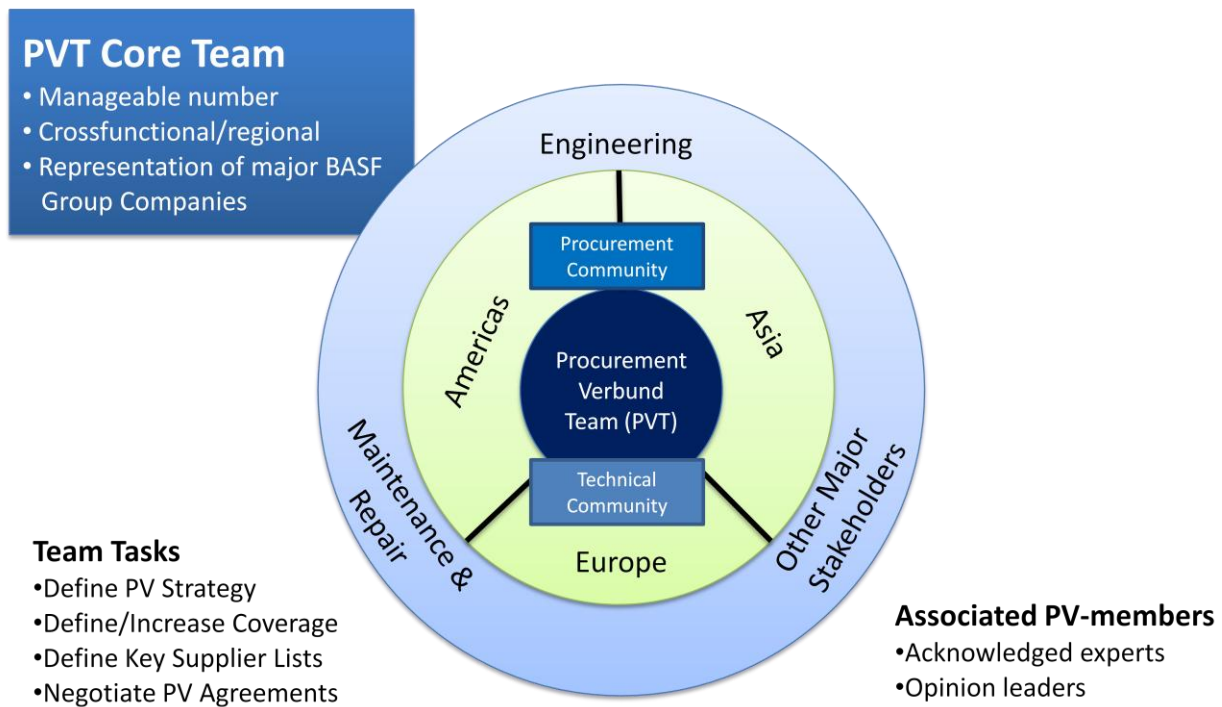


Figure 5.4 BYC's PV Teams structure

YPC's purchasing department does not make use of well defined cross functional teams in its operations as BYC does. Although the department carries out a lot of communication within department, between departments and between companies, their practice is more ad hoc than established. Due to the absence of cross functional teams in making certain key decisions,

the purchasing department is left with making most of the decisions regarding procurement and evaluation. This might not be the best approach in determining a cross organizational decision for a problem.

5.3 Organizational Structure of the Purchasing Department

The position of the purchasing department in a company's corporate structure signifies how influential the department can be in decision making processes that affects company goals and objectives. A function whose highest authority is an executive vice president is expected to have more influence in decision making than one whose authority is a manager. Generally if the purchasing department is higher on the organizational structure, it is more likely to play roles that support company objectives (Robert Monczka, 2005).

It is necessary for purchasing departments to structure themselves to be able to support specialized purchasing activities. Both BYC and YPC have internal structures that support their purchasing procedures.

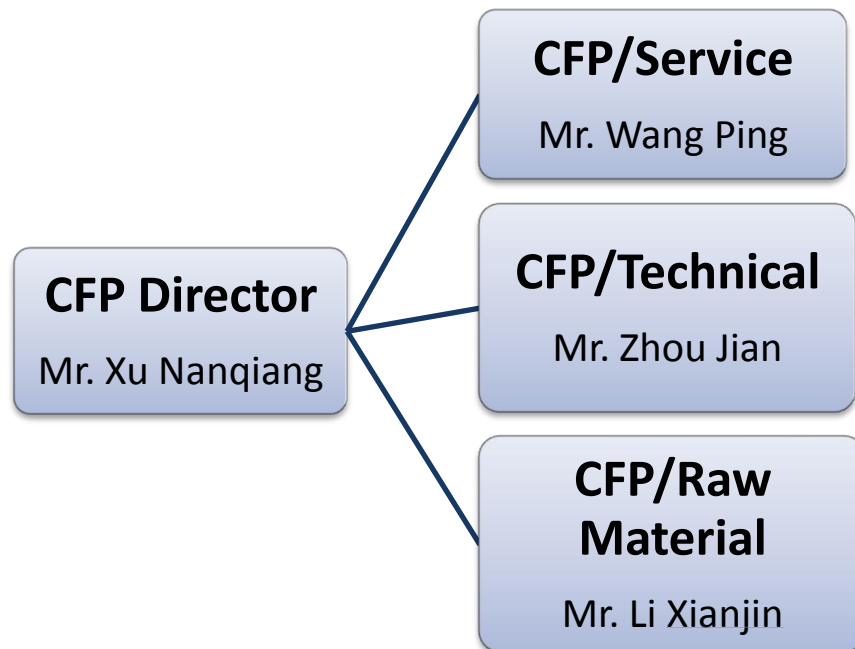


Figure 5.5 Structure of BYC's procurement department

BYC's purchasing department is divided into three segments where each segment has its own manager and staff, YPC also has different divisions within the purchasing department

responsible for different operations. There is the planning management group, the Quality management group and the purchasing management group who work together at different levels for a generated requisition to be completed.

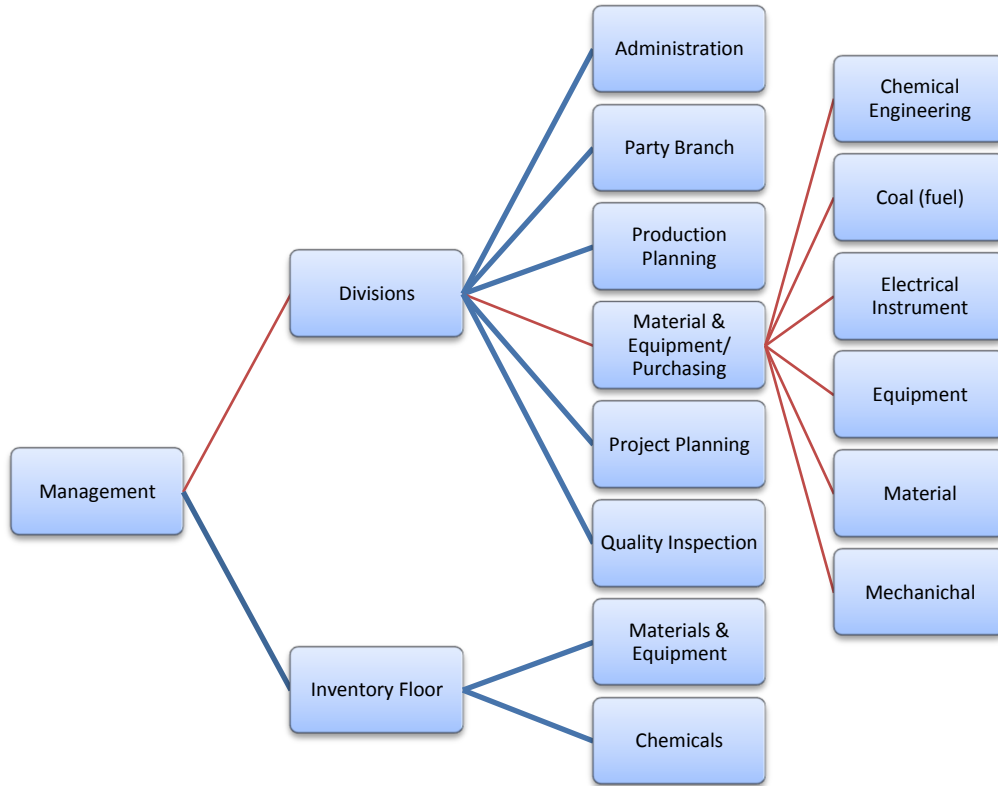


Figure 5.6 Structure of YPC's Purchasing Department

If purchasing will be able to meet their goals and align these goals to the organization's goals, they must work towards establishing specialized groups within their departments who will handle different levels of the procurement steps in line with the department's strategies.

5.4 Comparative Analysis Using Best Practices

Operations of the purchasing department in any organization are crucial to the realization of the firm's vision and objectives. The purchasing department as an important branch of a firm has its own goals to meet in order to align itself with the goals of the company as a whole. The department has to work to satisfy the operational requirements of its internal customers by providing an uninterrupted flow of quality goods and services to end users at the right price,

from the right source, at the right specification, in the right quantity, at the right time and to the right customer (Robert Monczka, 2005).

Both BASF-YPC and YPC utilizes different sourcing strategies in their procurement procedures. The companies demonstrate the use of some common techniques recommended by best practices. There are other practices that are unique to them and some that could be adopted from best practices.

Comparing BYC and YPC with Recommended Practices

Table 5.1 Comparison of BYC and YPC’s practices with best practices

Practice	Recommended	BYC	YPC
Sourcing strategically	A continuous process to determine best strategies	Utilizes PV teams to continuously define procurement strategies	Follows Sinopec’s 3 way procurement system
Integration	Use all possible strategies such as cross functional teams to achieve better integration	BYC’s PV teams seek best ways of effectively communicating with both suppliers and other departments and branches to promote integration. Uses integrated procurement to leverage better negotiating power	Does not use clearly defined teams to drive integration. However, YPC follows practices by its parent company, Sinopec. Sinopec uses a top down integrated procurement approach where it purchases for all its subsidiaries
Position of the Purchasing Department on the Organizational ladder	The higher purchasing is in the corporate structure, the greater the role it plays in supporting organizational objectives	The purchasing department reports to a position one level lower than the President	YPCME, which is the materials and equipment department reports to the president

The effective use of technology can be employed by both YPC and BYC in strategy development; it will be necessary to reinforce and enhance procurement. Very effective procurement strategies will improve operational integrity, manufacturing uptime and productivity. A successful procurement plan will drive down production cost and improve overall product quality.

Also, proper monitoring of both direct and indirect purchases will provide the two companies with better information on spending patterns. Knowing spending trends on items helps to identify areas of possible cost savings (Gebauer & Segev, 2000), which will help the purchasing departments of these two companies to develop better procurement strategies.

5.5 Supplier Evaluation and Selection

5.5.1 Supplier Evaluation and Selection Process

Evaluating and selecting potential suppliers has no single procedure to achieving the ultimate task. However, irrespective of the approach used by purchasers, an ultimate goal should be to reduce purchasing risks and to maximize overall value. A general approach to supplier selection and evaluation can be compared to the flow chart shown below.

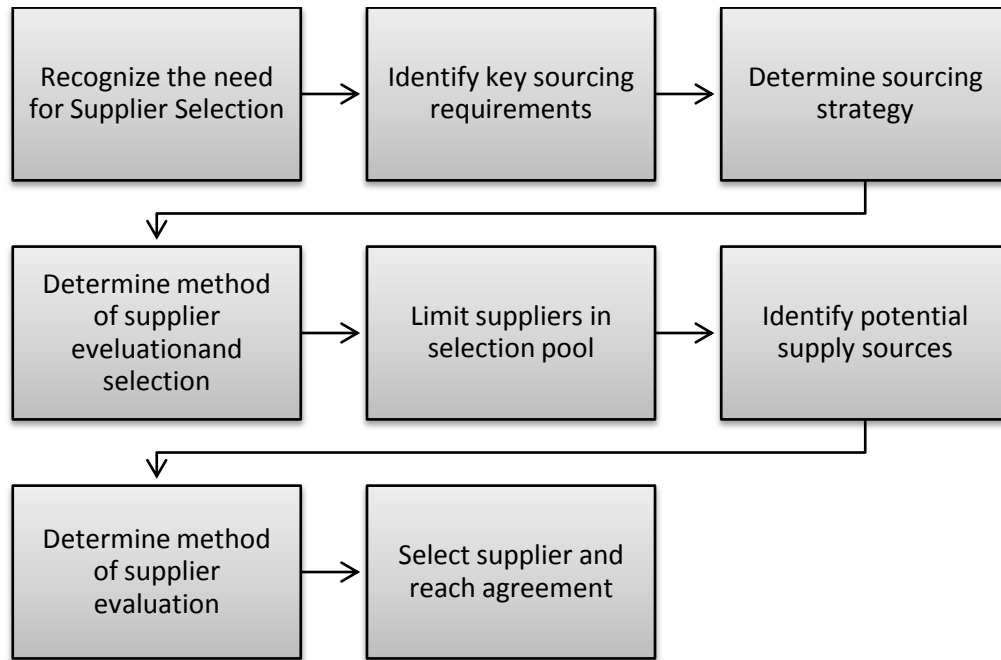


Figure 5.7 Supplier evaluation and selection process (Monczka, Trent, & Handfield, 2005)

Supplier Evaluation Criteria

Supplier selection criteria vary between organizations depending on the industry of the buyer. However, three general criteria that every buyer takes into consideration in its evaluation processes are cost, quality and delivery. These three apply in any industry and all suppliers are assessed based on how well they do in these areas. Other evaluation criteria are industry specific and the following are some areas that buyers look at:

- Management Capability
- Employee Capabilities
- Cost Structure
- Overall Quality Performance
- Process and Technological Capability
- Environmental Compliance
- Financial Stability
- Production Scheduling and Control Systems
- E-Commerce Capability
- Suppliers Sourcing strategies, policies and Techniques
- Willingness to Form Longer-Term Relationships

5.5.2 Comparing BYC and YPC's Evaluation and Selection Processes

BYC uses a cross-functional team strategy; Procurement Verbund Teams (PVT) in all aspects of its procurement and supplier management. This strategy is to help the company to pay attention to value added activities in all of its processes and to eliminate waste. For supplier evaluation and selection, the company uses the PV teams to ensure fairness in the process and also reduce the risk of not choosing the right vendors or suppliers. BYC's strategy can be summarized as shown in the supplier evaluation matrix below.

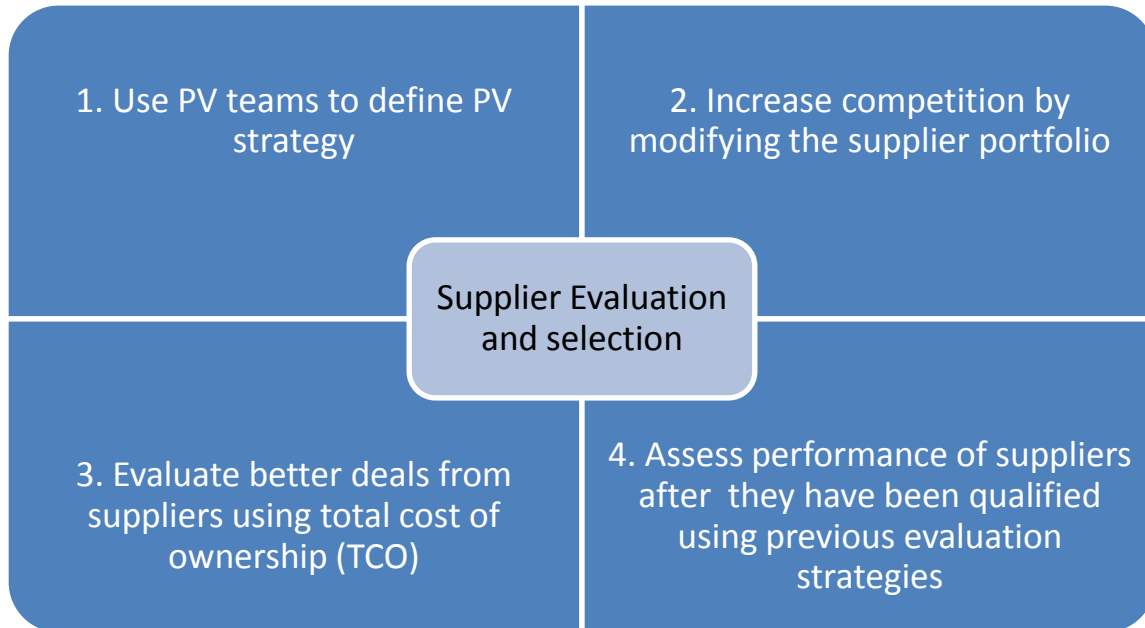


Figure 5.8 Matrix of BYC's supplier evaluation and selection strategy

The steps in the above matrix are some basic processes that BYC uses to ensure that supplier selection and evaluation is done in a way to reduce cost and add value to the company's supplier management.

The company uses the PV teams to define PV strategy; to define key supplier lists and establish the need to limit suppliers to decrease cost and increase negotiating power

BYC's PV teams work on selecting new suppliers based on the company's supplier portfolio selection procedure. The portfolio clearly defines how the team should select a vendor. Following this procedure the team is expected to come up with a list of good suppliers and evaluate them. If for a particular purchase the team cannot find a supplier from their supply list, it goes into a supplier haunt. One of the first options is to inquire whether certain suppliers that can supply their needs have been used by any of their parent companies or other branches before.

If they have, their performance over the period is confirmed from the parent companies or the branch that used them to see if they will make it to an initial supplier list. If no such supplier is found through the above approach, the selection team will turn to the internet to look for suppliers that can supply what they want to purchase.

Once a supplier is recommended for the initial supplier list, it goes through further evaluation by answering some survey questionnaire from BYC. The survey seeks information on the supplier's performance, appearance, capacity, machinery, certificate, licenses and ability to deliver. When information from the questionnaire is received, the results are compared to the requirements of their standards and a qualified supplier is chosen. Once the supplier meets BYC's requirement on all these criteria, the supplier is approved, and added to the bidders' list.

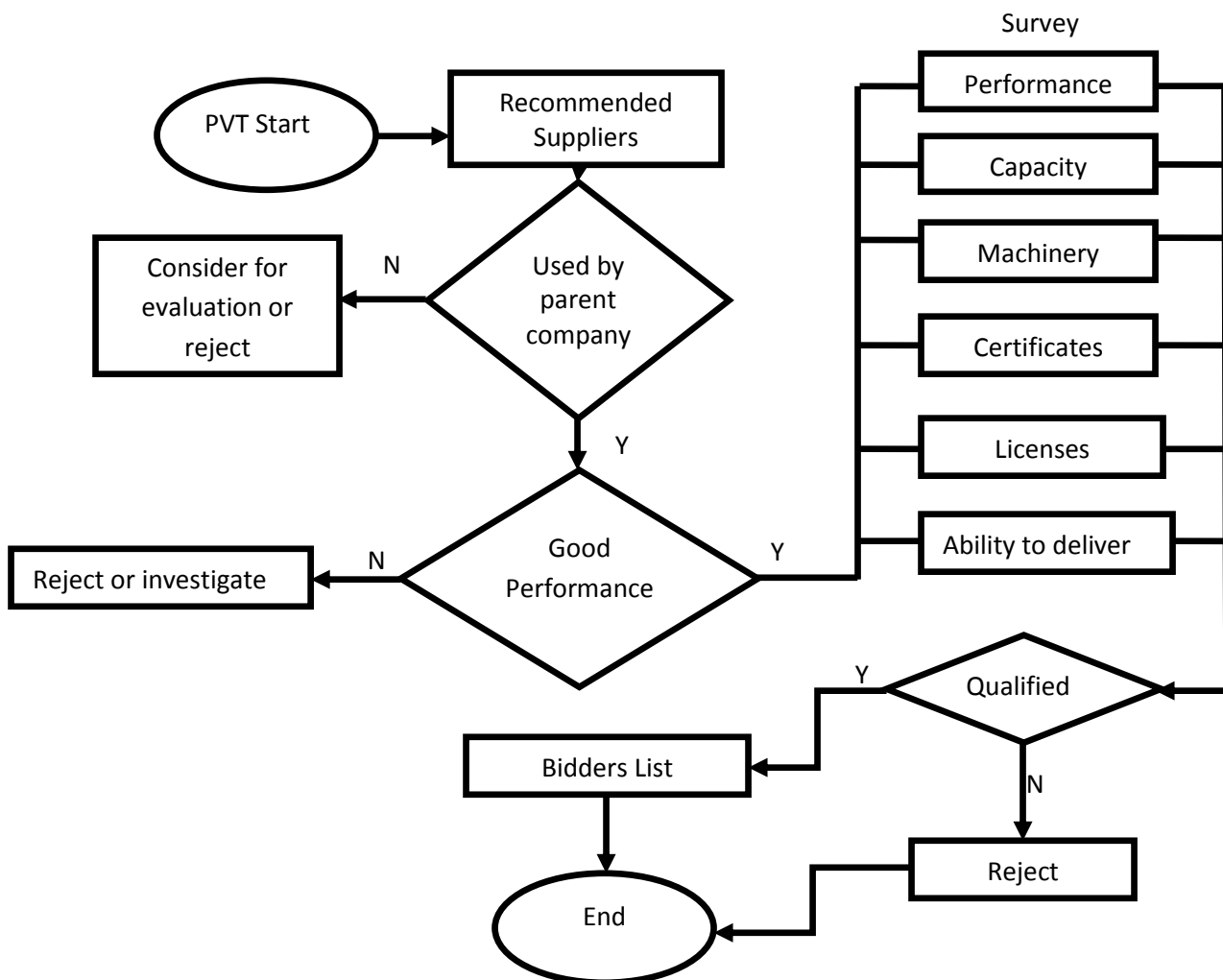


Figure 5.9 Supplier Selection Process for BYC

After the bidding process is complete, the winner of the bid signs a contract with BYC to supply the items demanded. The contract period varies depending on the item being purchased and the terms of contract are also case specific. When the period is over, the supplier's performance is evaluated and the contract is either extended or ended. BYC does not have standard selection criteria for all its suppliers, due to the nature of their business; however, their supplier management portfolio spells out the guidelines to be used for the process. Selection of suppliers will depend mostly on the items or materials they purchase. One of the techniques that the company uses in the cost structure category in evaluating the cost of a demanded item is total cost of ownership (TCO).

Total Cost of Ownership by BYC

The Cost of items purchased is usually one of the key components that companies consider in their supplier evaluation and selection process. As part of assessing the cost structure of their potential suppliers, BYC does cost/benefits analysis using the Total Cost of Ownership (TCO) strategy to ensure that the right vendors are selected for the right value. Apart from the initial costs of an item, TCO takes into consideration other costs such as operating and salvage costs

Table 5.2 Shows some components of a TCO analysis

Initial Costs	Operating Expenditures	Decommissioning Costs	Valuation
Engineering Costs	Operating Costs	Dismantling	Discounted Cash Flow, valuation period 10 years
Quality Assurance	Maintenance	Disposal	Internal Interest 11%
Equipment Cost	Downtime (defined in technical specification)		Depreciation based upon local tax law
Construction	Plant Improvements (not considered for technical bid evaluation)		Consideration of partial spare & wear parts cost if lifetime exceeds valuation period
Commissioning Cost			(Annual costs times four are equal to initial cost)

Although the TCO Analysis is a reasonable evaluating method of associating cost with prospective suppliers some parts of the analysis which is much more subjective, such as operating costs is not very easy to calculate. This becomes a challenge for companies who want to implement TCO to implement it efficiently.

Example of BYC’s Bidding and Awarding Process

Purchase of a distributed control system (DCS): A PV team which is a global team is tasked with this type of procurement. As shown in the table below, the team has to identify the procurement characters of this item and identify the suppliers to be used for this process.

Table 5.3 Bidding process for the purchase of DCS by BYC

	Multiple supplier site (more than one DCS system)	Single supplier site (Only one DCS system)
New Site	BID	BID
New plant, new DCS	BID	Award or BID
Plant expansion	AWARD or BID	AWARD
Minor modification refreshment	AWARD	AWARD
DCS migration	BID	AWARD or BID

*(BID means put up for bidding, Award means award directly)

*Decisions based on Life Cycle Costs

*BID recommended for DCS migration

As shown in the table, the process for selection depends on the purpose of the purchase. Column one shows whether the DCS is being purchased for a new site, for an expansion work or for modification. For this particular item, BYC has the following suppliers on its list:

- ABB
- Emerson
- Invensys
- Siemens

Legacy supplier

- Honeywell

If any of the suppliers in the list had supplied the system before, then depending on the type of purchases as spelt out in column 1 of table 5.3 they could be allowed to participate in the bidding process or they could be awarded the contract directly.

5.5.3 YPC’s Evaluation and Selection Process

YPC’s evaluation and selection process differs from that of BYC mainly due to how selection decisions are made and who makes the final decision. Depending on which kind of procurement method is being used, the evaluation and selection process could be made solely by Sinopec, YPC’s parent company, by the purchasing staff of YPC, or a joint process between Sinopec and YPC; where Sinopec will recommend the suppliers for YPC to choose which ones to use for the bidding process.

YPC uses an electronic database in its vendor selection process. If the company has a need for an item or product that it can purchase by itself, they publish their need for such suppliers on their e-commerce website where prospective suppliers can visit and register

themselves to be considered into Sinopec's supplier list. On the other hand YPC can search for suppliers by first enquiring for such suppliers from any of the other subsidiaries of Sinopec, by asking other companies in the same business as them or search the web for suppliers. If YPC uses the latter process, it will contact suppliers and discuss the possibility of using them. Any supplier that is considered to be used by YPC has to be registered and admitted into the supplier network of Sinopec. Before registration they are required to meet some criteria put out by Sinopec. Once all these criteria are met the prospective supplier can upload their information on the website to be verified by Sinopec or by YPC.

The e-commerce system is the main tool that the company uses to manage its supplier base. Besides supplier selection the system is also used for price quotations, and feedback about purchases. When the supplier information is uploaded, it will be verified and approved by YPC if the supplier is registering to do business with only YPC, on the other hand Sinopec's headquarters will verify and approve the supplier information if the vendor wants to do business with the headquarters and its subsidiaries.

The suppliers' information provided in the supplier management system is verified by the purchasing staff using an internal control guideline that puts the selection process in check. The following criteria are used to approve the suppliers:

- Cost of the item
- Implementation of contract terms after the contract
- Inspection and payment after delivery
- Onsite service and other important factors

The supplier with the satisfactory score and the one that can provide the best value is selected and qualified to be approved by the headquarters and added to the supplier network of Sinopec. If the supplier is solely for YPC, they will then establish a business relationship with them. Once the selection process is over, the qualified suppliers are then listed in a bidders list and allowed to bid for the supply of the items.

The winner of the bid signs a contract with the company to supply needed items. The contract period depends on the items purchased and the period the item is needed. The contract can be ended or extended after the initial period based on the results of a comprehensive supplier performance evaluation.

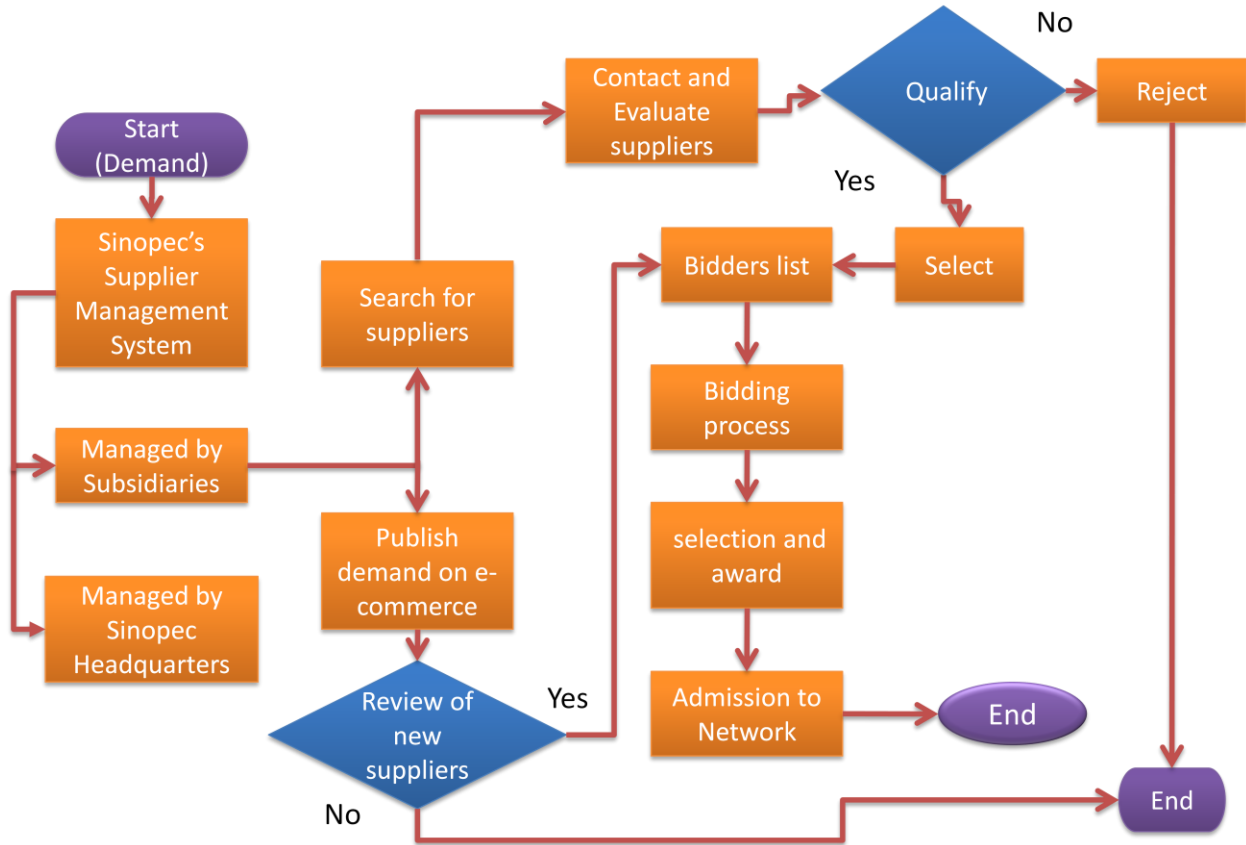


Figure 5.10 Supplier Selection Process of YPC

Internal Control System of YPC

The selection process is monitored by an internal control system put in place by the headquarters of the company. This system is to check each step of the selection process, and is put in place to ensure that the selection process is carried out in a more effective way, but more importantly it is to ensure that the system is more transparent and that the risk of malpractices is lowered. The system works such that during the selection process staff from the purchasing department who are in charge are expected to fill out certain forms to answer some questions about the steps they followed. These forms are checked on occasional basis to ensure that required procedures are being followed.

Evaluation of suppliers for bidding focuses on technology and quality. Suppliers are mostly evaluated based on their products and services; the quality of their products and how effective they offer services to the company will determine their qualification for the bidding process. The ability to deliver the needed item on schedule is another factor that YPC considers

in choosing a supplier. The cycle time for an item is estimated when a demand is generated, and based a supplier's ability to meet this cycle time they can be considered if all other factors are also met.

5.5.4 Analysis Using Best Practices

Initial supplier evaluation and selection is a critical step in the success of any organization's procurement process. As is the goal of any purchasing department to minimize risks and add value to their overall purchasing practices, all necessary steps should be taken by BYC and YPC to ensure that the best suppliers are chosen for the right supplies. The selection and evaluation process is a dynamic; therefore, purchasing staff must have clear strategies on how to land the best deals for their companies (Robert Monczka, 2005).

There are several implications that are likely to hinder production and the smooth operation of plants if supplier selection is not done well. Much as both YPC and BYC use practices that would ensure the selection of the most appropriate suppliers for their needs, there some differences in their respective approaches and with some recommended practices. Table 5.3 compares the practices of these companies with some recommended practices.

Table 5.4 Comparing Supplier Evaluation with Best Practices

Practice	Recommended	BYC	YPC
Evaluation and selection process	Vary the process based on the strategic importance of the purchase being made. Utilize different strategic approaches and involve different expertise in the process to achieve best results	Utilizes a PV teams for strategic purchases and local teams for non critical purchases. The strategic supply teams could be global or local, and members are made up people from different departments	Uses an integrated supplier management system with its parent company Sinopec. Does not necessarily utilize strategic teams for the selection process, it uses an internal control system to oversee the process.
Three key evaluation and selection criteria	Mostly evaluate suppliers on cost, quality and delivery	Evaluates prospective suppliers using total cost of ownership as one of its assessment tools for cost. It also investigates quality and delivery performance of the customer	YPC does not actively use TCO in assessing the cost of purchases, however the company compares prices of items it wants to purchase with market prices, price based on past purchases, and from other suppliers
Other selection evaluation criteria	To have very comprehensive knowledge to help in the selection process, suppliers can be evaluated based on the following: Management Capability - how well the suppliers manage their companies; planning competitiveness and other relevant information.	BYC’s supplier management portfolio spells out their criteria for supplier selection. Different purchases are associated with different criteria. Some of the criteria used for initial vendor selection include: performance, capacity, machinery, certificates, licenses, and ability to deliver	As best practices recommends, YPC uses selection processes that best suits their needs. In their vendor verification process they take into consideration the cost of the item, how suppliers execute contract terms, and the services that suppliers offer to the buyers on site. Like BYC YPC uses different selection processes based on the importance of the item being purchased.
Evaluation and Selection Cycle Time	Purchasing managers should make continuous efforts to continually reduce the time it takes to deliver services to internal customers	BYC enquires from it requesting departments the time frame by which they must get the item. Based on this information, they factor into their search timelines by which the needed item should be received. These timelines are sometimes met but not all the time	YPC also communicates with the end users of items to find out about how critical the item is to their operations. With this knowledge they try to get suppliers that meet their timelines.

5.5.5 Implications of BYC and YPC's Evaluation and Selection Processes Utilization of Cross Functional Teams

The supplier evaluation and selection process requires varying strategic approaches to ensure that the right suppliers are chosen to meet the needs of internal customers. The selection decision making has become very important such that more companies are using cross functional teams in making such decisions instead of just the traditional purchasing staff. In the case of BYC the PV teams will guarantee a well executed selection process which can reduce or eliminate a host of problems that are associated with not making the right selection. Although the use of cross functional teams is not the only guarantee for making better supplier selections, involving professionals from different departments brings proper control to the process.

For example, it would be a good idea for YPC to involve a production engineer or mechanical technician in the early stages of the selection of a supplier for a steam turbine. This person will be able to ask the right questions about the equipment than a traditional procurement staff would. Leaving the entire selection and evaluation process to only purchasing staff may end up leaving many questions unanswered, which might end up slowing down the process.

In choosing a supplier purchasing would want to ensure that an item of acceptable quality with a good price takes preference over one with very good quality but very expensive. A mechanical engineer might prefer the best quality and not care so much about cost. Because of such differences in preferences, a strategic procurement team that includes both the engineer and the purchasing staff can minimize such differences when the two work together for a common goal. There can proper control and members of the team are more likely to achieve company objectives than departmental objectives.

Using Total Cost of Ownership in the evaluation Process

The total cost of ownership is a very viable tool that organizations can use in their supplier selection process in order to have a better idea of the true cost that a prospective supplier is offering. On many occasions the true cost of an item is not known by suppliers because they fail to factor in their evaluation process some hidden cost that are not so obvious but very

important. Such costs can be estimated if companies utilize TCO in estimating the true cost of an item being purchased. Apart from incurred costs which are always obvious, other cost that are linked to performance and policies end up causing the true costs of items to be much higher.

Performance costs such as maintenance costs or late delivery time costs are some hidden costs that must be critically considered. If an item is not delivered on time as promised by the supplier, all the costs associated with the late delivery should be estimated. The maintenance costs associated with the operations of an item should be factored into the supplier selection process. Using TCO models to estimate these costs will be helpful for making the right decisions about the item to be purchased. If these costs are not considered before a purchase is made, the department may end up spending more than its necessary. Other costs that come up as a result of policies such as taxes, social requirement and others also end up increasing the cost of an item (Baron).

5.6 Supplier Performance Evaluation

5.6.1 Supplier Performance Measurement and Decisions

It is imperative for buyers to have a system that helps them to collect and measure information from their suppliers. This information could be used to rate or rank supplier performance on a continuous basis. Scores could be assigned to suppliers based on how well they meet the standards of buyers and key decisions on supplier performance and development are made using these results.

5.6.2 Supplier Performance Evaluation by BYC

As an ongoing process BYC tries to increase competition by modifying its supplier portfolio regularly. It accomplishes this by:

- Increasing the number of suppliers for a particular item to break up single sourcing
- Reducing the number of existing suppliers
- Keeping the number unchanged but replacing existing suppliers with more competitive ones
- Changing the origin of suppliers by replacing foreign suppliers with domestic ones or domestic ones with foreign ones.

After a contract period is over, the company reevaluates the supplier to see whether to extend or end the contract. BYC's supplier evaluation and selection sometimes varies based on the particular items that are being purchased, and present prevailing conditions such as previous contracts signed with the same suppliers, or other suppliers.

For its supplier performance evaluation, BYC uses a Global Supplier Evaluation System (GSE) to assess how well their suppliers meet their standards. After a purchase order is issued, a questionnaire with relevant evaluation criteria will be automatically generated to be answered by relevant parties. That is purchasing staff will respond to questions regarding price, and end users will respond to questions on delivery time, quality and services offered on site. Once these questions are answered, the system will automatically assign scores based on the answers entered by the various departments.

Results from the evaluation is displayed on BYC's web system and shared with all the BASF groups globally. To determine whether a supplier needs to be maintained or dropped from the supplier list, BYC does not only use the score that such a supplier received from them, but the score from other companies are also considered. For each supplier the GSE generates an average score using scores from different companies in the BASF group that makes use of the same supplier.

Supplier Development and Improvement

After reviewing evaluation results BYC decides on which suppliers to keep and which ones to stop business with, for suppliers that do not perform to the company's standards, BYC will make a decision whether to share with the results with them or not. BYC only shares results with key suppliers that are very crucial to BYC's processes. For such key suppliers it is important for BYC to work with them in developing very good relationships. These are suppliers that cannot be switched for different ones easily. In this case BYC shares evaluation results with them and helps them to improve on their performance. For other suppliers whose services are not so crucial to BYC's operations, it is much easier for them to be dropped from the supply base; especially if there are other suppliers that are competing to offer the same services.

5.6.3 YPC's Supplier Performance evaluation

YPC's supplier performance evaluation is done in twofold: the first round of evaluation is

done by YPC as a subsidiary company and the second round which determines whether a supplier will be maintained or eliminated is done by Sinopec. The performance evaluation system consists of three scoring sections: scoring after each purchase order, scoring on performance (according to the annual quantity of products and services provided by each supplier), and scoring on a supplier’s qualification (its financial statement, capacity, and others). YPC does the first round of scoring which is basically assessing the supplier after each purchase and Sinopec does the next two evaluations. An extensive score is drawn after giving different weight to each score.

Scoring by YPC

At the end of each purchase order, the supplier will be evaluated by YPC using a questionnaire. The questionnaire gathers data on supplier Performance in the area of price, delivery time, quality and service. Based on the result of the survey, suppliers will be ranked and the result will be sent to Sinopec as part of the integrated annual appraisal method. Together with previous questionnaires, Sinopec uses a grading process towards each supplier concerning its capital, capacity and other relevant aspects to the service they provide to Sinopec and all its branches.

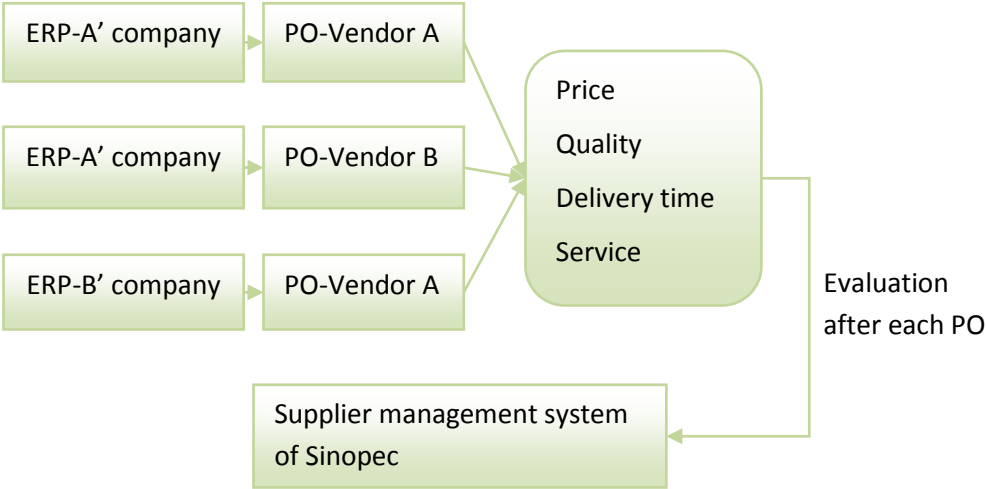


Figure 5.11 Vendor evaluation process of YPC

Table 5.5 Example of YPC’s score card for its suppliers

Areas of evaluation	Scores	Description
Delivery time	0	The delivery is badly delayed, great impact on production
	10	The delivery is delayed, some effects on production
	20	The delivery is a little behind the contract, minor effects on production
	25	The delivery is a little behind the contract, no effect on production
	30	The delivery is on time
Quality	0	Quality problems exist, fail to meet major quality criteria, return
	10	Quality problems exist, fail to meet some of the quality criteria, accepted by compromise
	25	Minor quality problems exist, meet major quality criteria
	35	Good quality, meet the criteria
	40	Excellent quality, meet all the criteria
Pricing	6	Offer price is the same as market price
	8	Offer price is a little lower than market price
	10	Offer price is much lower than market price
Service	0	Not in accordance with the contract, or not involved in client’s production processes
	10	In accordance with the contract, not fully involved in client’s production processes
	15	In accordance with the contract, involved in client’s production processes
	20	In accordance with the contract, involved in client’s production processes and offer value-added services

All suppliers are annually evaluated by Sinopec based on information that YPC and other subsidiaries provide to the headquarters. All the purchasing orders and requisitions are generated from Sinopec’s ERP system in electronic version. Using the extensive scores, Sinopec takes measures to reevaluate the vendors in its supply base. Based on the scores some suppliers will be eliminated and others will be kept. If a vendor has a relationship with some of its subsidiaries, Sinopec will inquire from the branches and seek advice from them whether to keep using these vendors or eliminate them. If by the end of the overall evaluation a subsidiary wishes to keep a supplier, it should provide reasons and sufficient evidence on the supplier’s performance to justify why continuous business with such a supplier will benefit the company. If the relationship

is between the supplier and the headquarters, Sinopec will eliminate the vendor directly based on results from the evaluation.

The scoring process helps Sinopec to have a centralized control over its supplier base. It also enables YPC to evaluate its own suppliers and come up with its own opinions on supplier retention. After the annual supplier performance evaluation, Sinopec will have all of the suppliers on list graded with a weight-point system. Suppliers with high scores are awarded with a bonus score, which gives them an advantage in future bidding. Suppliers that performed poorly and as a result had very low score will go through some form of evaluation from Sinopec whether to retain them or eliminate them from the supplier list.

YPC, together with Sinopec and all its subsidiaries, uses this process to eliminate suppliers who are not qualified and competitive enough in the market. The process also helps suppliers to become more competitive and provides an opportunity for potential growth.

5.6.4 Strategies for a stronger supplier relationship

Managing the relationship between suppliers and buyers is very important for organizations to be able to align the performance of their suppliers to their company objectives. A strategic relationship management will help both parties to handle changing requirements, be able to make plans for the future, continuously improve on services and contracts, have effective communications throughout the organization, be able to handle risks and promote transparency. An efficient supplier relationship management will increase customer satisfaction and increase stakeholder value (Madow, 2007).

BYC and YPC have a choice, to foster very effective relationships with their suppliers in order to add value to contract deals with them, or allow relationships to go sour between them and their vendors. The latter can guarantee the loss of millions of money as a result of losing key suppliers.

5.6.5 Vendor Relationship Management by BYC

To maintain a very good relationship with their key suppliers and gain a better negotiating power, the company tries to utilize a strategic supplier performance management approach to strengthen relationships with these suppliers. As part of this strategy, BYC:

- Holds workshops with them to discuss diverse issues regarding their supply chain and how both parties can work to improve the processes
- Gives these key suppliers more opportunity to take part in the bidding process
- And they work with these suppliers to develop new technologies to satisfy their needs

To help develop their suppliers, BYC shares evaluation results with very key suppliers. These suppliers are those whose services are very pertinent to BYC's operations and as such they cannot afford to lose them; these include monopoly suppliers. If after performance evaluations some of these key suppliers are found to have unsatisfactory results, BYC informs them of their performance and talks to them about improving on their services. This communication is either at annual review meetings or BYC decides when to share such important information. For suppliers whose operations face a lot of competition from other s and as such can be replaced easily, BYC does not put in a lot of effort in developing them. They their services are either dropped or replaced with more competitive suppliers.

5.6.6 Relationship Management by YPC

In March 2003, YPC started to use ERP as the first petrol refinery of Sinopec to do so. YPC also adopted the VMI strategy to create a collaborative relationship with its upstream suppliers. Although one of the basic requirements for implementing a VMI system is information sharing, YPC has not been able to open itself up to its suppliers and therefore the lack of information sharing has hampered the full utilization of the system (Zhao & Zeng, 2007).

To help enhance information sharing which will eventually help YPC forge very good relationships with their suppliers, an alternative system: The Collaborative Inventory Management System, which allows suppliers to have access to some information on YPC's material consumption, demand forecasting and lead time. This helps the suppliers to make early arrangements to replenish YPC's stock.

Communication between vendors and clients is very important for the development of good supplier client relationships, and information sharing helps with supplier relationship. YPC shares results from its performance evaluation with suppliers who do not perform too well, yet

their services are really needed. In that way the suppliers are given the opportunity to improve on their performance. On the other hand suppliers who do not perform very well and yet face strong competition from other suppliers are likely to be eliminated from YPC's supplier list.

With proper measurement techniques, companies conduct supplier performance evaluation in order to optimize their supply base. Companies keep eliminating marginal suppliers from their supply base. They replace the suppliers from whom few purchases are made with good suppliers, and good suppliers with better ones so as to keep the supply base made up of the best performed suppliers (Robert Monczka, 2005).. Supplier's involvement in new product development and cost reduction decision making is crucial to supplier improvement as a consequence of effective performance evaluation. (Morgan, 2004)

Table 5.6 Comparing BYC and YPC with Recommended Practices

Practices	Recommended	BYC	YPC
Measurement criteria	The criteria should include main quantitative factors such as quality performance, delivery performance, etc. together with necessary qualitative factors like problem resolution ability, new product support, etc.	BYC uses questionnaire consisting of standard questions together with specially tailored ones according to the purchase order.	YPC uses a scoring system to evaluate supplier's performance in each purchase order mainly from four aspects: price, quality, delivery time and service; insufficiency in regular qualitative measurement.
Measurement techniques	Weighted-point system is recommended in measurement so as to gain flexibility, wholeness and moderate costs. In implementing the system, inter-functional effort is expected to make sound evaluation.	The Global Supplier Evaluation system uses a weighted-point system and they have people from different functional departments who are qualified to answer the questionnaires.	YPC uses a weighted-point system to evaluate the suppliers, but they only have purchasing staff doing the scoring using information from others who have first-hand knowledge of supplier's service and quality of its supplies.
Supply base optimization	It is recommended to eliminate marginal suppliers and those from whom little purchase is made. Companies should keep replacing good suppliers with better ones so as to maintain a supply base with best performance, which substantially reduces implementation costs.	BYC keeps increasing competition by modifying supplier portfolio, reevaluating suppliers, reducing suppliers or replacing existing suppliers with more competitive ones. BYC has a relatively lean supply base compared with other companies in China.	YPC, as a subsidiary of Sinopec, uses the comprehensive score system to evaluate its suppliers, the result of which is crucial to the decision making of keeping a supplier. Based on the classification system of Sinopec, YPC has a more complicated supply base which is managed in two ways: centralized by Sinopec and respectively by YPC.
Supplier relationship management	Supplier involvement in production planning and new product development will benefit both parties substantially. Companies are expected to help suppliers improve their capability.	BYC doesn't usually help suppliers with product development. If the supplier is quite independent to its client, and is a strategically key supplier to BYC, the company will hold workshops to involve the supplier into production process.	YPC collaborates with its suppliers every year, mainly on research development project about products and technology. But limited attentiveness is placed on it.

Implications

Looking at YPC's supplier performance evaluation, the project team inferred that the system could be improved the current system could have some flaws. Using the purchasing staff to evaluate every criterion of the supplier's performance is not the best idea, some implications could be:

- **Unfairness in the process:** If the same person scores all aspects of the supplier's performance, the scorer could be biased toward the supplier and this will reflect in all aspects of the scoring.
- **Inconsistency in Reporting:** The current scoring system requires the purchasing staff to obtain information from other staff that had first hand information. Obtaining such first results could be inaccurate especially if they are not documented just when the item is delivered.
- **Inefficiency in the scoring Process:** After the generation of a purchase order, the purchasing staff that does all the scoring does not do it immediately. At times this evaluation is postponed to a later time, which implies extra man hours will be spent to do the scoring again. However this could be done by different people and immediately after receiving the item. This would eliminate any delay, and would ensure fairness since internal customers who have first hand information will do the scoring.

6 Recommendations

After studying the procurement strategies and supplier management methods of the two companies, it was evident that there were more differences in their practices than there were similarities. Information obtained from BASF-YPC suggested that the company utilizes many best practices in their procurement and supplier management processes. Based on this information the team did not identify any area of concern that needed improvement. Information obtained from YPC however showed that YPC's Materials and Equipment department could do more to improve on their methods.

Based on this finding, the team proposed four recommendations to help optimize YPCME's procurement processes and supplier management practices. The recommendations were prioritized into short-term, medium-term, and long-term based on the current conditions at YPC and the resource investment involved in undertaking these suggestions. For a short term recommendation a revised scoring process utilizing cross-functional teams was proposed. For a medium-term recommendation the team suggested the utilization of a more robust communication scheme in supplier selection and the use of an analysis portfolio to help the department to source strategically. Finally for a long-term recommendation, the team suggested that YPC should take TCO beyond an ideal and fully implement a TCO scheme focusing on strategically significant purchases.

6.1 An Alternative to the Current scoring System at YPC

YPC's current scoring process could be modified to make it more efficient than it is now. The current system does not guarantee fairness in the scores that suppliers get because only one staff member does all the scoring for a single purchase order. A potential alternative to this current process, as shown in Figure 6.1 would be to have appropriate staff from all departments who are involved in the transaction process contribute to the scoring. For example, a mechanical engineer who supervises the installation of a pump would likely be in a better position to assess the quality of that specific pump. This engineer can therefore score the quality of such a pump instead of the purchasing staff. Figure 6.1 shows a block diagram of YPC's current scoring process.

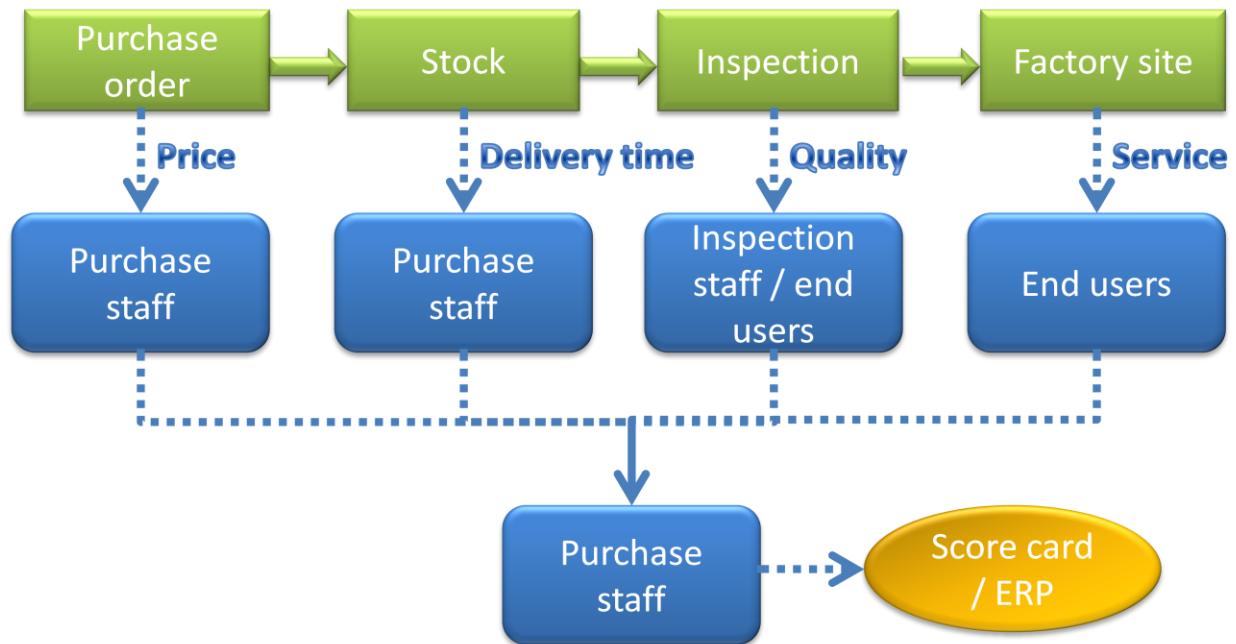


Figure 6.1 YPC's performance scoring process

The proposed alternative is to involve all the staff from different departments who are involved from the generation of a demand to the time it is delivered on site. In this process staff will enter a score for each relevant step of the process as soon as they finish executing it. For example, the purchasing staff that completes the price negotiation of an item will immediately give a score to the performance of the supplier in the price criterion. This score will then be registered in the ERP system. Also for delivery time the staff that receives the item can immediately enter a score for this criterion. The scoring continues until all the people involved have scored immediately the item is on hand. In this way the scoring cannot be postponed and it will minimize the possibility of having inaccurate assessment. Another benefit of this system is that scoring will not be done by just one person, therefore purchasing staff will not be overwhelmed with multiple POs at the same time, and YPC may only need to commit limited resources or might not have to commit any resources to this, since the YPC materials and equipment department already makes use of an ERP system.

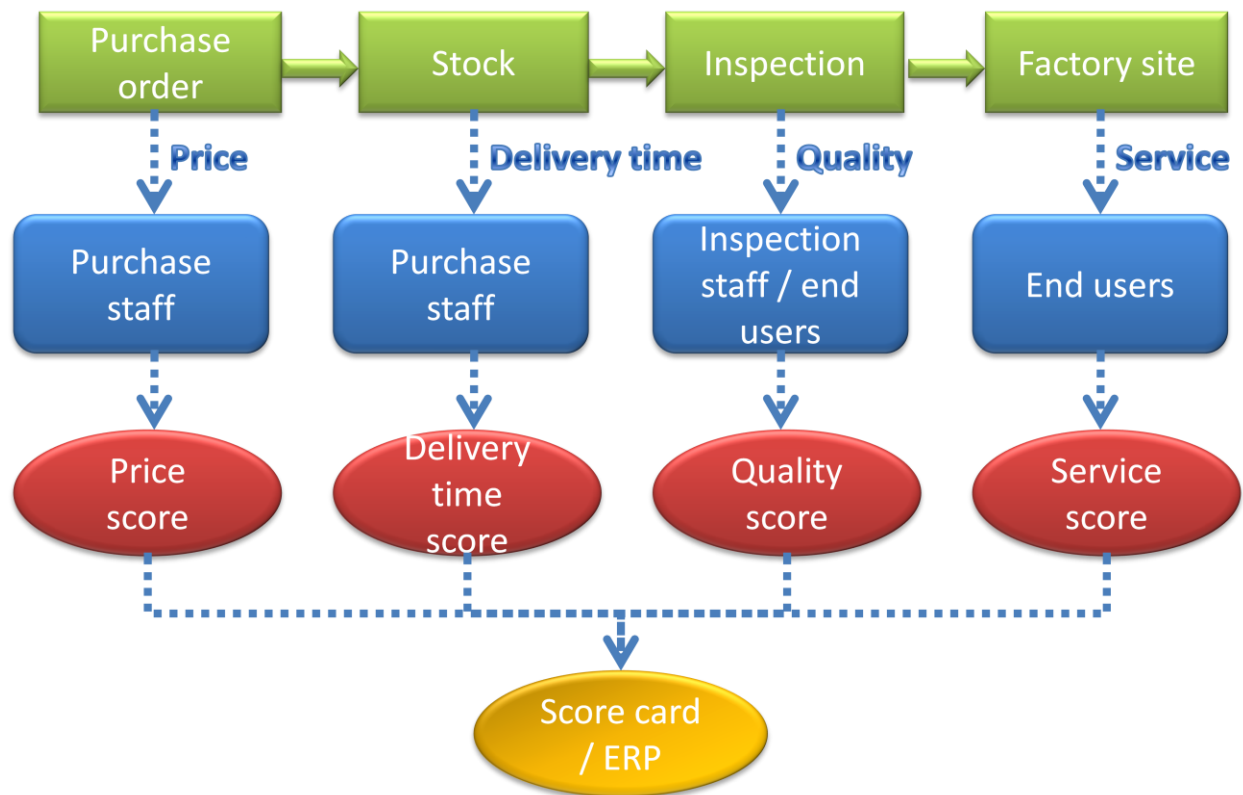


Figure 6.2 Proposed scoring process for YPC

6.2 Use of Cross Functional Teams

To ensure control of the evaluation and selection process at YPC, the company uses an internal control system to keep the process in check. Utilizing cross-functional teams in the supplier selection process is one of the supplier selection best practices that help deal with this issue. Through involving personnel from different departments and with different back grounds, many perspectives are accounted for and there are multiple checks and balances in the decision making process. If well structured, and implemented, cross functional teams can work to ensure that the selection process is well controlled because the decision will be from different opinions.

In YPC's current evaluation process the purchasing staff does all the evaluation based on information that is provided by prospective vendors in the supplier management system. In place of having the process go through the internal control check, teams of people with different expertise could be used to achieve the same purpose. There are several benefits to making a decision based on varying opinions.

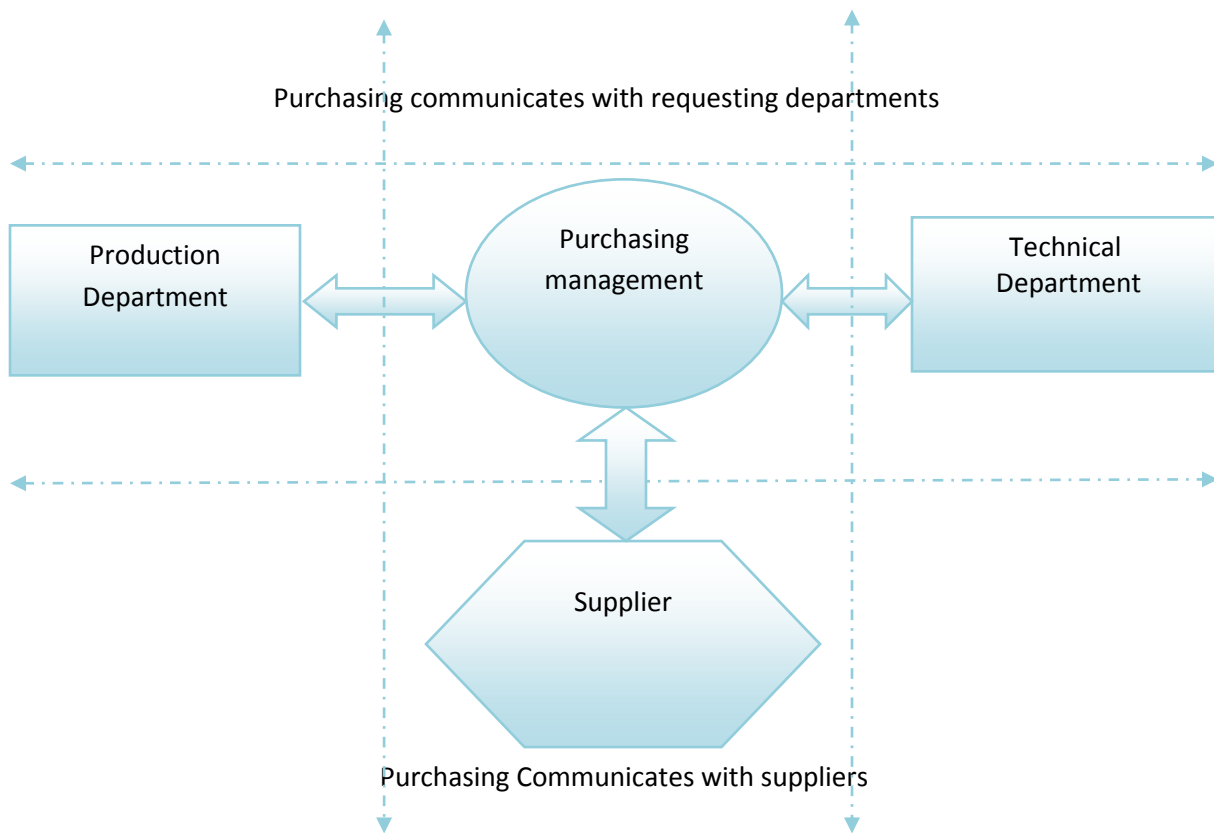


Figure 6.3 YPC's current selection system

Figure 6.3 shows the processes that purchasing goes through in order to select a supplier for an item. The requesting department can only communicate their needs to purchasing staff. As a result the purchasing staff must make their selection of a supplier based on this communication and communication with vendors. The requesting department almost has no opportunity of directly engaging with suppliers. A cross department sourcing team would involve staff from both the production department and the mechanical department and eliminate this communication and information sharing barrier.

The team recommends that YPC should consider involving other expertise in their sourcing and selection procedures. A multi functional team can be a very good substitute for the internal control system not only to control the fairness of the process, but such a team will also ensure that the right vendors are sourced. A team that has at least one member from the

requesting department can be a good asset in the decision making process to choose a supplier. Information from all represented departments can be shared without too much effort from the purchasing department. A cross functional team can be used for making types of decisions: strategic, tactical, and operational.

Designing Cross Functional Teams

In their book “Purchasing and Supply Chain Management” Monczka, Trent and Handfield proposes how organizations can make use of cross functional teams. As shown in Figure 6.4 below, the teams could be formed for very specifics tasks or for permanent tasks. In this proposal, the project team recommends that YPC can begin by involving other departments in their supplier evaluation and selection process as a first step and develop the concept for other uses (2005).

		Time Frame	
		Finite	Continuous
Personal Commitment	Full-Time	Moves from Project to Project	Assigned permanently to specific team with changing responsibilities
	Part-Time	Supports a specific team assignment in addition to regular responsibilities Dissolved after completing task	Ongoing support of team assignments in addition to regular responsibilities

Figure 6.4 Uses of cross functional teams (Monczka, Trent, & Handfield, 2005)

A cross functional team is likely to reduce time that the purchasing department spends communicating with the requesting department just to get the right specifications for an item to be purchased. For example, if a mechanical engineer is put on the sourcing team for the purchase of a compressor, he knows exactly the questions to ask suppliers, and the information he expects from the suppliers be sure that the technical specifications of such a compressor will be correct.

Decisions made by such teams are owned jointly by team members and less prone to inefficiencies because they are based on opinions from different backgrounds.

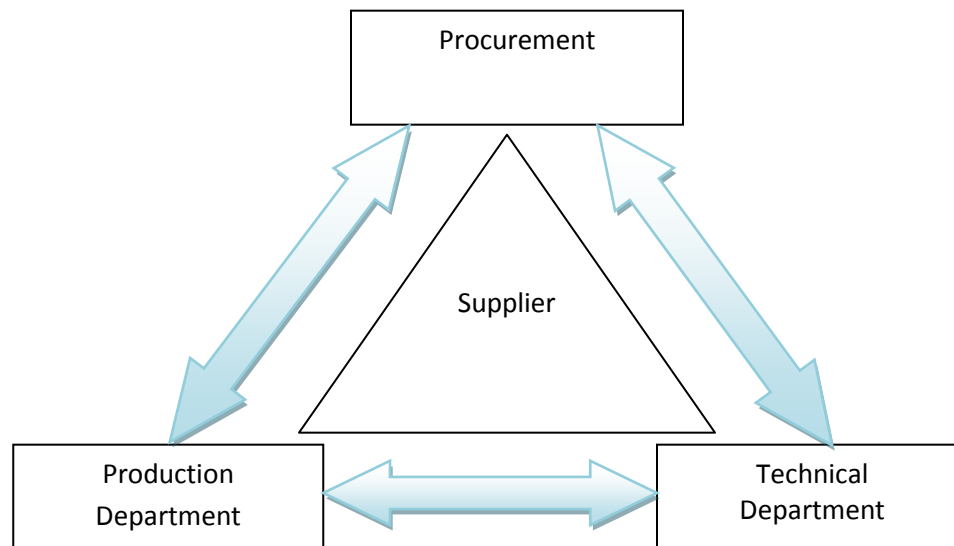


Figure 6.5 Cross functional decision process

In the figure above, a team with representatives from different departments communicates among themselves to reach accepted decisions and collectively choose suppliers to include in the bidding list for a purchase. YPC stands to benefit from using such teams not only to source strategically but also to use them in other critical decision making processes. Some benefits that the purchasing department can derive include:

- **Reduced time to complete a task:** working in a team can reduce time used to reach a decision on a critical situation. It can also reduce individual approval and sign off times since any decision reached will be collective (Robert Monczka, 2005).
- **Joint ownership of decisions:** Once teams come together to make decisions, members are more open to listen to each other's requirement and when agreements are reached they reflect a collective understanding of the organization's objectives not individual ones.
- **Enhanced communication between functions or organizations:** Cross functional

teams reduce communication barriers between departments and organizations. Either by electronic means or in person, the team approach makes it easier to make early changes in a decision making process. For example change of product specifications or during new product development (Robert Monczka, 2005).

These and many more are the benefits that YPC can derive by using the multi-functional team approach in decision making. However, there are some potential drawbacks that need to be mentioned.

Cross-functional teams do not always produce what they are formed to do. Sometimes these teams deviate from their tasks or their results do not reflect the size and background of the team. At times lack of commitment from team members causes the entire team to slack and therefore does not produce desired outputs. Also, some team members can influence the decisions of other members at times. When this happens the purpose of having different opinions in the final decision is defeated. Although these barriers exist, they can be addressed as soon as they come up in order to realize the full benefits of using such teams.

Any cross-functional team must have a team lead that is capable of moving the group towards their goal. Each member of the team should know the purpose of having such a group; there should be open, clearly stated action plans, and open communication between team members aimed toward achieving a common goal. All members of the team must agree to work together for the benefit of their organization but not to perpetrate their own personal interests. In addition, the team must win the support of upper management (Stimson, 2002).

6.3 Using Total Cost of Ownership

Although YPC holds the use of TCO as an ideal, it does not use the approach in its evaluation process in the purchase of an item. Using TCO can help the company make better decisions on which vendor to select for a particular item, especially for those that are very capital intensive and ones that have very long life spans. As best practices recommend, YPC may want to start using the total cost of owning such items in their spend analysis, which be a very good measure to include in tracking expenditure.

As a medium-term recommendation, YPC can begin considering TCO models that suit their purchases, and use in their cost decision processes for future purchases. The YPCME department can also develop its own TCO models using the example below as a template.

To build an acceptable model, the department should be able to estimate all relevant cost associated with an item from the time the decision is made to purchase the item to the time the item reaches the end of its life cycle and is decommissioned. These costs can be categorized into four main groups: Purchase price, Acquisition costs, Usage costs, and end of life cycle costs (Monczka, Trent, & Handfield, 2005).

- Purchase cost is mainly the price tag of the item being purchased.
- Acquisition costs are all the costs associated with moving the item from the vendor's property to the buyer's location. These include transportation, taxes and administrative costs.
- Usage costs are all costs associated with operations from the time a purchased item is acquired. For capital equipment, the usage costs will include, cost of installation, training, operation, maintenance, downtime and any other costs that will be incurred on the equipment.
- Finally the end of life cycle costs includes all the costs associated with decommissioning the equipment; the cost of dismantling the equipment and the cost of disposing it.

Building the Model

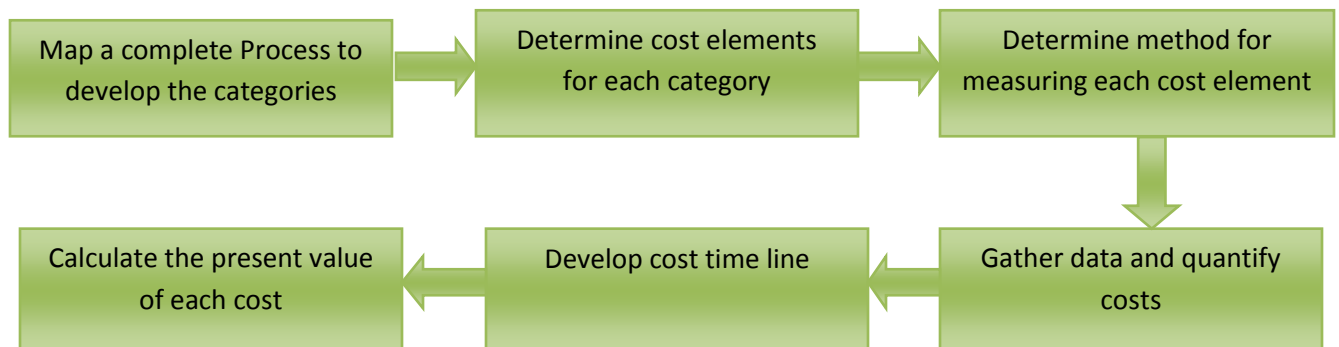


Figure 6.6 TCO mapping process

Step 1

A complete process of the entire purchase activities should be mapped out to develop the TCO categories. All the activities from the day the need for an item is realized to the day it is disposed off.

Step 2

Once a complete mapped out process is established, the process can then be used to determine cost elements that make up each category.

Step 3

In this step, how each cost element in step 2 will be measured should be determined. This when the metrics needed to quantify each cost element must be determined. Example the labor hours and amount of time that sourcing staff spend on the sourcing activities.

Step 4

All the relevant data that make up the categories can be collected at in this step. All sources of data should be searched and explored to obtain data. At this level support must be sought from all departments that must supply data.

Step 5

A cost timeline for the length of the life of the item can then be developed and the cost of each element developed can be placed in the appropriate time period. The totals for each time period can then be calculated.

Step 6

The costs calculated in step 5 above can be calculated in the present value. This is necessary because of the time value of money. The value of money spent today will not be the same in one year. The sum of the present values of each of the time periods calculated is the TCO.

YPC can use this mapping process example a template to help them map a complete process of acquiring an item as a first step of building their own TCO model. Based on the process they can then continue and estimate the associated costs of each category of TCO.

There could be some barriers to effectively using TCO as a tool, and unless steps are taken to avert these barriers, YPC would not be able to realize the benefit of this technique. Using TCO can be very time consuming from the beginning. This is partly due to the amount of data that needs to be collected, and the time it takes in gathering this data. Another major hurdle is being able to predict costs, especially future costs. These are two major areas that could easily discourage the department from going ahead with the model. YPC should develop strategies to handle these barriers as they arise.

One useful step that will help address these issues is communication. The YPCME Department should try and communicate the benefits of using this tool to all the relevant departments that must provide data. They must be told why it is important to obtain all the data and they must be encouraged to be part of the success of the process. Once the sources for all the data are available, the team that must build the model can make good progress in collecting the needed data.

6.4 Sourcing Strategically

To develop effective procurement strategies, YPCME managers can refer to the following recommended practices. Purchasing must identify a set of broad level goals that it must achieve at the commodity or family level. This step will help drive the strategic direction that purchasing hopes to go through. It is necessary for purchasing to relate the importance of any purchase made to the business unit objectives.

This step can be achieved by utilizing a strategy segmentation tool known as portfolio analysis. This tool can help YPCME to classify any purchase into one of four categories.

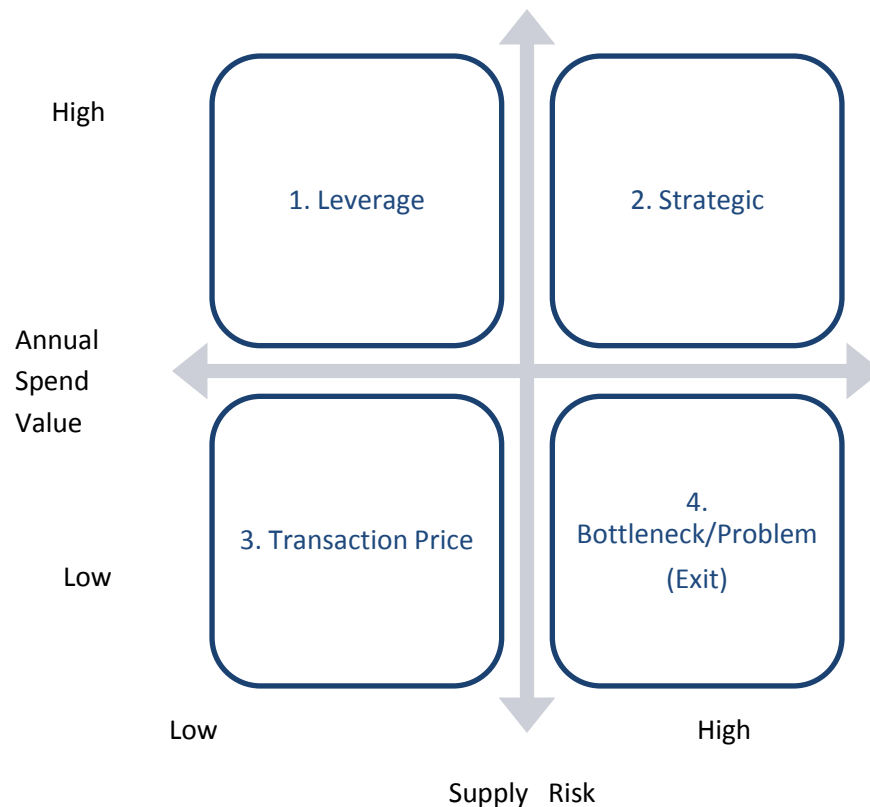


Figure 6.7 purchasing portfolio analysis tools (Monczka, Trent, & Handfield, 2005)

With this analysis tool YPCME staff can make their decisions based on the quadrant that an item falls after segmentation.

Quadrant 1: Items in the first quadrant are those that are purchased mostly in large quantities and as such have many capable suppliers. They can be items that might be widely used by the company and for that matter may be one which is of industry standard. Also these items have medium-to- high annual expenditure but limited supply risk. In developing an efficient procurement strategy, YPCME can capitalize on the large volume of these purchases to consolidate their purchases and reduce their supplier base. This will help the department to have a better leverage at negotiating better deals, and will benefit remaining suppliers as well.

Quadrant 2: The second quadrant in the tool contains items that are very critical to the success of the organization but has limited critical suppliers. These items could be unique or customized items that YPC uses or could be very high dollar items. They could be items whose development may include unique technology, or unproven technology. In this case the limited number of

suppliers gives YPC very few options to switch between them. Examples of such items could include new chemical compounds, new DCS systems, some special rotating equipment, and catalytic converters. It is highly recommended that there should be early cooperation between suppliers and YPCME on such items.

Quadrant 3: The transaction/price quadrant contains items that are mostly standard and have standard suppliers. With these items, YPC should strive to minimize effort, transaction costs, and price. Mostly purchase decisions are based on price, and unit's price is generally lower. These items are generally low dollar value and have standardized quality and technology requirement, therefore the "switching cost" of moving from one supplier to another is low. On acquiring these items, the purchasing department should focus on removing the effort and transactions required in obtaining them. Typically most maintenance, repair and operating items (MRO), office supplies and other items that need short notice fall into this category. YPCME can reduce the effort and transactions required in purchasing these items by establishing systems such as procurement cards, electronic catalogs, and direct ordering systems through the internet and other automated purchasing systems that eliminate the efforts.

Quadrant 4: Quadrant four is the bottleneck quadrant and in this quadrant suppliers are the sole sources of the product they offer. These suppliers often require specifications with no substitutes because such vendors are very high performers with a competitive advantage. The availability and suppliers of such items are very limited and these items could be items that are very important to YPC. The strategy should therefore be to exit this quadrant through standardization, specification change, adding new suppliers and supplier development.

Once the commodity is classified into one of the four categories, those responsible for proposing a strategy will be able to understand the strategic importance of the item to the company. They can then review the status of the commodity and compare it to the business unit as a whole (Robert Monczka, 2005).

7 Conclusions and Future Works

After studying the Purchasing departments of BASF-YPC (BYC) and YPC, the team came to the conclusion that although the two companies are very much related, and are in the same region which means they face similar regional challenges, their practices are very different. BASF-YPC uses more standard practices than YPC. One of the reasons the team found was due to the influence of BASF on the joint venture. As a world class company BASF ensures that all its subsidiaries and affiliates including BASF-YPC makes use of international standard procedures and this was the reflection of the purchasing department's procurement practices.

Unlike BASF-YPC, YPC uses more localized practices than globally recommended standards. As a subsidiary of Sinopec, most of YPC's practices are a direct result of the parent company's influence. Because of this, the team found areas that may have a lot of room for improvement. YPC may want to move their relationship with BASF-YPC beyond being a parent company, and establish a real collaboration between them, so that YPC can learn from BYC's practices. BYC seem to have a lot to offer in the area of management and YPC can take advantage of their relationship and tap into that.

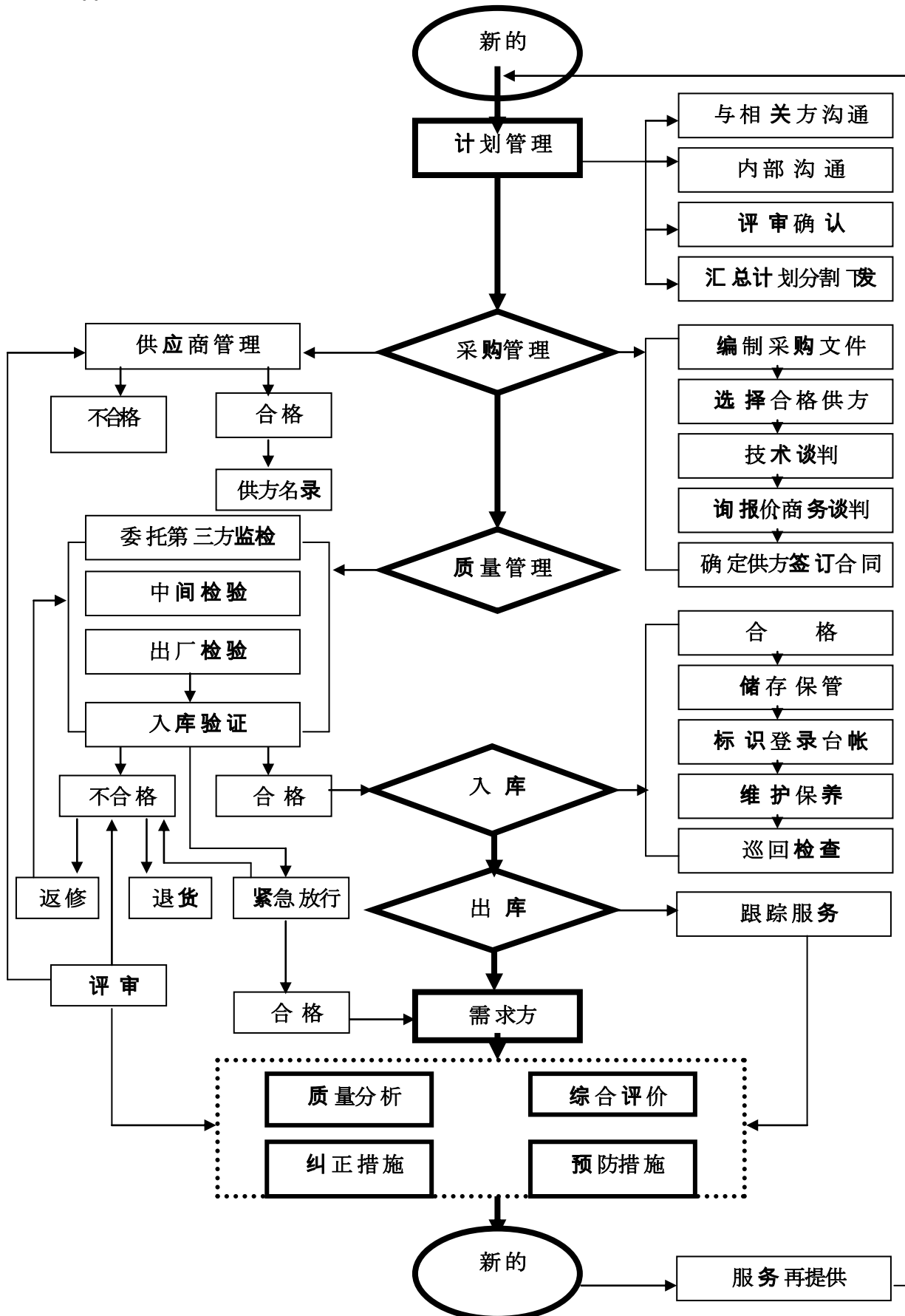
One intriguing thing that the team found was that, although BYC is a 50/50 joint venture between BASF and YPC, it adopts more practices from BASF than it does from YPC, which made the team question why that was so. It was concluded that being a subsidiary of Sinopec which has the Chinese government as the major stakeholder, YPC has more "soft" issues to deal with: cultural, political, and social obligations which makes it difficult to influence the joint venture or to adopt most of its practices.

While working on the project the team discovered some areas that merit further research. One of these areas was YPC's vendor managed inventory system (VMI). Currently YPC's VMI system is limited by its lack of information sharing with its suppliers. Vendors are unable to accurately predict and manage the demand of a company without information on what the company has in stock and the rate at which they use their inventory. Another area that YPC could improve is total cost of ownership for their large purchases. This will allow them to more accurately predict the full price of a piece of equipment and hopefully allow them to make value-adding procurement choices. The team also believes that YPC could optimize its supply base by

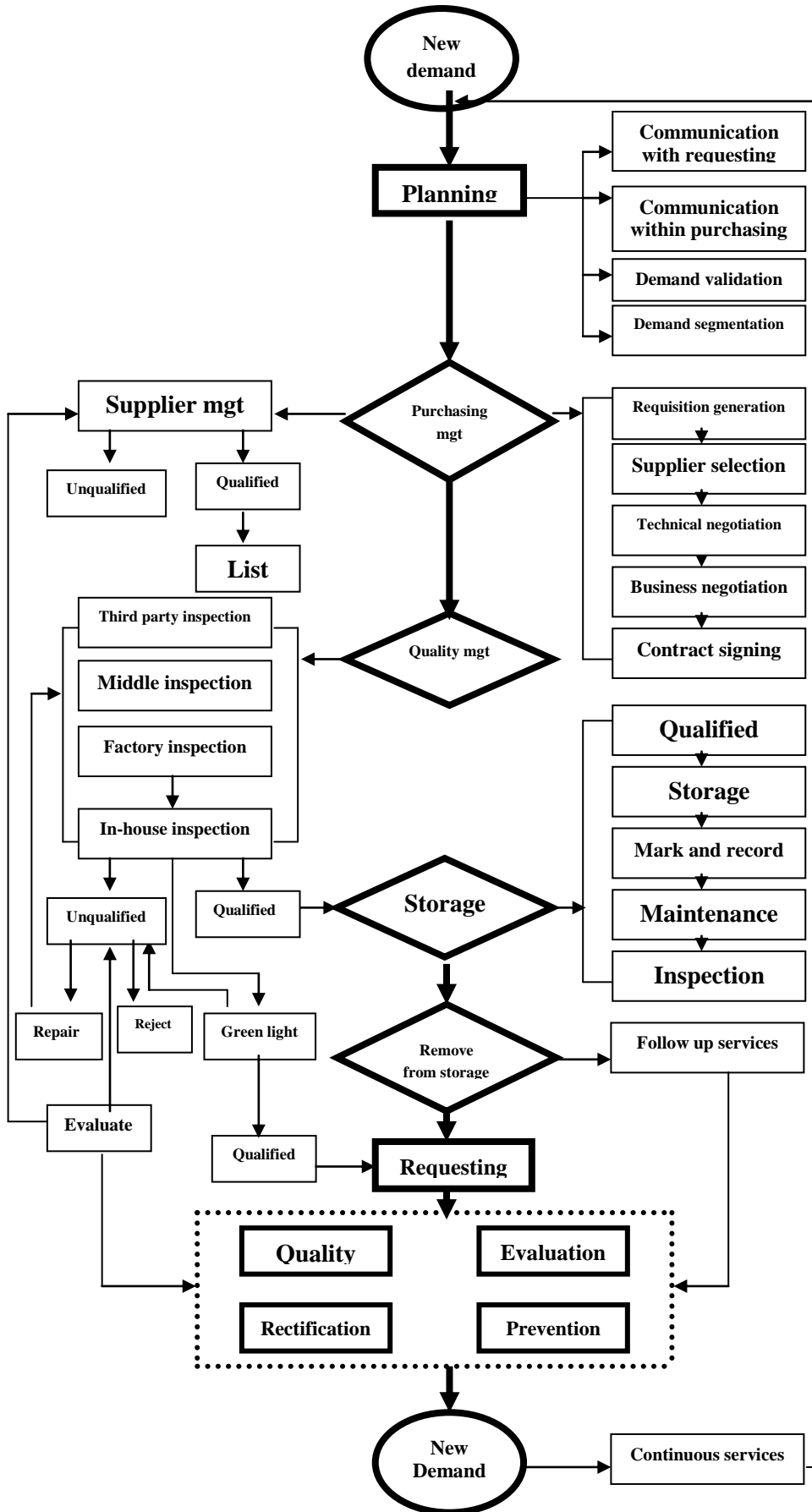
aligning itself with critical suppliers and reducing its overall number of total suppliers to add value through bulk purchases.

8 Appendices

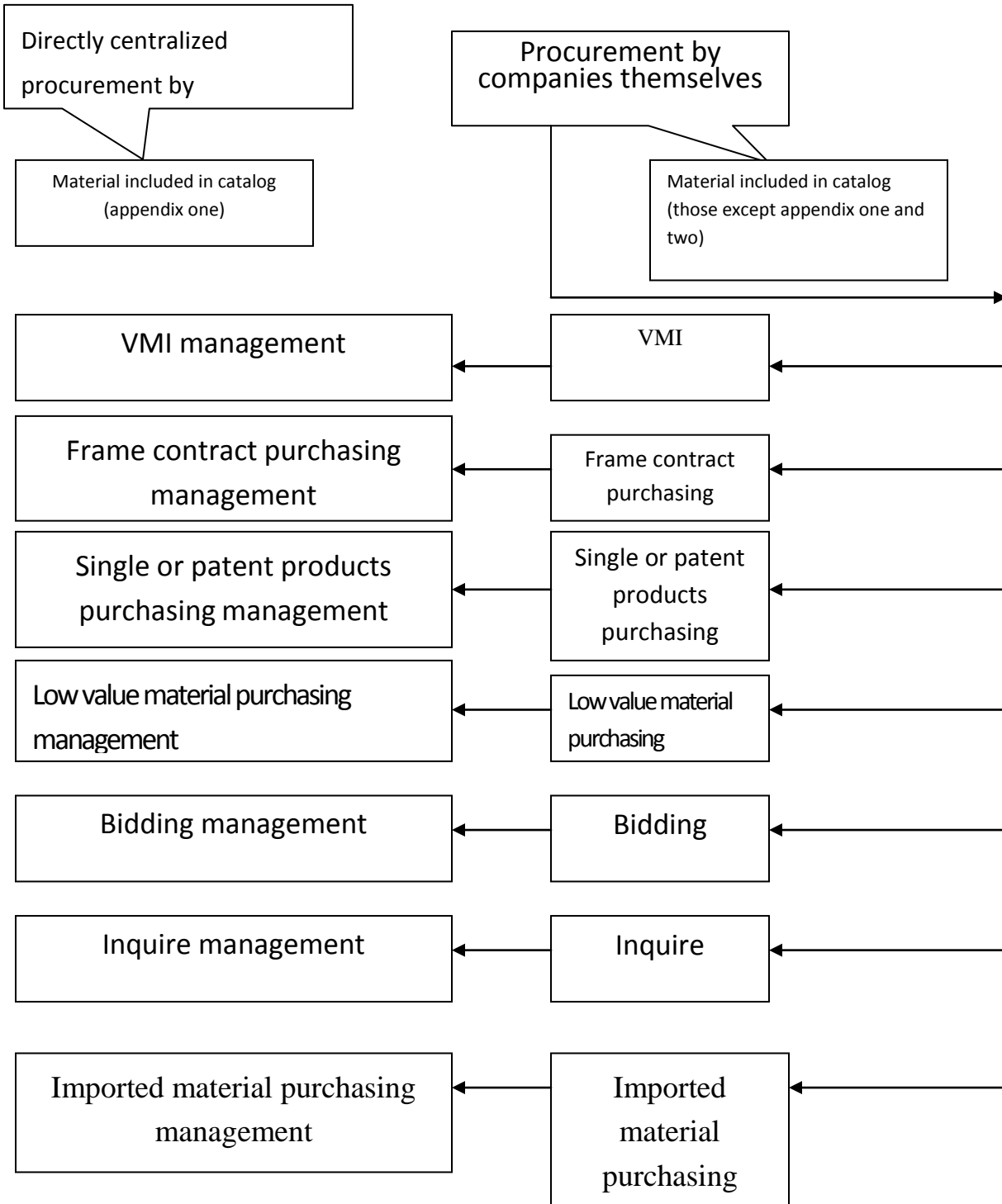
Appendix A.1: The Procurement Process in YPC



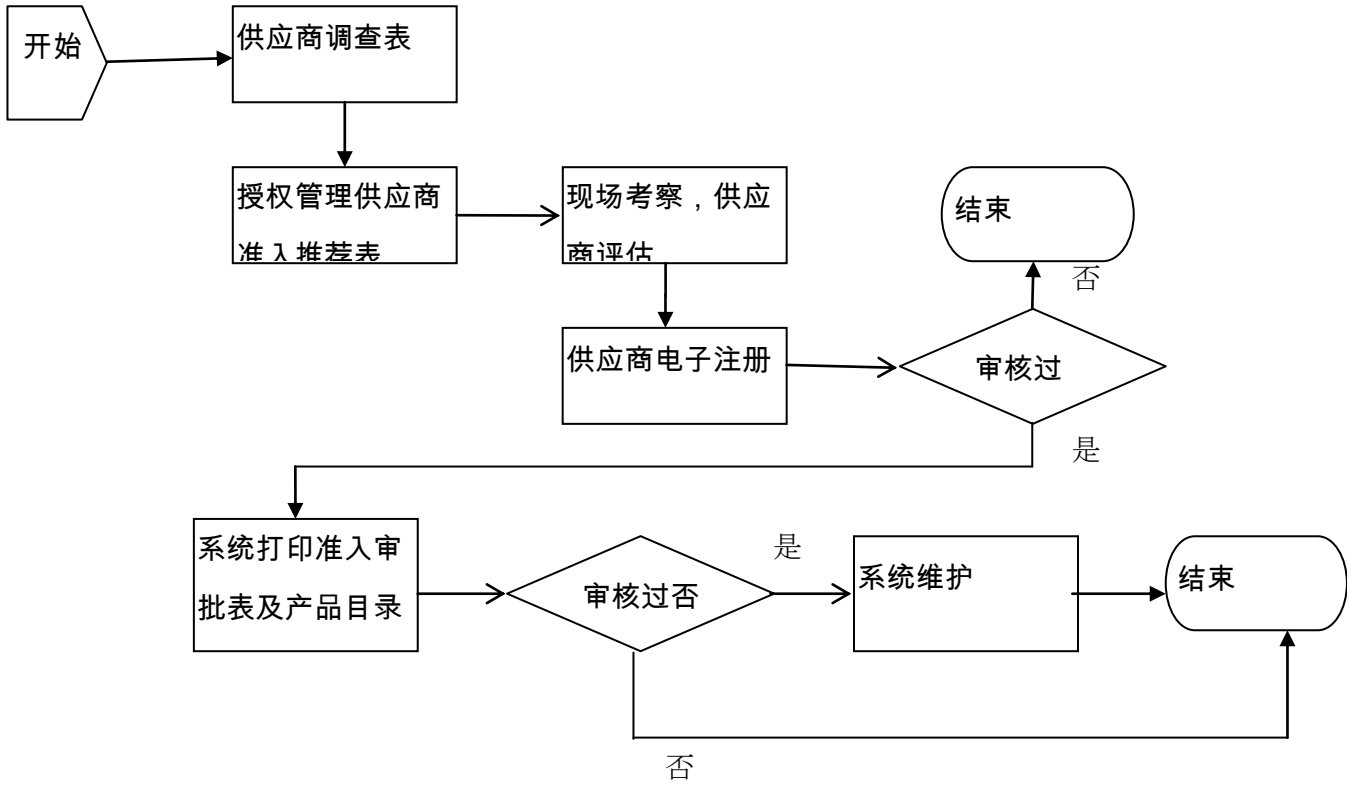
Appendix A.2: The Procurement Process in YPC



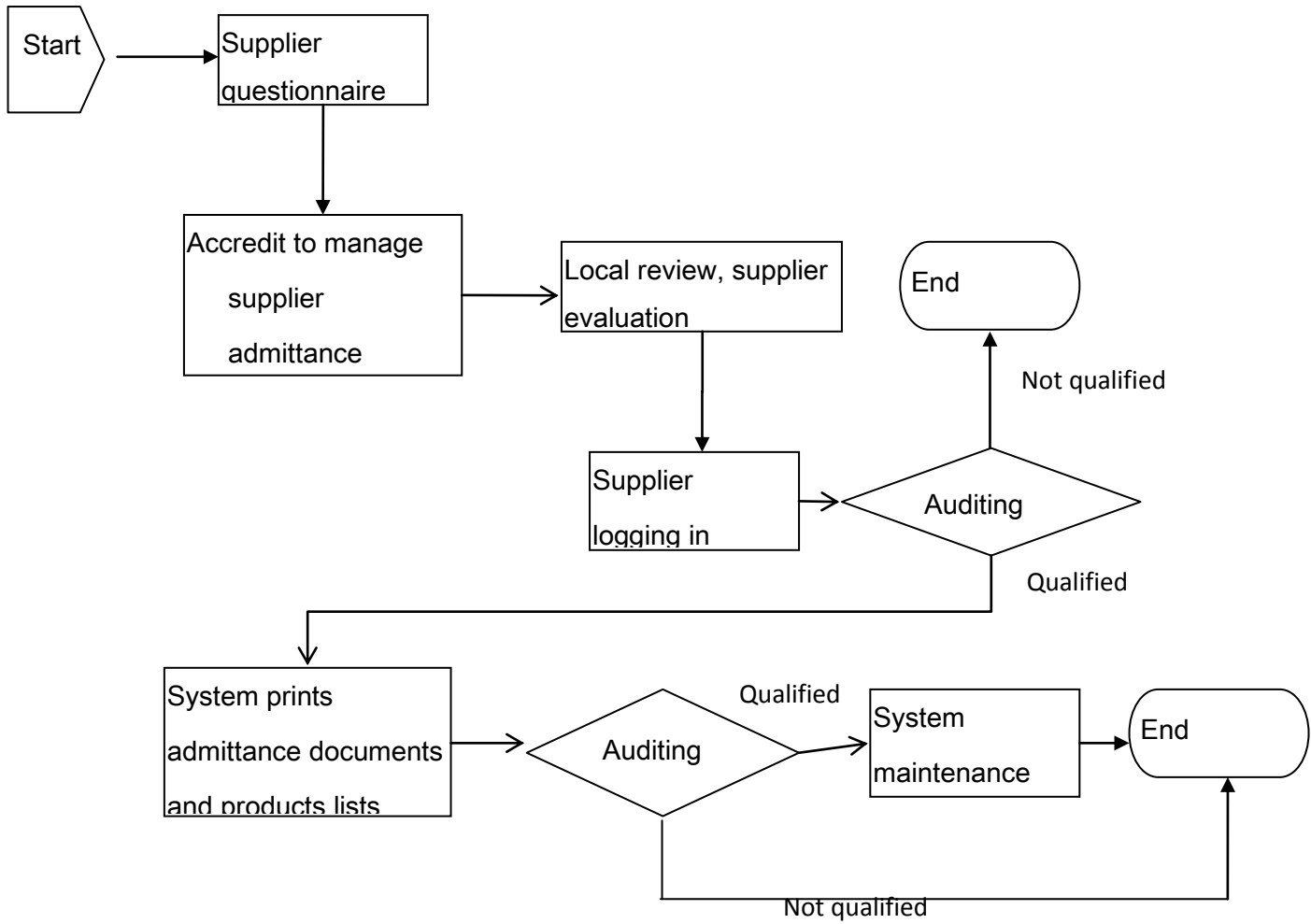
Appendix B: Selection of Procurement Methods in YPC



Appendix C.1: Process of Supplier Admittance



Appendix C.2: Process of Supplier Admittance



Appendix D: Recorded Meeting Proceedings; First Visit to YPC

所以说扬子的采购策略跟中石化差不多，单从采购来说，我们主要针对（依据）刚才那本书，是08年发布的中石化的物资编码，每种物资都有编码和分类。中石化从02年开始推行erp，使用的是r3的系统，是德国sap公司的。在整个软件系统的管理下，中石化（和子公司）的很多策略基本是一样的，从采购来讲，物码建立之后，很多采购划分是按物资的类别来分的，比如供应商管理、物资采购，现在按采购类型分，比如框架协议采购，在这种采购模式下，是一些招标、询比价、独家采购等。这样的采购策略跟扬巴差不多，在策略层面是一样的，差异在操作上，比如我们现在在推行流程化操作专业化，我们和扬巴有区别，他们部门和职责分的很清晰，他们的采购是一个纯的采购，叫做技术采购和服务采购，我们是沿用国企的模式，采购什么都管，比如我们负责采购煤炭、三剂化学品、设备材料采购，我们的原料采购不在物装部，在生产经营部，但它也在erp的mro模块中。

我们的架构，从管理层讲，有一个主管经理和三个副经理，还有一个副总工程师，下面是科，一个行政科，党群工作科，两个负责计划的科室，一个叫项目科，负责投资类项目的计划，一个叫生产计划科，负责生产类的计划；在管理科室里，还有负责质量检验的质检科，还有物资管理科；底下还有六个采购科室，煤炭科、机械科、电仪科、化工科、材料科、设备科，这个分工是按照物资分类来的；底下还有两个车间，车间主要是仓储，一个设备材料仓储车间、一个化工仓储车间。我们所有的采购的分工、采购的制定和供应商管理都跟这个物码有关。我们采购中框架协议这块，针对的物资品种通常是采购量大、需频繁采购但价值量小的这种，我们通过年度签订框架协议，然后以子订单或供应商寄售（vmi），实际上现在在国企应用的不是严格意义的vmi，我们跟供应商签订一定期间的价格和量，这是通过招标或比价的方式来选择的供应商，然后拿出我的市场份额，我再集中给几个供应商，通过市场份额换取共赢。这样不需要频繁地给供应商发pr，一年度签完后，用多少你放我这里，用了多少系统自动一个月结算一次，这个对供应商来说，最大的好处是有计划的送货，不用频繁的接到紧急订单，也不需签订po，且供应商能把更多的时间放在生产中，可以跟我一起协商耗量、技术的改进等；对我来说，我的供应有保证了，我的库存资金占用减少了，价格也会获得批量的折让。这里面主要的问题是信息流沟通，我的erp是不对供应商开放的。因此供应商无法实现对库存的管理，只是在每个月打一张单子给供应商。扬巴的erp也不对供应商开放，他们有本土化倾向。

当然我们也有跟他们学习一些先进的理念，所以扬子和扬巴有些像，但像他们那样严格分工是不行的。他们的采购既不管前也不管后，前面接单抓药，中间只负责采购策略，后面质检、入库等也不管，所以他们采购人员少。所以国企在职责的划分上不清晰，要做的工作多，导致人多。

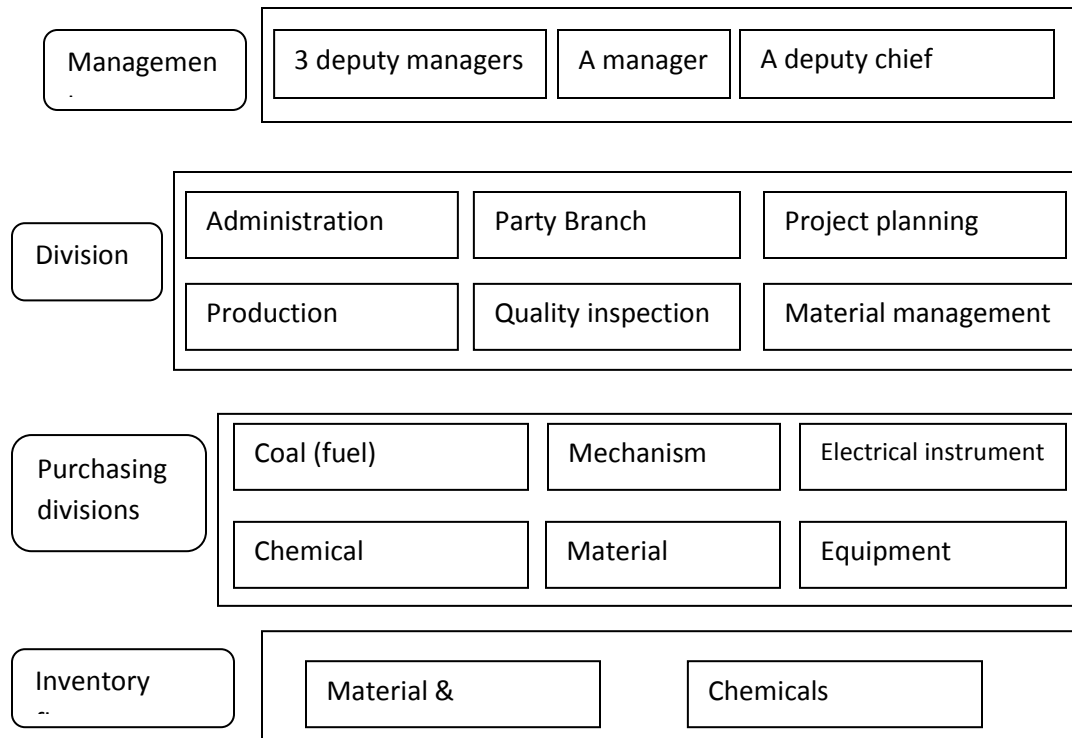
我们现在在大力推进框架协议采购，其中有两种方式，vmi接触的比较，实际上vmi和框架子订单是实现框架采购的方式，其他的比如询比价、招标、独家供应商采购是比较正常的采购。在实现整个采购里面，有计划管理、采购管理、质量管理、库存管理，是贯穿上下游的全过程。采购中有许多控制，包括价格、供应商选择、采购类型。我们还有一个

中石化电子商务的平台，我们把erp的采购信息上传到电子商务，在里面选择供应商，制定询价方案，供应商报价，确定最优供应商，签订订单，然后在erp系统操作，打印订单，供应商签字等。供应商选择是第一步的，我们有内控程序，供应商选择有权限的控制，价格形成过程也有控制，合同签订后执行的控制，到货之后检验、收货、付款控制，现场服务的控制等，每一段都有。内控是对采购的每一个节点加以控制。国企中通过控制让更多人承担责任，避免错误的减少。控制点增多后以牺牲效率为代价。我们反对一竿子插到底的工作方式，扬巴是一个人把工作全干完，我们有个概念，叫做不相容岗位的分离。（这样做的好处是把风险和责任平摊了）

扬子有一种讲法，叫业绩引导订货，培育主力供应商，即业绩好的供应商，给他多的份额，把他培养大，同时取得共赢的局面。但这做起来很困难，很多事采购部门说了不算，但很多时候只是给供应商提供更多的机会，因为资金是管理在财务手上，他说不行，你就会遇到阻力。我们去年推行了一个全生命周期的考虑，但在实际中非常难以实现，我们现在做的是成本测算（成本构成分析）。中石化推进的是框架协议的采购，另一个是理性的采购。

Appendix D: Recorded Meeting Proceedings; First Visit to YPC

- YPCME (Material & Equipment Dept.) has a similar procurement methodology with BYC. YPCME is responsible for MRO procurement.
- Sinopec has its purchasing system.
 - Integrated procurement with headquarters:
 - ◆ Direct procurement by headquarters: the headquarter contracts with certain suppliers on certain items, and all the branches of Sinopec will purchase from these suppliers. All the international suppliers of Sinopec is included in this category.
 - ◆ Instructed procurement: the headquarter contracts with several suppliers who are qualified to offer certain items. Its branches can choose some of the suppliers and set up a business relationship. Whenever a branch (YPC) wants to purchase an item, the procurement staff can put the code of this item into the database and choose a supplier in the list.
 - Procurement by the company itself
- Purchasing of YPC is based on the classification and code of each item. A company may produce an item, a type of pump for instance, that is qualified to be used in Sinopec. Sinopec may contract with the company on this type of pump. The company is listed among the suppliers under the code of this type of pump.
- Organizational chart:



- The frame contract of YPCME is mainly for those items that need large scale and frequent purchasing, while the value is relatively low. They sign frame contract with suppliers on a yearly basis and generate sub orders or use VMI to maintain supply. The VMI strategy that is widely used in China's government companies is different from the standard one. YPC selects suppliers by bidding and sign a contract with them on price and quantity for a year. According to the contract, suppliers provide certain items to YPC and stock those items in YPC's inventory. The inventory is settled once a month. Advantages:
 - To suppliers, they can make regular deliveries and there's no need to sign a PO. The suppliers can devote more time to production and make joint effort in demand prediction and technology development.
 - To YPC, the supply is guaranteed, the inventory takes less cash and YPC gets discounts

But the major problem is the information flow for communication. YPC's ERP system is not open to its suppliers, so are many other companies in China. So suppliers have to approach to carry out instant management to YPC's inventory, they only receive orders on monthly basis. The ERP system of BYC has the similar problem cause most managers of its procurement dept. are from YPC, so their perception is similar.
- YPC is also learning from BYC of its advanced management perceptions. But one thing is different. The purchasing dept. in BYC is just in charge of purchasing according to requisitions; they don't have to worry about the follow-up procedures, such as delivery, transit, quality inspection, etc. So they have a much lower staff level.
- YPC has a e-commerce system in line with its ERP. They use this system to select suppliers, make quotation plans, get feedback from suppliers, identify the optimal supplier and make purchasing orders.
- Cost structure analysis. In the bidding process, if necessary, YPC makes cost structure analysis to see if the supplier is offering a reasonable price.

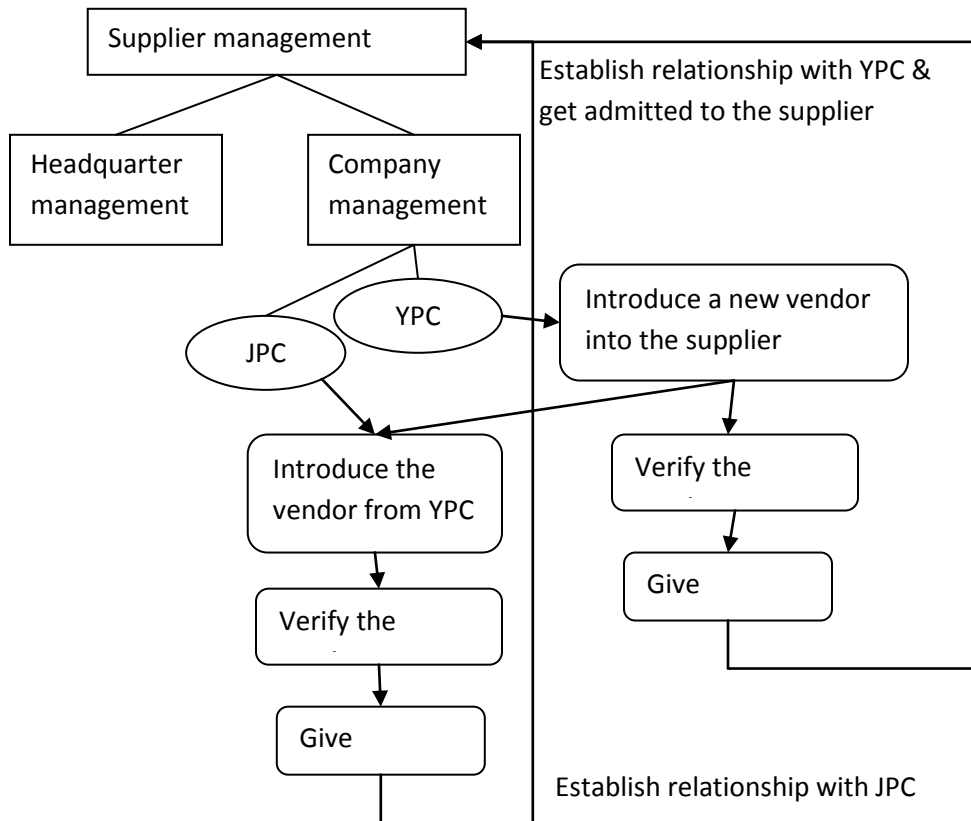
- Supplier management:
 - Sinopec has 23000 suppliers
 - 1. Direct management by headquarters. 2. Supplier management by delegation (branches and subsidiaries)
 - Suppliers should first get admitted to Sinopec's suppliers database and establish business relationship with YPC.
 - Supplier selection. YPC has an inter control process. They have control over every step in supplier selection (unlike BYC who has an integrated procedure): supplier selection authority, form of price, implementation after contract, inspection and payment after delivery, on-spot service, etc. In a government company, they use control in every aspect to make more people involved in a responsibility, thus make the system more secured and lower the risk of malpractice.
 - Supplier evaluation.
 - ◆ Quantitative evaluation of Sinopec (yearly): At the end of each PO, the supplier will be evaluated by YPC using a questionnaire. Performance (price, delivery time, quality and service) of the supplier will be ranked and the result will be sent to Sinopec as part of the integrated appraisal. Together with the previous questionnaire, there'll also be a grading process towards each supplier concerning its capital, capacity and other relevant aspects.
 - ◆ Comprehensive evaluation for bidding (yearly): it concerns the comprehensive performance of suppliers' products. It is made out related to departments of procurement, technology and quality. This evaluation is used in bidding process which is equally important as price.
 - The supplier management system was adopted in 2007.

Several data:

- 331 employees in the department: 4 managers, 2 deputy chief engineers, 78 procurement staff, 171 inventory staff.
 - Data of 2008:
 - YPC spent 4.34 billion Yuan: 1.29 billion on equipment and spare parts, 1.28 on chemicals, 1.77 billion on coal, and 4.00 billion on supplies.
 - Signed 246 contracts on procurement this year, sum up to 79.89 million Yuan, 40.56% of the total sum of money in procurement (except the direct purchasing of headquarters)
 - 6149 POs, 1.97 billion in purchasing (except the direct purchasing of headquarters). 9.64 million Yuan on saving, 4.89% of previous year.
 - YPC had business relationship with 658 suppliers, 20 fewer than the previous year.
 - Inventory at the beginning of the fiscal year is 55.70 million Yuan and 45.26 million Yuan by the end of the year. There's a 18.75% drop.
- On disposal of old equipment and materials 2.83 million Yuan

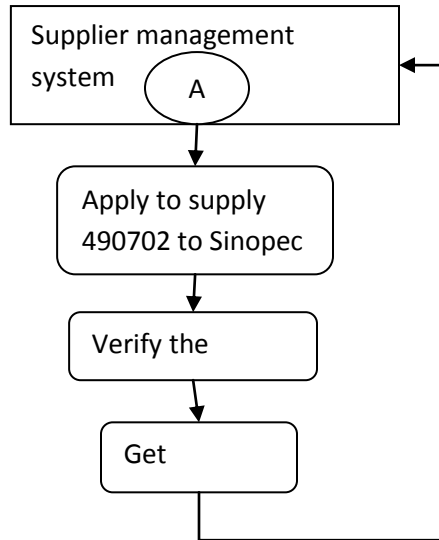
Appendix E: Recorded Meeting Proceedings of Second Visit to YPC

1. How can suppliers get admitted to the supplier network of Sinopec?



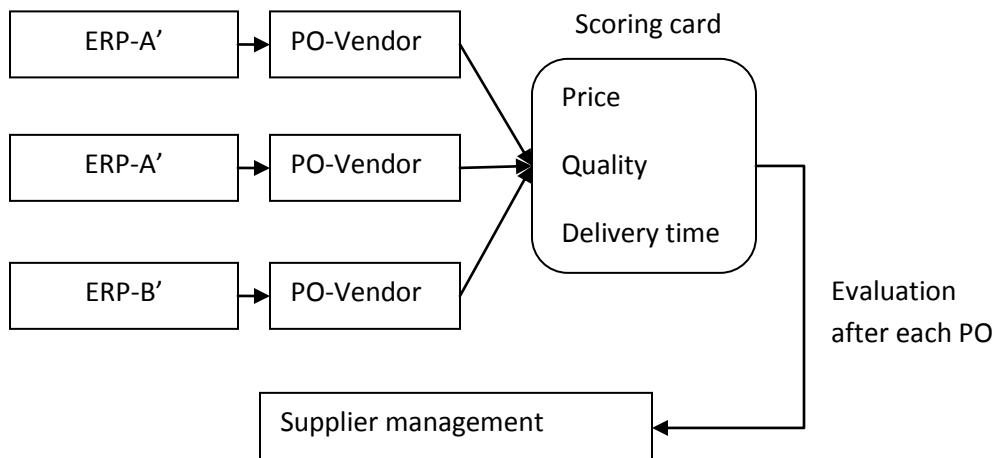
- A vendor can upload its relevant documents () and the item they want to provide to the supplier management system. The supplier management can be divided into two parts, one is in the charge of headquarters, and the other is in the charge of the company.
- If YPC want to introduce a new vendor (A) to the supplier system of Sinopec, they should go through the permission process. After the vendor is verified to be qualified to supply certain items to Sinopec, it can get approval to be added to the supplier network of Sinopec, and the relationship with YPC to supply certain item is established.
- If another branch of Sinopec, JPC for example, also wants to use the vendor A, it should verify the vendors' quality again to give approval to and establish relationship with the vendor.
- The headquarters also goes through such process to add new vendors to the network.

2. How can a vendor enlarge its production line in supplying Sinopec?



- Vendor A is qualified to provide item 490704 to YPC. If he wants to enlarge its line and provide item 490702 to YPC, they can hand in the application and go through the process. If he's approved to provide item 490702 to YPC, the supplier management system will be updated.
- The supplier management system of Sinopec is based on the catalogue of items and the service relationship between suppliers and company. A supplier's allowance to provide a certain item is based on the catalogue, and its allowance to provide such item to a certain company is based on its relationship with the company. If he doesn't have relationship with the company, he can't do business with the company.

3. Supplier performance evaluation



- Supplier performance evaluation system consists of three scoring sections: scoring after each PO, scoring on performance (according to the yearly supply quantity of the supplier), scoring on supplier's qualification (its financial statement, capacity, etc.). An extensive score is

drawn after giving different weight to each score.

- All the purchasing orders and requisitions are generated from the ERP in electronic edition.
- According to the extensive score, Sinopec will take measures to reevaluate the vendor. If the vendor has relationship with some of its branches, then Sinopec will ask for the branches' advice to keep using these vendors or not. Reasons are also required if the branch wants to keep using these vendors. If the relationship is between headquarters and the vendor, Sinopec will eliminate him directly.

4. Scoring system

- Each PO is graded by purchasing staff. However, concerning the four entries in the scoring card, different stakeholders should be involved in this scoring system. Quality inspection department know more about the quality of the items, and users are the group of people who should grade the service. This scoring system needs improvement to increase its effectiveness.
- Evaluation after each PO requires a lot of work which is a burden to the purchasing staff. YPCME now deals with about 5000 POs a year, and each professional grades 70-80 POs a year. Moreover, too much repetitive work lead to formalism in performance evaluation.
- It's inefficient to draw professionals from different department to form a cross-functional team for scoring and evaluation. Because the scoring system involves the whole process of procurement. The requirement of such a cross-functional team is very high and appointing professionals to do this work is a waste of human resources. But it's advisable that we can divide the scoring card and tell relevant staff to do such evaluation.(Sara: that's the cross-functional team actually, isn't it?)

Question: Why don't you split the scoring card to different department since you have this idea?

Answer: we don't have the power to change the system. This supplier management system is designed and implemented by Sinopec, and branches can only bring up suggestions. I've suggest this change in the general meeting, and the headquarter said the system was still young and we could put off this upgrade. Actually, this supplier evaluation system was put into use in 2008, and we have just started.

BYC's supplier performance evaluation: (Mr. Zhang said that BYC's manager has been talking about this evaluation system for three years, but they might not have used it. It's from BASF.) They use well-designed questionnaires to do supplier performance evaluation. Firstly, they randomly pick out a supplier, if it's a new supplier, or it's a regular supplier but supplies the item for the first time, they'll send the questionnaire to the department who generate the demand or the quality inspection department, asking for evaluation. If it's a regular supplier, they'll do the evaluation randomly. This system is more reasonable than YPC's.

YPC also takes complementary measures to make the evaluation system more effective. They asked the factory floor to give feedback on the quality of the items. But this practice is just to encourage users to give first-hand information on quality and is not included in the evaluation system, thus the feedback is insufficient.

5. Procurement methods of the two companies

BYC: the cost centre generates a demand; the purchasing department of BYC only chooses the supplier considering price and operational expenditures. The technical staff in sourcing decision-making is responsible for confirming rationality of the demand. They lack supportive data to see if there could be better choices with lower TCO.

YPC: the cost centre report its demand to YPCME indicating that they need to buy something of some standard. Then the purchasing department will negotiate with the cost centre about the specification of the demand. Staffs of YPCME use their experience to cut cost.

6. What's your opinion of the increasing control from Sinopec?

Since 2003, companies of Sinopec have been using ERP, and Sinopec will start to use ERP this year. At present, over 50% of the purchasing is done directly by headquarters. Sinopec uses this integration to generate large quantity of demand so as to gain the most cost efficiency in negotiating with suppliers.

Sinopec has studied some American petrochemical corporations to determine whether to integrate or distribute. It takes a long time to develop into the system as it is now. In the past, YPC's procurement is distributed to many different departments: the factory buy the spare parts, and different departments and divisions are involved in purchasing materials, mechanical equipment and minor spare parts. Now, all the MRO items are purchased in YPCME. The gradually integrated approach has positive effect on the companies.

But the staff level in Sinopec is insufficient to support a larger amount of purchasing demand, so in the short term, the integration level is unlikely to increase.

7. What has handicapped the companies in China to implement more effective management system? (Soft side)

The system in China works differently from that in western countries. In America, for instance, it takes them several years to change the policy or an entry in regulations. But in China's companies, there are far more regulations and they are changed frequently. These frequent changes result in resistance and contradiction from employees, which, in turn, cause the management to take out new regulations to complement the implementation of the existing system. Thus this cycle worse off and hindered the company from making necessary improvement.

Apart from that, insufficient feasibility study before carrying out a new policy is another reason that makes a policy hard to live long in the system.

In the management system of China, people emphasize more on changing and improving. Management often takes steps in order to enhance the system, while, to some extent, stability is required on operational level.

8. How to decide whether to purchase one item from one company or both items from one company?

- If the two items belong to different categories (equipment parts and chemicals), we don't consider demand bundling in this case. And we don't encourage our vendors to have such a broad production line.
- If the two items are in the same group (chemicals), we'll consider demand bundling if the two chemicals "work with each other". If such effect doesn't exist, we won't consider bundling as it doesn't make great differences. For one thing, our system is based on catalogue; such case is not very common. For another, one code in the catalogue is inclusive. If one vendor produces one kind of spare part, he is likely to produce other similar parts.
- In the supplier management system, you can also look up the items a certain vendor is qualified to supply.

9. do you have pressure to use smaller suppliers?

No, we don't have such pressure. According to the performance evaluation, we eliminate vendors whose score is low and performance is not good. We are motivated to downsize our supplier basis. We give priority to the supplier who got high scores in performance evaluation in bidding processes. We help the competitive vendors to grow and become stronger.

10. Procurement system of Sinopec.

- Direct procurement by headquarters:
 - Integrated procurement: the headquarters purchase directly for all the branches.
 - Instructed procurement: the headquarters don't purchase for the branches. In the shortlist of suppliers who are qualified to provide certain items to Sinopec, the headquarters recommend some of them to the branches and tell the companies to buy from these vendors. They might sign frame contract with the vendors, and branches can purchase from them based on entries of the contract.
- Procurement by companies:
Companies purchase from vendors (in the supplier network) with or without the instruction of headquarters.

Appendix F: Follow up questions to YPC with answers

1.在**供应商**准入和引入过程中，**审核供应商**过程中有哪些具体的**标准和流程**？

答：对于**供应商**提供的**产品**按照**种类**的不同有不同的**准入标准**，发给你一个附件供参考。**入网流程**都是一样的，要**考察**，**打分**。

1. What are the criteria that the company uses to verify the supplier? (YPC)

There are different criteria according to the different kinds of products which are offered by the suppliers. The processes of entering into the system are nearly the same, with evaluation and scoring needed.

2.您曾提到在**供应商选择**过程中要**考虑**的因素有**产品成本**、**合同执行**、**现场服务**等，**这些因素**是怎样**综合影响****供应商**的**选择**决策的？如果有**打分系统**或**类似**的方法，希望您能具体**介绍**一下。

答：**供应商**管理系统的**综合考评分数**可以用来参考，**企业**自己的**ERP考评分数**也是**考虑**的因素。

2. Need clarification what grading system is used? (YPC)Refer to selection criteria

Comprehensive scores of supplier management system and scores of ERP can be the references in making the selection.

3.**扬子石化**评价和**选择**一个**供应商**的**时间**周期通常是多少？在**购买**一项**物资**前，你们是否**计划**提前期？提前期通常是多少，能否**举**一两个例子？

答：按**物资类别**的不同，**物资**供应部门要求**需求计划**提**报**部门在**上报**时有一定的提前期，**这个时间**主要是为**采购**留出周期，主要是**整台设备**，**一般物资**的提前期均在**一个月**内（**通用物资**，**易损件**等）

3. How long does it take the companies to evaluate and select vendors? Do they have cut off times?

According to the different kinds of materials, Material Supply Department requires Request & Planning Department to make a cut off time when they hand in the request. The cut off time is used for the procurement cycle, especially for whole equipment. The general materials' cut off time is less than a month.

4.扬子石化同供应商之间的关系是怎样的，例如信息共享的程度等？请您提供一份关于扬子石化VMI系统的资料，以及您对这个系统做出的改进，谢谢！

答：给你我的关于VMI的论文供参考

4. What kind of relationship does YPC have with their suppliers, what information do they share?

I will give you my paper about VMI.

5.扬子石化是否和供应商合作一起进行产品开发？

答：每年均有，主要是科研开发项目，有产品类，技术攻关、设备和备件的国产化，我手边具体的资料不多。

5. Do they collaborate for new product development?

Every year we do. It's mainly research development project about such as products, technical improvement, realization of devices and spare parts' homemade. I don't have much information about this part, either.

Appendix G Sinopec's Supplier Access Criteria (Electric and Instrument Subject: translated from Chinese)

1. Application

The criteria apply to the access of Sinopec's transmitter (3811) supplier and on-site assessment.

2. Basic conditions for access

2.1 Production suppliers

2.1.1 Certificate complete: including business licenses, tax registration certificate, and organization code certificate, professional production permits.

2.1.2 Transmitter enterprise with good production and detection capability, complete quality system, after-sales service capability.

2.1.3 ISO quality system certification.

2.1.4 Have a link to the Sinopec materials procurement e-commerce sites.

2.1.5 Sincere cooperation with the Sinopec, subject to management, no illegal acts.

2.2 Flow-based suppliers

2.2.1 Certificate complete: including business licenses, tax registration certificate, and organization code certificate.

2.2.2 Registered capital of over 1,000,000 Yuan and annual sales of over 1,000,000 Yuan.

2.2.3 Transmitter product sales more than three years.

2.2.4 Have long-term and stable relationship with both domestic and foreign manufacturers implementing agencies have long-term and stable relationship as a first class agent.

2.2.5 Have a link to the Sinopec materials procurement e-commerce sites.

2.2.6 Sincere cooperation with the Sinopec, subject to management, no illegal acts.

3. On-site assessments

3.1 Suppliers' on-site assessment based on access criteria.

3.2 Request for examination comprising: at least three or more procurement and professional technical staff.

3.3 Score the supplier based on-site assessment criteria with signature confirmed

3.4 Generate an assessment report at the scene based on the on-site assessment result.

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