HOW AN ABC STUDY HELPED A CHINA STATE-OWNED COMPANY STAY COMPETITIVE
Pingxin Wang; Qinglu Jin; Thomas W Lin
Cost Management; Nov/Dec 2005; 19, 6; ABI/INFORM Global
pg. 39

HOW AN ABC STUDY HELPED A CHINA STATE-OWNED COMPANY STAY COMPETITIVE

Since China entered the WTO in December 2001, many Chinese State-Owned Enterprises have tried to reform their management planning and control systems. This article reports on a Xi'an area agricultural machine company's experience of losing competitive bidding of its core product, and the company's decision to seek advice from ABC consultants to evaluate its traditional direct labor hour based overhead allocation method, and to conduct an activity analysis.

PINGXIN WANG, QINGLU JIN, and THOMAS W. LIN

As a typical state-owned enterprise, X Agricultural Machine Company (XAMC) in the Xi'an area, specializes in manufacturing agricultural machine products designated by the Ministry of Machine Industry in China. While less machine-intensive, the company organized its production to meet the actual level of sales orders placed. Thus, it keeps a low inventory level, with a large variation across the production volumes of different products. There are 1,200 employees in the firm. Its total asset value is 110 million RMB (USD1 = RMB 8.27, the currency unit hereafter is referred to as RMB), while the fixed assets are valued at 62.23 million.

The company has six main products: 4-wheel tractors, 24-row large seeders (with two products: 24A and 24C), 12-row seeders, 2BM-2 covering layers, and sprinklers. The core product, 4-wheel tractors, is a high-volume, low-complexity product. Its production quantity has declined in recent years due to higher cost and losing bids to competitors.

In contrast, the two types of 24-row large seeder are rapidly growing, branded quality products with moderate volume, dominating the market with a market share of more than 60 percent. The main customers of the large seeder are the large military farms located in Northeastern China and Xinjiang in Northwestern China, and the increasing demand is far beyond the present production level. Designed for medium and small farms, often supported by individual farmers, the 12-row seeder is a low-volume, high-complexity product. It also leads

PINGXIN WANG is Professor of Accounting in the School of Accounting, Xi'an Jiaotong University, China. He has published several cost management articles in Chinese language.

QINGLU JIN is Professor of Accounting in the School of Accounting, Shanghai University of Finance and Economics, China. He has published several cost management articles in Chinese language.

THOMAS W. LIN is Professor of Accounting and Leventhal International Faculty Fellow in the Leventhal School of Accounting, University of Southern California. A CMA and a member of the Institute of Management Accountants and the American Accounting Association, he has published two co-authored books in 2005: Cost Management: a Strategic Focus, *3rd edition, and* Cases and Readings in Cost Management, *3rd edition.*

the market with good sales. Both the 2BM-2 covering layer and the sprinkler are new products with relative small sales volume.

XAMC Company uses TQM principles in all production processes to ensure its product quality is a competitive advantage, but it has faced increasing pressures in recent years due to the falling product price from intensive competition and private suppliers. As a disadvantaged product, the tractor line has been targeted for discontinuation. Despite its large market share, the high cost of the 24-row seeder narrows the company's gross margin and presents the dilemma of increasing the market share. Company management recognizes that good cost management is a key factor to its performance against its competitors.

XAMC used a *fixed quantity cost allocation* method, designating the workshops as cost centers, and allocating manufacturing overhead costs based on direct labor hours. About one year ago, the XAMC company controller read an English accounting article on benefits of activity-based costing (ABC). He then approached the Xi'an Jiaotong University Accounting Department to hire two professors and six graduate students as consultants to conduct an ABC study. Based on the preliminary data gathering and analysis, the consulting group found the following reasons to apply ABC to this company:

- High manufacturing overhead cost running 200% of the direct labor cost
- Small product order quantity
- Large volume variation across products
- Large differences in complexity across product lines
- Inappropriate allocation of overhead costs to products—especially over-allocation to company's core product, 4W tractor—resulting in an increased incidence of successful bids by competitors

As a result, XAMC Company decided to implement the activity-based costing to enhance its core competencies.

ABC procedures and methodology

The consulting team conducted an ABC study for XAMC in two phases: preliminary preparation and ABC design. Preliminary preparation consisted of interviews with key XAMC personnel, determination of appropriate allocation periods and cost objects, and a product cost survey.

By way of preliminary preparation, the consultants conducted interviews with the CEO, controller, marketing manager, and plant manager regarding the current operation situation, main issues, corporate vision, and market environment, to get a big picture about the company. They then studied the company's accounting and financial policies and procedures, studied cost data to get basic information about product cost structure and various expenses, and prepared for collecting the raw data by frequent, in-depth communications with the accounting staff and introducing the ABC method to the controller.

Since the more current data more accurately reflects the company's actual current costs, and the allocation period included the complete production cycle, the most recent six-month data was selected as the allocation period. The cost objects chosen include the six products mentioned above: tractor, 24A seeder, 24C seeder, 12R seeder, covering layer, and sprinkler.

Through interviews and inquiry, the information regarding the product cost of the six-month sample period based on traditional allocation method appears in Exhibit 1.

ABC design

The consulting team began their ABC design process with an on-site operational survey. In the first step of the design process, they interviewed workshop chiefs and accounting staff to learn about the production flow, cost allocation, and cost management methods. Then they observed the production steps and procedures, talked with the division chief and workers about the detailed workflow, and collected the information about the features of the workers' activities, workload, and worksites. The team wanted sufficient information about workflow to avoid mistakes in the implementation process, since

XAMC USED A *FIXED QUANTITY COST ALLOCATION* METHOD, DESIGNATING THE WORKSHOPS AS COST CENTERS, AND ALLOCATING MANUFACTURING OVERHEAD COSTS BASED ON DIRECT LABOR HOURS.

EXHIBIT 1 Unit Product Costs Allocated by Traditional Method

Unit Cost: RMB

Product	Direct Material	Direct Labor	Manufacturing Overhead	Unit Cost	Six-Month Volume
4W Tractor	6,537	327	452	7,316	1,083
24A Seeder	11,760	369	1,077	13,206	354
24C Seeder	9,401	399	974	10,774	101
12R Seeder	2,131	198	770	3,090	50
Covering Layer	1,225	348	850	2,423	75
Sprinkler	5,994	354	620	6,968	19

Note: One U.S. Dollar is equivalent to 8.27 RMB

workflow is the basis for activities classification and cost drivers applied in ABC.

The team then moved to activity analysis and definition as the second step in their ABC design process. The plant has five departments: (1) molding, (2) forging, (3) metalworking, (4) R&D and design, and (5) assembly. The activity analysis classified plant activities based on an understanding of the workflow. The consultants first listed the technical activity descriptions, determined the main work performed, and classified other types of work into different activities. For example, the activities of the molding department could be classified based on the following workflow before it was transferred as work-in-progress to the next station:

- Design the plan for foundry mold according to component requirements
- Mold based on the plots
- Make sand models with the mold
- Smelt the iron for casting
- Cast the melted iron from the smelter into models
- Clean the castings and rub off the sand on their surface

Based on the workflow, the above six activities are identified as designing, molding, modeling, smelting, casting, and cleaning. The characteristics and cost drivers of the activities described naturally follow.

For the designing activity, the plan designing activities are based on the models of the components and irrelevant to product volume. Thus, the activity level is the product and the cost driver is direct labor hour.

For the molding activity, the number of batches of raw materials determines molding. It is irrelevant to product volume in each batch. Thus the activity level is batch. The resources the molding consumes fall into two categories: one is related to the molding components types, leading to the use of the number of component types as the cost driver because one set of molds is generally needed for one kind of component; another is related to the material handling, which includes material application and material processing, leading to the use of the number of materials handled as the cost driver.

The modeling activity was approached in terms of the activity level as unit, and the cost driver as direct labor hour because it consumes labor resources.

The smelting activity uses a three-ton capacity furnace to smelt iron. The activity level is batch. The resources it consumes fall into three categories: (1) the weight of the smelted iron (consuming related amounts of raw materials and coke), leading to the use of the weight of smelted iron in kilograms as the cost driver; (2) the material handling, including application, selection, and combination, leading to the use of number of material handling times as the cost driver; (3) the machine and equipment, leading to the use of the machine hour as the cost driver for this type of resource.

Finally, the casting activity level is unit and the cost driver is direct labor hour, and the cleaning activity level is unit and the cost drivers are direct labor and machine

EXHIBIT 2 Activities and Cost Drivers

Primary Activity	Activity Level	Cost Driver	Secondary Activity	Activity Level	Cost Driver
Designing	Product	Direct Labor Hours	Machine Setup	Batch	Number of Setup
Molding	Batch	Components Types No. of Material Handling	Mold Setup	Batch	Number of Setup
Modeling	Unit	Direct Labor Hours	Machine Packaging	Unit	Direct Labor Hours
Smelting	Batch	Smelted Iron Weight No. of Material Handling	Machine Moving	Batch	Moving Distance
Casting	Unit	Direct Labor Hours			
Cleaning	Unit	Machine Hours Direct Labor Hours			
Material Handling	Batch	No. of Material Handling Direct Labor Hours	Components Tooling	Unit	Direct Labor Hours Machine Hours
			Material Handling	Batch	No. of Handling
Machine Setup	Batch	No. of Preparation	Order Processing	Batch	Number of Orders
Punching	Unit	Direct Labor Hours Machine Hours	Receiving	Batch	No. of Receiving
Welding	Unit	Direct Labor Hours	Machine Repairing & Maintenance	Batch	Direct Labor Hours
Rolling	Unit	Direct Labor Hours			
Surface Heating	Batch	Consumed Fuel Weight			
Spoking	Unit	Direct Labor Hours			
WIP Transferring	Batch	No. of Transfers			
Initial Painting	Batch	Direct Labor Hours			
Surface Painting	Batch	Machine Hours Direct Labor Hours	Material Inspecting Product Inspecting	Batch Unit	Direct Labor Hours Direct Labor Hours
Assembling	Unit	Direct Labor Hours Machine Hours	Advertising	Product	No. of Advertising Direct Labor Hours
Debugging	Unit	Direct Labor Hours	Shipping Selling & Customer Relations	Batch Product	No. of Shipping No. of Customers Direct Labor Hours

hours. The team identified and analyzed a total of 18 primary activities and 14 secondary activities for all departments as listed in Exhibit 2.

Cost allocation

After the activities were defined and classified, the next step was to figure out the cost of the resources consumed in the different activities and determine the activity costs. Generally, some of the necessary data could be acquired directly from the existing cost reporting system, while other data had to be obtained separately by analyzing the activities' characteristics and taking advantage of some of the data in the existing information system.

For example, the information for determining the costs of the six activities in the Modeling Workshop is obtained as follows. For designing, the cost driver is the direct labor hour, and the activity's volume consumption data can be obtained directly from the statistics in existing cost analysis and calculation. For molding, the measurement for component types, the first cost driver could be obtained directly from the production plan. Then the material costs, mold workers' salaries and benefits, and tools depreciation could be obtained from the workshops' ledgers, and the sum of these three items should be added to the molding activity cost.

Since there is no data regarding the number of materials handled in the existing cost analysis system, this cost driver activity's volume consumption data must be calculated separately. Considering that the number of materials handled is based on the number of material applications, the number of application orders can be used to get this cost driver activity's volume consumption data. Meanwhile, the assistant workers' salaries and benefit fee, the fee for the preliminary cutting of the materials, and other miscellaneous fees should be added to the molding activity cost.

The weight of the smelted iron could be ascertained directly from existing production records. The number of materials handled can be obtained from the number of application orders and should include the relevant workers' salaries and benefit fees, cutting and moving tool expenses, machine depreciation, and power expenses. As there is no data for machine hours consumed in the existing cost analysis system, estimation was recommended based on production tasks and furnace characteristics and capacity. Furnace depreciation, power expenses, workers' salaries and benefit fees, and supporting equipments depreciation should be included in this activity cost.

Similar to the process for modeling, the casting activity's cost information can be obtained directly from the statistics in the existing cost analysis and calculation. Finally, there was no data regarding the machine hours as the cost driver in the existing cost system. Again, the consulting team recommended estimation based on the cleaning machine capacity, average cleaning time, and the total number and sizes of components. Additional cost should include machine depreciation, power and water consumption, relevant workers' compensation, and iron powder cost. The activity's volume consumption and fee data for direct labor hours, another cost driver in this activity, can easily be acquired from the existing cost system.

AFTER THE ACTIVITIES WERE DEFINED AND CLASSIFIED, THE NEXT STEP WAS TO FIGURE OUT THE COST OF THE RESOURCES CONSUMED IN THE DIFFERENT ACTIVITIES AND DETERMINE THE ACTIVITY COSTS.

Though complicated, the deliberate steps in this process are very important. The consulting team encouraged a detailed analysis for every type of cost and careful allocation to the different activities defined. The ABC system's effectiveness is highly sensitive to the initial success of cost allocation in these steps.

With resource driver and resource cost data, dividing the latter by the former could produce the specific cost driver allocation rate. Then, the activity costs can be obtained by multiplying the quantities of activity volume that cost drivers consume by the relevant cost driver allocation rate.

Extending the ABC design

The first stage in extending the ABC design established for the fabrication of parts follows a similar sequence for the company's other areas: identifying main activities, designating cost centers, and determining cost pools to calculate cost driver allocation rate. With considerations concerning the importance of manufacturing, technical processes, and the cost of every activity, 14 activities were identified as main activities: molding, smelting, material handling, punching, modeling, surfacing painting, assembling, machine setup, machine moving, components tooling, order processing, machine repairing and maintenance, inspecting, and customer relations.

Cost pools can be established based on the main activities. The minor activities should be merged into the main activities they support, and the main activities can be merged into different cost pools based on their relationships. The cost pools should be designated after the merger. Meanwhile, a manufacturing support activity should also be established as a management activity to represent the management staff wages, welfare, and other expenses unrelated to other activities.

Two cost pools deserve special attention: setup and moving. The setup cost pool includes the setup for all the machines and molds except the machine setup in the punching cost pool due to its unique feature. Other setup work is homogeneous and thus is put into one cost pool. Another cost pool, the moving pool, is responsible for the management and assignment of all the forklifts in the company, as an improvement from the previously decentralized method of forklift management. The cost driver for the moving cost pool is moving distance, measured in units of 100 meters.

After the establishment of cost pools, cost driver allocation rate can be obtained by selecting the core activity and the core cost driver. The core activity is selected from the activities included in a cost pool, based on their relative cost, measuring

EXHIBIT 3 Activities Cost Allocation

Unit Cost: RMB

Cost Pool	Activity Cost Driver	4W Tractor	24C Seeder	24A Seeder	12R Seeder	Covering Layer	Sprinkler	Total Activity Consumption	Cost Driver Allocation Rate in RMB
Molding	Component Types	3,500	3,600	3,200	1,400	320		12,020	5.05
Smelting & Casting	Smelted Iron Weight	97,410	58,441	15,015	3,519	983		175,368	1.20
Mat. Handling	Labor Hours	2,660	4,454	660	355	663		8,792	6.22
Punching	Machine Hours	307	59	372	178	200		1,116	34.45
Modeling	Labor Hours	2,130	3,242	1,118	465	893	112	7,960	8.21
Painting	Machine Hours	950	853	950	160	127	60	3,100	0.97
Assembling	Labor Hours	30,620	16,516	6,414	220	310	220	54,300	7.42
Setup	No. of Setup	420	210	170	140	85	59	1,084	12.46
Machine Moving	Moving Distance	1,635	1,374	408	151	255	61	3,884	18.60
Components Tooling	Labor Hours	6,829	3,201	1,247	3,760	5,175	1,458	21,670	8.03
Order Processing	No. of Orders	32	22	13	10	12	21	110	438.82
Maintaining	Labor Hours	2,520	780	650	370	210	90	4,620	5.96
Inspecting	Labor Hours	1,517	1,172	420	256	330	185	3,880	8.15
Selling & Customer Relations	No. of Customers	27	22	15	8	5	3	80	3,824.04
Labor & Overhead Activity Cost		680,452	482,484	236,873	105,656	104,032	41,319	1,650,817	
Materials Cost		7,079,738	4,163,015	949,450	106,554	91,846	113,880	12,401,994	
Total Costs		7,760,190	4,645,500	1,186,323	212,210	195,878	155,199		
Volume		1,083	354	101	50	75	19		
Unit Product Cost		7,165	13,123	11,746	4,244	2,612	8,168		

EXHIBIT 4 Product Cost Difference Analysis

Unit Cost: RMB/Item

Product	4W Tractor	24C Seeder	24A Seeder	12R Seeder	Covering Layer	Sprinkler
Volume (item)	1,083	354	101	50	75	19
Traditional Method[1]	7,457	13,448	11,098	3,344	2,668	7,177
ABC Method[1]	7,165	13,123	11,746	4,244	2,612	8,168
Difference Percentage[1]	4.0%	2.5%	-5.5%	-21.2%	2.1%	-12.1%
Traditional Method[2]	920	1,668	1,697	1,213	1,443	1,183
ABC Method[2]	628	1,363	2,345	2,113	1,387	2,175
Difference Percentage[2]	46.5%	23.8%	-27.6%	-42.6%	4.0%	-45.6%

Notes:

Difference Percentage = (Cost under Original Method–Cost under ABC Method)/Cost under ABC Method

[1] Including direct materials cost

[2] Excluding direct materials cost

cost, correlation between its cost driver (referred to as core cost driver) and the main resource the cost pool consumes, and behavior influences.

The 14 core activities were identified based on principles discussed above. Their core cost drivers are components types, smelted iron weight, labor hours, machine hours, labor hours, machine hours, labor hours, number of setup, moving distance, labor hours, number of orders, labor hours, labor hours, and number of customers, respectively. Once the total activity volume consumption measurement for the core cost driver in a cost pool has been determined, dividing the cost pool with it can derive the specific cost driver allocation rate.

Second stage: allocating activity cost to products to get product cost

An analysis for the components' related cost pools are needed if the components of a product have to be determined and classified into different categories. With the records of the activity volume consumed by core cost drivers in the cost pool, the covered cost in each cost pool can be figured out with the cost driver allocation rate obtained above. Furthermore, the sum of the covered cost in the cost pools would represent the total product cost and dividing it with product volume can derive the unit cost. The outcome of this analysis and calculation is given in Exhibit 3.

Analysis of the difference between ABC and Traditional Method

Since selling expense is not included in the product cost in the traditional cost method, ABC and traditional methods cannot be compared directly. As a solution for an unbiased comparison base, the selling expense can be allocated to the product cost in proportion to the direct labor consumption under the traditional method. After such a treatment, the comparison of the two methods appears in Exhibit 4. Since the direct material cost included in the product cost is the same for the two methods, it can be deducted from the product cost to reflect the sharp difference in cost allocation under the two methods.

It can be concluded that costs of the 4W tractor (highest volume) and the 24C Seeder (second highest volume) have been overestimated under the traditional method, while those of the 24A seeder (relative low volume), the 12R seeder (second lowest volume), and sprinkler (lowest volume) have been underestimated. The cost of the 4W tractor, representing 64.39 percent of total product volume, was overstated by 4 percent with the traditional method, while the cost of the 12R seeder, representing 2.97 percent of total product volume, is understated by 21.2 percent.

With the exclusion of direct material cost, the difference between the two methods is more remarkable, with the 4W cost overestimated by 46.5 percent and the 12R cost underestimated by 42.6 percent. This substantiates that traditional cost accounting overestimates the cost of products with high volume and low complexity while it underestimates the cost of products with low volume and high complexity in accounting theory.

Interestingly, the costs of 24C and 24A behave differently, overestimated and underestimated respectively, under the traditional method, though they are similar products. One explanation lies in the difference between the two products' volume—the former tripling the latter. Another reason is that the 24C has a lower cost as an improved model. ABC reflects such differences while traditional methods fail to do so.

The two reasons behind the underestimated cost of the sprinkler and the 12R seeder under the traditional method with a large deviation are as follows: first, as new products they are still in the improvement process with lower efficiency; second, the setup and adjustment cost is relatively high with lower volume. Traditional method cannot reflect such differences and gives underestimated costs, while ABC can reflect the real resource consumption of products.

The distorted product cost yields the distortion in terms of gross margin and product profits. The gross margin of 4W is underestimated by RMB 292 per tractor, and the gross margin for the 1,083 tractors produced during the six-month sampling period is underestimated by RMB 316,236.

The distorted information would seriously delude management in related decision making processes. For example, even with fierce competition, the company didn't respond by lowering the price of 4W with the overestimated cost and thus missed an opportunity to enlarge its market share and increase its current and future profits. Similarly, management may choose to dramatically increase the less profitable 12R production with the underestimated cost and decrease the more profitable 4W with overestimated cost, under a limited budget, which would aggravate the profit situation due to the doubled mistake. Obviously, ABC gives more reliable and convincing product cost than the traditional method.

SINCE SELLING EXPENSE IS NOT INCLUDED IN THE PRODUCT COST IN THE TRADITIONAL COST METHOD, ABC AND TRADITIONAL METHODS CANNOT BE COMPARED DIRECTLY.

Recommendations to XAMC

The ABC analysis can be used in cost control by eliminating non-value-added activities in the production based on the value chain analysis, and seeking cost reduction with analysis of the relationship between the consumed resources and the cost drivers. The following recommendations are made based on the ABC cost analysis for the XAMC Company.

1. Fully Adopt the Activity-Based Costing System—Since the XAMC Company's six products have different customer order volume, size, and complexity, it should adopt the activity-based costing system to reduce overhead cost allocation distortions, and to provide better product and customer profitability measures.
2. Operation Management—Activity-based management and PERT methods are suggested as two powerful tools for the operation management, and non-value-added activities should be eliminated.
3. Reduction in Redundant Labor—Centralization for production coordination, inspecting, repairing, and machine moving are recommended and thus, the redundant labor should be eliminated.
4. Enterprise Resource Integration—A centralized moving center is advised to effectively allocate and assign

the forklifts currently used in the workshops.

5. Components Standardization—Standardized components will significantly lower the product cost as the component type is a core cost driver and represents large resource consumption.
6. Procurement and Supplier Management—Better procurement and supplier management would lower the material cost and ensure the material quality, which would consequently lower the product cost.

XAMC Company has adopted the ABC system, and its core product, the 4-wheel tractor, has gained more competitive biddings in recent months since becoming operational as a decision making resource. ■