Procurement Management Optimization based on Life-cycle-cost Analysis for Telecom Companies

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Abstract

Under the tide of convergence in telecommunications industry, almost every telecom company is considering transformation strategies. Besides, increasing demands for communication services have stimulated increasing deployment of ICT infrastructure in emerging market. As the situation becomes more urgent, telecom operators are required to invest more than ever to purchase large quantities of equipment. Since procurement costs account for more than 50 percent of overall costs of telecom companies, how to effectively reduce these costs is very important for their transformation strategies, and especially critical for continual development of telecom companies.

The concept of Life-cycle-cost (LCC) was initially proposed by the U.S. Department of Defense, which refers to total costs involved in the entire life cycle of a product, mainly covering research, experimentation, procurement, maintenance, transport and storage. Procurement Life-cycle-cost (PLCC) is the core concept of life cycle management of procurement, which implies that the procurement activity determines not only the current costs, but also latter costs related to the product. Comparing with traditional approaches of procurement cost management, during which companies only pay attention to the original purchase price and lose control of the quality of the product, PLCC extends cost consideration to the entire life cycle of the product, which includes maintenance costs, usage costs, fault losses, etc. It provides an efficient solution to quality pre-controlling and cost reduction (including CAPEX and OPEX) for companies, and will have a direct impact on the value of business, quality and competitive status.

Based on Life-cycle-cost theory, this paper focuses on procurement management of a domestic mobile telecom company. Through an empirical analysis of PLCC of 25 types of equipment in a mobile telecom company, we firstly identify LCC-sensitive factors for each type of the equipment, then calculate the degree of sensitivity, and try to find out key points of cost-control for future procurement activity. Furthermore, in order to make procurement management more efficient and orderly, we adopt the cluster analysis function of SPSS to classify all the equipment into eight categories, and bring forward corresponding procurement optimization strategies, which could be an useful reference for setting and controlling procurement budget and making right purchase decisions for the company. We believe that the method and optimization strategies would be valuable for other telecom companies and similar capital-intensive enterprises.

Key words: LCC, procurement, telecom companies, sensitivity analysis, cluster analysis, optimization strategy

1. Overview

As a result of fierce competition from both domestic and foreign countries, price regulation from government, and increased investment on new technologies, business revenue of telecommunications operators declined, and profits dropped sharply. Under such circumstances, it is crucial and imperative to lower the total cost of ownership (TCO) of telecom companies. As for TCO, it is composed of CAPEX (Capital expenditure) and OPEX (Operating expenditure) . As telecom companies are capital-intensive, CAPEX usually accounts for more than 50 percent of total costs in China [1]. Construction of substantive telecom infrastructure for providing public services and investment on new technologies in the current trend of convergence takes a large amount of expenses. Meanwhile, demands for more investment to strengthen universal telecommunication services and upgrade the level of popularity of informationalization become more and more urgent. Nevertheless, equipment-related OPEX occupies an even more significant proportion of total costs, since the operating expenditure will last through the entire life cycle of equipment. In other words, procurement activity has even more influence on operating costs of telecom companies rather than that in the purchasing period. Therefore, it is of key importance for the transition strategy of telecom companies as well as their sustainable development.

Previously, telecom companies mainly focused on purchase price when making procurement decisions. By bargaining with suppliers, they usually select products with the lowest price in order to reduce purchasing expenditure. With the popularization of centralized procurement, large-scale procurement has made contract price of purchased products declined substantially, but meanwhile the quality and availability of some of the products deteriorated, resulting in increased subsequent maintenance expenses, or even causing huge losses because of equipment faults, which had a negative influence on the company's overall operating revenue and quality of communication services.

What telecom companies concern most is to get a balance between lower purchase prices and reliable quality and performance of products, so as to obtain the lowest costs in the entire procurement life cycle. To achieve this goal, telecom companies should evaluate key factors of costs as well as other related potential long-term costs involved in the entire process, which means not only purchase price, but also transportation, installation, debugging, maintenance, use, delayed delivery, fault losses and other expenditure factors included in the course of operating.

2. Life-cycle-cost Theory

2.1 Concept of LCC

The concept of Life-cycle-cost (LCC) was originally proposed and used by the U.S. Department of Defense, mainly applied to the procurement of important U.S. military equipment. LCC refers to total costs involved in the entire life cycle of a product, mainly

covering research, experimentation, procurement, maintenance, transportation and storage [2]. As a frontier cost management theory, it believes that the value of procurement activity is not simply limited to purchase price, but has more significance in terms of other associated costs, such as transaction costs, financing costs, maintenance and use costs, and opportunity losses. Although invisible, these costs cannot be ignored. The basic meaning of LCC is to achieve the lowest cost of equipment in the total life cycle of ownership on the basis of meeting requirements of reliability.

According to the international standard for life-cycle-cost IEC 60300-3-3[3], prepared by International Electrotechnical Commission, LCC includes costs occurring in a number of stages, such as concept and definition, design and development, manufacturing, installation, operation, maintenance, and disposal. The total costs can be calculated by summarizing related costs at each stage and generally be divided into procurement costs, ownership costs and disposal costs.

$$LCC=C_{procurement} + C_{ownership} + C_{disposal} \quad (1)$$

Compared to ownership costs, procurement costs can be readily evaluated since it is often a major component of LCC and it is visible. Ownership costs are a composite of operating and support costs. Disposal costs may or may not be significant costs depending on the industry.

2.2 Literature Review

Empirical studies on the use of LCC theory have been conducted in some leading companies from different industries overseas. Rajkumar Pant and V. Ev. Jayakrishnan studied the application of the LCC theory to American military equipment [4]. The results showed that if properly applied, LCC concepts could assist in the deployment of cost-effective weapons systems. Because of the deployment of the LCC method in the U.S. Department of Defense, the proportion of use and maintenance costs of weapons systems had been declining year by year since 1980, lower than procurement costs by 1982. At the same time, the growth rate of annual costs of major weapons systems reduced from 6% in 1972 to 3.9% in 1980. Lennart Borghagen and Leif Brinkhagen presented a practical study on Swedish State Railways [5]. Adtranz, a local company, applied the LCC technology contract in the country's X2000 high-speed train project in 1987. The contract included RAM / LCC norms, forecast data obtained from the development of the project, as well as the verification of previous operation experience. The results were proved to be successful, failure rate decreased and the number of non-plan overhaul reduced to be lower than required standards. B.M. Pryor, D. Gibson, R. Blakeley made an analysis and calculation of the reliability and LCC of a 400KV transmission substation which were accessed to a real system in Sweden Power Systems [6]. Results demonstrated that if the reliability and availability of relevant units of the substation were increased, the efficiency of the substation would be improved.

Comparing with former studies which focused on military equipment, railways, power systems, etc., the application of the LCC theory in telecommunication industry is rather limited, especially in the procurement activity of telecom operators. Through an empirical study on the procurement LCC of a domestic mobile telecom company (M Company), this paper aims to promote the application of LCC to improve cost management in telecommunications industry and find out efficient means to optimize the procurement management.

3. Application of LCC in Procurement Management of Telecom Companies

3.1 Introduction of the Case

Methods of LCC analysis, equipment information of M Company, PLCC model for M Company, and questionnaire for involved departments are introduced in this part to facilitate latter case study.

3.1.1 Methods of LCC Analysis

Chart 1 shows methods of how to carry on the LCC analysis. Initial modeling based on the concept of LCC is necessary, which will instruct the latter survey and definition of data. Accordingly, further survey will help revise and improve the LCC model so that it suits M Company better. Later on, we need to make face-to-face communication with staff from related departments to obtain required equipment information. This process may continue again and again until we get accurate information we want. Then quantitative calculation of the LCC of all equipment as well as sensitivity analysis and cluster analysis are pre-requisite, which underlies the latter part of classification management and targeted procurement optimization strategies.

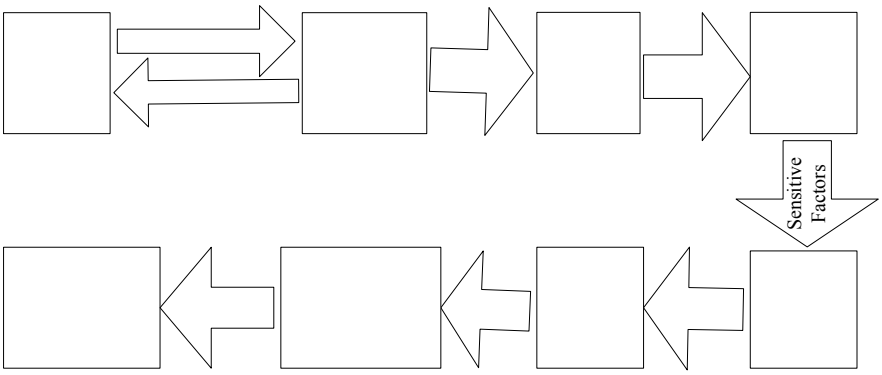

Chart 1 Methods of LCC Analysis

3.1.2 Equipment information of M Company

In this paper, we conduct our study on a regional mobile telecom company in China, M Company. There are totally 7 categories and 25 types of equipment involved in the research, which almost cover its Centralized Procurement Directory (2007), as shown Table 1.

Categories (7)	Mobile Communications Equip	Transmission Equip	Transmission Line Materials	Base Station and Ancillary Equip	IT Network Equip	Computer Products	Power and Dynamic Environmental Monitoring Equip
Equipment (25)	MSC, SGSN, SMS System	SDH Transmission Equip in Computer Room, SDH Transmission Equip in Base Station, Distribution Frames, Network Management System for SDH Transmission Equip	Optical Fiber and Optical Cable	Main Equip in Base Station, Feeder, Antenna, Iron Tower	Router, Local Area Network Switch	UNIX Server, Disk Array, PC Server, Notebook Computers	Power Supply, Batteries, Diesel Generator, UPS, Air Conditioning, Low-voltage Power Distribution Equip, Central Air-conditioning Water Chiller

Table 1 Equipment information of M Company

3.1.3 PLCC Model for M Company

From the perspective of cost-control, the PLCC (Procurement Life-cycle-cost) model established for M company is composed of two parts, conventional costs and opportunity costs, including capital costs, time costs, quality costs and operating costs which take place through the whole process of the business stage, construction stage, maintenance stage and use stage, as shown in Chart 2.

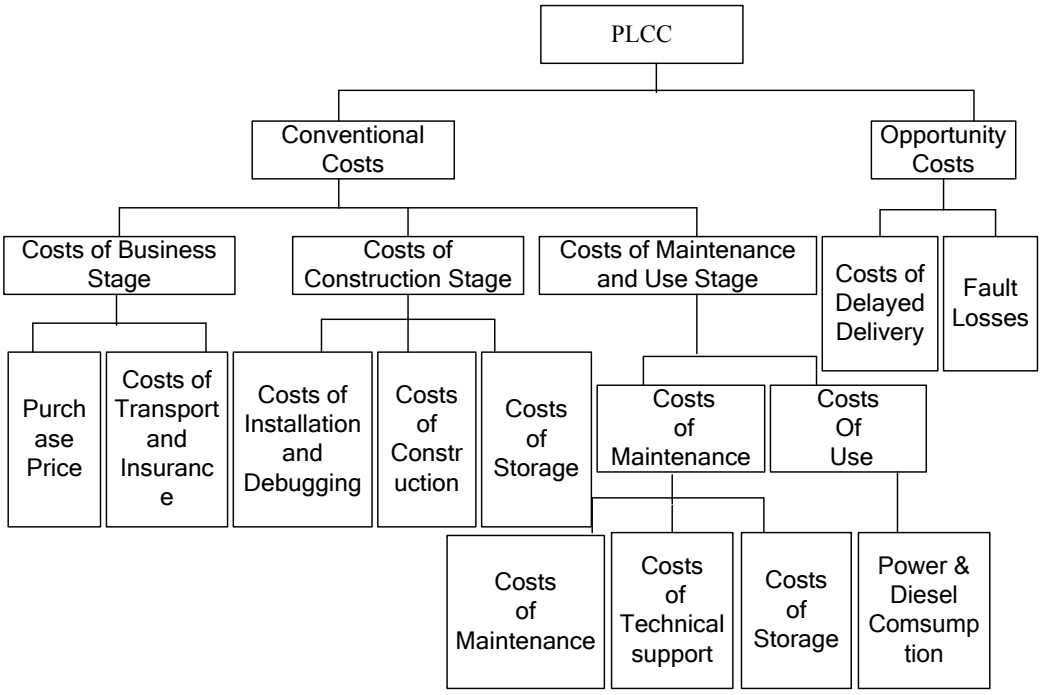

Chart 2 PLCC Model for Telecom Companies

As depicted by Chart 2, the PLCC of each type of equipment is composed of conventional costs and opportunity costs. Conventional costs can be further divided into costs occurring in business stage, construction stage, maintenance and use stage. Moreover, specific costs, like purchase price and costs of storage, are important components of costs of each stage. Similarly, opportunity costs are made up of costs of delayed delivery and fault losses.

$$LCC = C_{conventional} + C_{opportunity} \quad (2)$$

$$C_{conventional} = C_{business} + C_{construction} + C_{maintenance\ and\ use} \quad (3)$$

$$C_{opportunity} = C_{delay} + C_{fault} \quad (4)$$

For a certain type of equipment, the change of these components determines the change rate of its PLCC, so they are called sensitive factors. In all, there are 10 sensitive factors involved in 25 types of equipment that we have covered, which are Purchase price, Delay of Delivery, Costs of Construction, Costs of Installing and Debugging, Costs of Maintenance, Costs of Technical Support, Power Consumption, Fault Rate, Costs of Diesel, Costs of Storage.

Comparing with previous procurement process, the PLCC model has made comprehensive consideration on costs of construction, maintenance, use and possible opportunity losses, which changes the way of quality control and information collection from prior post-control into pre-control. Through identifying every PLCC-sensitive factor of each type of equipment, we can find out specific characteristics of each type of equipment as well as define the direction of cost control.

3.1.2 Questionnaire

In order to apply the LCC theory to M Company, we need to make deep survey to get required equipment information from related production and management departments, such as Network Maintenance Department, Procurement Department and Project Management Department. The following table depicts the questionnaire we designed for involved departments.

LCC	Stage	Data	Unit	Data Source
Conventional Costs	Business Stage	number of equip	-	Network Maintenance Dept.
		purchase price	yuan	Procurement Dept.
		costs of transport and insurance	%	Procurement Dept.
	Construction Stage	costs of installation and debugging	yuan	Procurement Dept.
		costs of construction	yuan	Procurement Dept.
		costs of storage	yuan	Procurement Dept.
	Maintenance and Use Stage	life span	year	Network Maintenance Dept.
		costs of maintenance	yuan/month	Network Maintenance Dept.
		costs of technical support	%	Network Maintenance Dept.
		warranty duration	year	Network Maintenance Dept.
		power consumption	yuan/month	Network Maintenance Dept.
		diesel consumption	yuan/month	Network Maintenance Dept.
Opportunity Costs	Construction Stage-Costs of Delayed Delivery	delay of delivery	day	Project Management Dept.
		revenue per base station	yuan	Network Maintenance Dept.
		coefficient of delay	-	Project Management Dept.
	Maintenance and Use Stage-Fault Losses	fault duration per year	day	Network Maintenance Dept.
		coefficient of fault	-	Network Maintenance Dept.
		revenue of euip per month	yuan	Network Maintenance Dept.

Table 2 Questionnaire for Involved Departments

3.2 Application of LCC in M Company

3.2.1 PLCC Analysis

When carrying out PLCC analysis of telecom equipment, we firstly calculate a large number of data derived from deep surveys of M Company. Through calculating related items of costs in the model, we get conventional costs, opportunity costs as well as costs of three stages. Then, we make further analysis of the composition of PLCC.

Taking SMS System as an example, the process of its PLCC analysis is shown below.

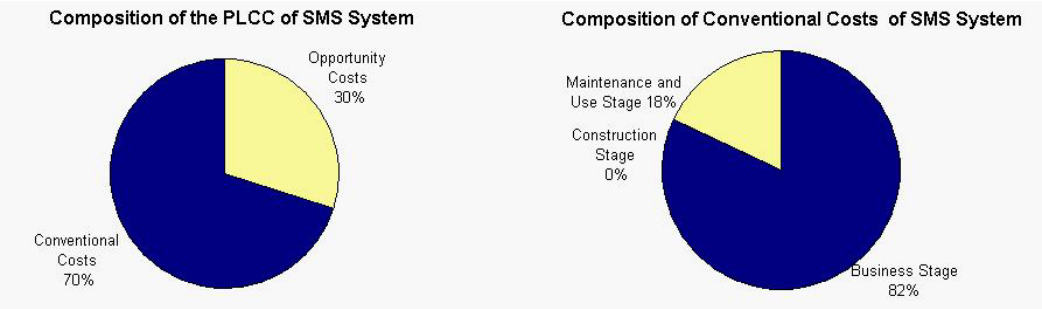

Chart 3 PLCC Analysis of SMS System

As revealed in the above chart, conventional costs account for 70% of PLCC of SMS System, of which costs of the business stage, maintenance and use stage account for 82% and 18% respectively, and there are no expenses in the construction stage. Opportunity costs, mainly caused by fault losses, account for 30% of its PLCC, and are measured by operating revenue losses due to equipment faults.

The same process also applies to other types of equipment. By way of figuring out the composition of their PLCC, we can set their cost-sensitive points in advance, which lay a foundation for making in-depth sensitivity analysis.

3.2.2 Sensitivity Analysis

Sensitivity analysis includes the following steps. First of all, we need to identify PLCC-sensitive factors, such as purchase price, power consumption, delay of delivery, maintenance costs and technical support. Then, through changing the numerical value of sensitive factors by 10% and calculating the changing rate of PLCC, we can measure the coefficient of these sensitive factors. The value of the coefficient determines to what extent the factor influence the PLCC.

The following chart shows how price, power consumption, technical support and fault rate affect the PLCC of the SMS System.

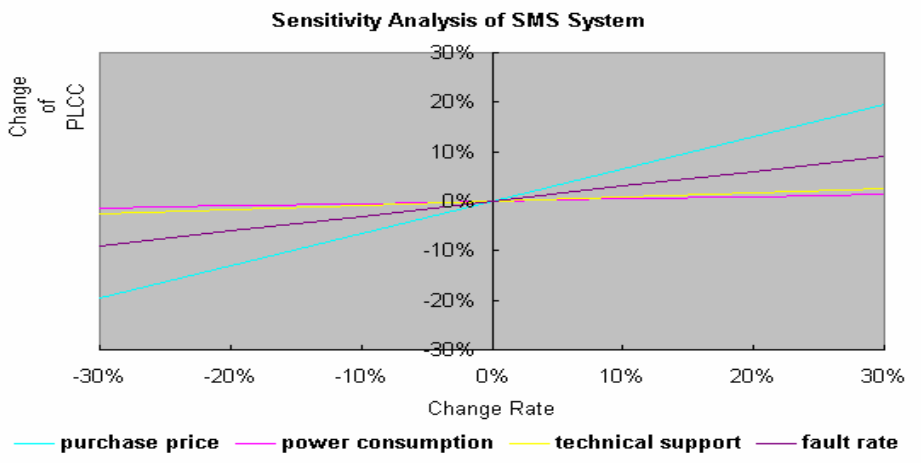

Chart 4 Sensitivity Analysis of SMS System

From chart 4, we can observe purchase price and fault rate are the most sensitive factors of SMS System, followed by technical support and power consumption. Accordingly, purchase price and fault rate should be regarded as the most important factors in making procurement decisions.

Similarly, sensitivity analysis can be carried out to other equipment. The result shows that different kinds of equipment have different sensitive factors as a result of their unique characteristics. For example, the PLCC of Network Management System for SDH Transmission Equipment is only sensitive to purchase price, while that of Central Air-conditioning Water Chiller is sensitive to three factors, which are purchase price, maintenance costs and power consumption. Therefore, the procurement department of M Company should only pay attention to price when purchasing the former equipment, but will have to consider price, maintain expenditure and power consumption when purchasing the latter.

3.2.3 Cluster Analysis

(1) Ward Method

In this paper, a widely implemented analysis tool is adopted, namely, Hierarchical Cluster Analysis method [7]. With this method, any variable or sample with numerical characteristics can be classified satisfactorily into several clusters, as long as we choose the right size of distance and suitable cluster methods. Comparing with other hierarchical methods, Ward Method is much better, since it is designed to optimize the minimum variance within clusters and creates clusters of near equal size, having hyper-spherical shapes. The algorithm begins with one large cluster encompassing all objects to be clustered. In this case, the error sum of squares is 0. The program searches objects that can be grouped together while minimizing the increase in error sum of squares. Error sum of squares is computed as:

$$SSe = x^2i - 1/n\ (Sxi)^2$$

Run SPSS version 13.0, input equipment information and coefficient values of all sensitive factors, and we will get the following result.

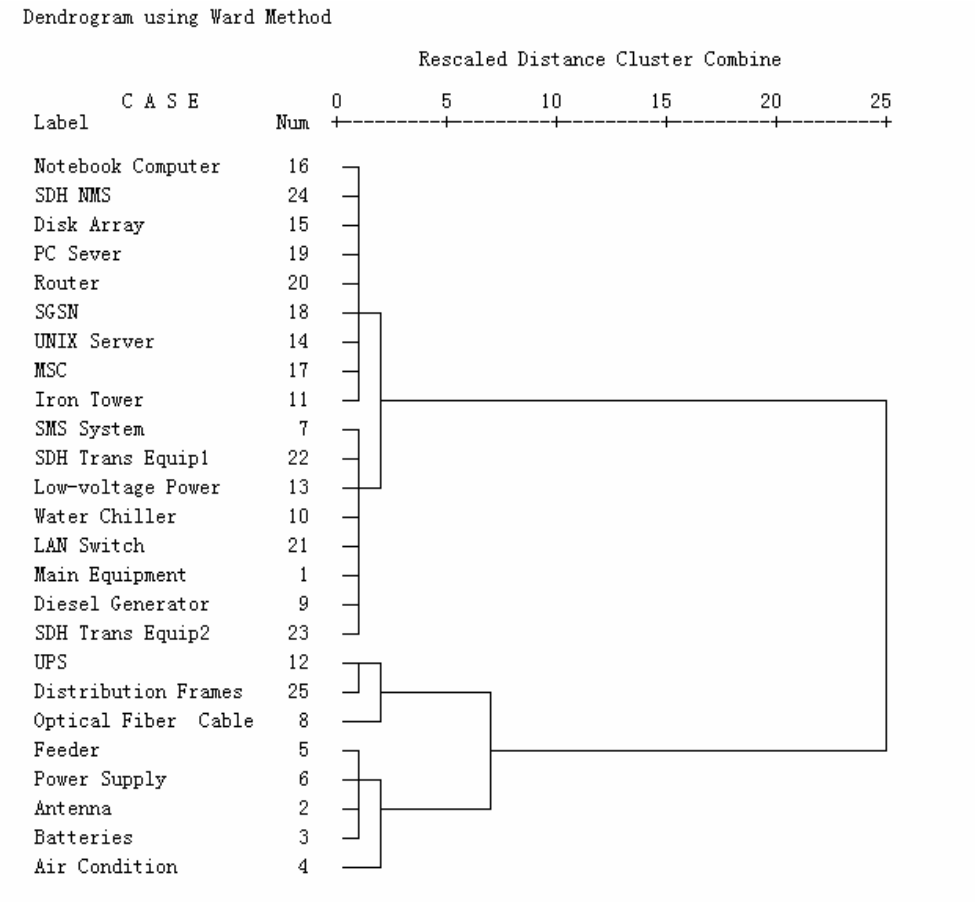

Chart 5：Result of Cluster Analysis

Note:

① SDH Trans Equip1 stands for SDH Transmission Equipment for Computer Room, and SDH Trans Equip2 represents SDH Transmission Equipment for Base Station.

② Noticing that different types of equipment have different sensitive factors and some of the factors, which are sensitive to the PLCC of certain types of equipment, but have little or no impact on that of other equipment, we set the missing value with zero to guarantee the integrity of data.

(2) Classification Results, Characteristics and Procurement Optimization Strategy

Through cluster analysis of all PLCC-sensitive factors, we classify the above-mentioned 25 types of equipment into six clusters. Based on the classification, we identify cost-control points of various clusters, and propose pointed procurement strategies to improve procurement management.

Cluster 1: Notebook Computers, Network Management System for SDH Transmission Equipment, Disk Array, PC Sever, Routers, SGSN, UNIX Server, MSC, Iron Tower.

Characteristics: Purchase price is the only sensitive factor of the PLCC of equipment in Cluster 1.

Procurement optimization strategy: Price-oriented strategy. Telecom companies need to gain the optimal purchase price by expanding the scope of tender, increasing the accuracy of requirements reporting, and enlarging the scale of purchasing. Furthermore, the suppliers' bid system should be established to enhance the bargaining power and reduce procurement costs.

Cluster 2: SMS system, SDH Transmission Equipment in Computer Room, Low-voltage Power Distribution Equipment, Central Air-conditioning Water Chiller, Local Area Network Switch, Main Equipment in Base Station, Diesel Generators, SDH Transmission Equipment in Base Station.

Characteristics: The PLCC of equipment in Cluster 2 is quite sensitive to dual factors, purchase price and another factor, such as costs of technical support, fault rate, power consumption and costs of maintenance, which varies depending on the type of equipment.

Procurement optimization strategy: Dual-factor-oriented strategy. In addition to purchase price, costs of technical support, fault rate, power consumption, costs of maintenance, etc. are also important aspects needed to be paid special attention to.

Cluster 3: UPS, Distribution Frames

Characteristics: The typical feature of equipment in Cluster 3 is they are single-factor-sensitive —maintenance costs.

Procurement optimization strategy: Maintenance-cost-oriented strategy. Procurement negotiations are extremely important for such equipment. The ratio of technical support/price, warranty duration, and other terms must be well agreed on in the contract. Meanwhile, purchase price should also be taken as a dimension to be considered in order to avoid the situation of low purchase price but high maintenance costs.

Cluster 4: Optical Fiber and Optical Cable

Characteristics: It is sensitive to a single factor—fault rate.

Procurement optimization strategy: Fault-rate-oriented strategy. As a type of product which is of great importance to the operation of telecom companies, Optical Fiber and Optical Cable is closely related to the operation of daily service providing, the entire business revenue and customer satisfaction. Therefore, the procurement department should pay special attention to its quality. Moreover, maintenance and inspection should be reinforced in the latter part of use to minimize fault losses.

Cluster 5: Feeder, Power Supply, Antenna, Batteries

Characteristics: The PLCC of products in Cluster 5 is single-factor-sensitive—sensitive to the delay of delivery.

Procurement optimization strategy: Delay-of-delivery oriented strategy. As network supporting products, they are always required abundantly, and their purchase price is almost the same. Generally speaking, there are mature suppliers, and delayed delivery is strictly prohibited since it will affect the progress of construction projects. For these reasons, the procurement management should pay more attention to their delivery duration. Through inviting more suppliers to attend the bidding, telecom companies can select reliable suppliers to ensure timely supply as well as guarantee the stability of supply.

Cluster 6: Air Conditioning

Characteristics: The PLCC of Air Conditioning is quite sensitive to a single factor—power consumption.

Procurement optimization strategy: Power-consumption-oriented strategy. As mature products, there is usually no different in price of Air Conditioning between different suppliers. Therefore, it is necessary to give indicators of power consumption the primary consideration. With quality and performance well guaranteed, the procurement department should give priority to low-power equipment.

4. Procurement Optimization Strategies

Establishment of LCC model can help telecom companies track related costs occurring in the entire life cycle of their equipment, find out all LCC-sensitive factors, assure cost-control points, and implement targeted classification management. With this method, the whole procurement process can be simplified and the efficiency of procurement management will be improved. To ensure good performance of the procurement activity, telecom companies should keep the following aspects.

(1) To establish the concept of LCC in the procurement management.

The LCC model clearly illustrates that total costs of procurement activity are determined by a series of complex factors. Besides purchase price, there are many other factors that compose the LCC. For different types of equipment, sensitive factors are rather different, and even for the same type of equipment, the degree of impact varies with factors. As long as telecom companies take all these factors into comprehensive consideration and make decisions accordingly, overall costs will be reduced.

(2) To apply classification management strategies.

Different types of equipment have different attributes, so the focus of procurement activity varies correspondingly. Through classifying all the equipment into several clusters and establishing specific procurement management optimization strategies, the procurement activity can be more targeted, simplified and efficient.

(3) To reinforce supplier relationship management.

For some types of telecom equipment, like transmission devices, quality and performance is especially important. For this reason, it is vital to establish a scientific supplier management system to select those who can provide reliable products. As a matter of fact, for a long time, telecom companies choose their suppliers based on their subjective impression, historical information of cooperation and purchase price, without a reasonable and systematic approach. Therefore, it is necessary to establish specifications for suppliers [8] and implement supplier relationship management by visiting them frequently, making essential guidance and setting up long-term partnerships. In addition, post-assessment of suppliers is indispensable. By reinforcing supervision of suppliers, eliminating unqualified ones promptly and offering incentive awards to top level ones, quality, availability, stability of products and standards of service will be improved.

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