ACTIVITY BASED COSTING IN A CITY GOVERNMENT ' S UTILITY COMPANY BUDGETING PROCESS

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THE objective of this study is to investigate the effectiveness of an Activity Based Costing (ABC) model in predicting aggregate budgeted cost for the utilities department in a local government. In the past few years, there has been a pressure on the city officials to reduce the costs. This is forcing cities to re-examine their current allocation of resources to various activities. We examine the budgeting process for the Utilities Department of City of Paris[1]. Our study uses ABC to predict the operating costs on a monthly basis based upon the identified cost driver. In the process, we have also been able to identify inefficiencies in the billing process, in particular, and provide an effective measure of reducing non-value-added activities in general. The application of ABC should benefit the cost control process in providing services.

Introduction

Efficient allocation and use of scarce resources is a problem faced by any organization. The problem becomes acute in the case of local governments, as the inflow of resources is restricted to the budgeted amount. The constituents increasingly want to hold the city officials responsible for the use of their hard earned tax money. This has increased the pressure on the city officials to look for more efficient ways of allocating and using resources. The city of Paris is no exception to the rule.

In the last few years there has been pressure on every department to reduce their cost of operations while maintaining the quality. Each department head is given broad parameters to reduce their projections and consequently their costs by a certain percentage. This blanket reduction is arbitrary and leads to frustrations among city employees and the city constituents. We offered to conduct a study for the city's Utilities Department to identify a more precise way to predict the total costs and also identify any non-value-added activities which may be consuming resources but not adding any value to the city's constituents.

The relevant feature of a local government is that there are a significant number of services or products being provided using the same organizational support, administration, and overheads. This is a very similar situation to many multi-product manufacturers in the private sector and so the use of ABC is appropriate.

One of the important stages in government financial administration is the budgeting process. Funds allocated based on budgets and, thus, the approved budgets act as a measure of control. This is the motivation for looking at the resource allocation process because a good control at the budgetary level will help with effective management of costs.

The logic is that if we can more precisely define the inputs (resources) for an "Activity" it would

1 The name of the city is being kept confidential at the request of city officials. Officials cooperated fully in providing actual data for this study.

improve allocation of resources at the "Activity" level and finally an effective use of available scarce resources at the Fund level. This is where ABC may be helpful.[2]

Activity Based Costing has been extensively used in corporate organizations world over, especially in the last decade. Managers need accurate costs for strategic decisions, product design, manufacturing and marketing decisions. These decisions will be influenced by the anticipated cost and anticipated profitability of the product. (Cooper and Kaplan, 1988) Conversely, if product profitability drops, the question of its discontinuance will be raised. As per Kaplan (1993), several companies are using forecasts of product volume and mix process efficiencies to obtain estimated spending for the future activities and resources. Used in this way, the ABC model becomes a powerful tool for the budgeting process.

ABC, when used along with the methods of continuous improvement, to eliminate the non-value added activities, has been termed as Activity Based Management. The terms ABC and ABM are now used interchangeably. Datar and Gupta (1994) have performed a statistical analysis as to why ABC gives better results than traditional costing. A new term Departmental Activity Based Management (DABM) has also been introduced. DABM translates information of ABM into common language of department information.

In general, Cooper, et al (1992) found that ABC management benefits both strategic and operational decisions. Companies use the information to make major decisions on product lines, market segments, and customer relationships, as well as to stimulate the process improvements and activity management. The success and use of ABC in the corporate world is well proven. Procter & Gamble, John Degree, Farall Corporation, Kraft USA, Slade Manufacturing, Advanced Micro Devices, ARCO Alaska, William Brothers are just few examples of the successes of ABC.

However, use of ABC is not very popular in the Government Sector, and literature is almost scarce in the local government application. In case of US Government the Defense and Department of Transportation have been the main users of ABC. The US Department of Defense is using activity-based costing in its drive to re-engineer critical processes and peg the value of information systems investments. The benefit of ABC is that it provides a way of benchmarking existing processes and finding ways to improve them (LaPlante and Altar). Outside of the US, Hoban (1995) has documented the usefulness of ABC in the Victorian Local Government in Australia.

Anderson (1993) has discussed an application of ABC in the City of Indianapolis. ABC was a necessary first step in deciding on which services (core vs. ancillary activities) the city of Indianapolis wanted to or should provide to the citizens. In order to specify the type of service to be provided the city has to come up with the cost of providing the services. Anderson provides a detailed example of how the consultant came up with the cost of snow removal process over one mile for Department of Transport. Significantly different costs in five different geographical regions was an eye opener for the city officials. ABC management is now used on daily basis in DOT, Indianapolis, where it aids in making decisions based on the costs that are approximately right rather than approximately wrong.

We were not able to find any application of ABC to the budgeting process in a local government. An important feature of Activity Based Budgeting is the strengthening of the interface between

2 Definition of an "Activity": The term "Activity" has a specific connotation in the government budgeting process. The broadest level at which funds are allocated is the "Fund" (for example, Capital Investment Fund). The resources sanctioned for a Fund are then allocated to various Functions/Programs (like Capital Improvement Projects, which is one of many capital projects). The next level of allocation is the Department level (e.g., Parks & Recreation Department). Following the hierarchy are "Activity", Character, and Object, in that order. To continue the example, the money allocated for Parks & Recreation Department is proposed to be spent on upkeep and maintenance of various parks. One of the projects is the renovation of Spanish River Park. This particular stage is referred to as one Activity. In this paper, the discussions are limited to an Activity level. The term Character refers to the nature of cost incurred, whether it is capital, current, or debt service. Object is the line item representation of various expenditures in the budget.

planning and budgeting (Wilhelmi, 1995). Our paper discusses an application of ABC in the budgeting process for the Utilities Department in a local government.

The Utilities Department of the City, although serving the external constituents, are the sole providers of water and sewage services to the residents of the city of Paris. Their survival is independent of threat of any competition. The lack of competition itself may make the officials a little laid back and serve as a de-motivator to try anything new. We conducted a study using ABC. Results show that transaction cost for the processing of a bill is significant. Currently, the city is not in a position to identify the transaction cost of preparing and collecting a bill. Similar situations exist for other activities also, implying that cost of providing services to the residents may not be known. Thus, it isn't feasible for the city to communicate the actual cost of providing services to the residents of the city. A corollary to this is that even if the city wants to contract out these services to a private organization they cannot make an informed decision as to whether they would gain or lose from contracting out these services.

Availability of right cost information is of strategic importance, in terms of allocation of resources and the fees that should be charged to the customers. The right information is necessary for holding the elected representatives and appointed officials responsible for their actions. ABC is a relatively new tool and helps in making strategic decisions on product pricing and resource allocation.

Activities of the Utilities Department

The Utility Services Department provides water and sewer services to approximately 32,000 accounts, including residential, commercial, industrial, and educational. The water service area encompasses approximately 35 square miles and serves a population of 110,000. The Water Treatment Plant (WTP) is a state-of-the-art facility with computerized control and monitoring of the supply, production, and distribution facilities. The water system includes raw water supply, treatment, storage, transmission, and distribution facilities. The plant has a capacity of processing 70 million gallons per day. The capacity utilization is about 60% and the excess capacity is expected to exist in the foreseeable future. The WTP also has a 10 million gallons per day (MGD) ground storage tank.

The water is distributed to customers through 516 miles of water mains. The average consumer consumes about 300 gallon of water per day. This is much above the nations average consumption. About 50% of water is used through the sprinklers.

The city of Paris has also owned and operated the waste water system since 1957. Wastewater Treatment Plant (WWTP) has a treatment capacity of 20MGD. An integral part of the WWTP is a wastewater reuse system which is capable of treating 9MGD is effluent for irrigation purposes and in plant use. The waste water service area is essentially same as the water service area with the exception of a few small areas in the city that have water septic tanks.

Other major activities include, sampling of 100 points in the distribution system on a monthly basis for bacteriological count. The water meters readings are taken once in two months.

Current Budgeting Process

The Budgeting process for the city starts with all departments receiving the budget forms and capital in progress (CIP) forms in the month of February. Departments indicate the capital project requirements for next five years in the CIP forms and prepare operating budgets. In April, the CIP committee discusses the capital projects for initial approval. The budget is submitted to the city council in July after two or three more budget review meetings. Public hearing of the budget takes place in September. Approval of budget by the city council (the elected representative of the people of city of Paris) takes place in the second public meeting.

Budgetary Projections for each department are based upon the overall budget for the city. Before 1991 each department used to prepare the CIP budget and for operating expenses and revenues the previous year approved budget was taken as the basis. Each item of expense (from the approved budget of last year) was increased by 5% and that was taken as the outlook for the next year. This increase hardly had any relation to the actual spending.

In last few years there has been pressure on the city and every department to reduce their cost of operations while maintaining the quality. Each department head is given broad parameters to reduce their projections by a certain percentage. The CIP budget is prepared first and then each department head assesses the need for various operations and determine the amount to be allocated for various expense heads. This again does not have much relation to the actual output. Thus, the city will never come to know whether or not it is more cost efficient to provide the services on its own or to contract out the services to a city approved provider. Therefore, in a case when there is a shortage of resources for a department, they have to draw upon the reserve, which has to be approved by the city council. The problem with this approach is the difficulty in estimating the final cost of a service provided. It is impossible for the taxpayer to know whether or not the services are efficiently provided.

We hypothesize that ABC can be used to predict cost and help the budgeting process, we propose to test the following two hypotheses:

Hypothesis 1: Change in cost driver activity will not change the total department cost.

Hypothesis 2: There is no significant difference between predicted variance and actual variance.

Predicted variance is defined as the difference between the actual cost for the quarter and predicted (new) cost for the quarter based on the model. Budget variance is defined as the difference between the budgeted cost and the actual cost.

Determination of Cost of Service

The rate setting process for billing begins with estimating the cost of operating each utility. Utility cost consist of two types – operating costs, or the cost to operate, manage and maintain the system and capital costs to build, repair and replace the system. These two costs together forms the total cost for the system.

Once the cost of service is determined, these costs are then distributed for sewer rates, between residential and commercial/industrial classes. Commercial/industrial costs are then allocated to water usage by the customer class in thousand gallon increments - Residential sewer rates are based on number of bathrooms, a proxy for water generation. Water rates do not distinguish between user classes, but between three types of costs:

- Customer Costs is the cost of preparing, billing, and collecting each account.
- Commodity costs are the cost of operating and maintaining the system.
- Capacity cost relates to the potential demand on the system in terms of equivalent population.

These costs are recovered under three different charges from the consumers. The capacity cost is a one time fees. Other two charges appear on the water bills every other month. The problem is that although the cost of generating water (as per the city officials) is $0.68 per thousand gallon, the city charges only $0.35 per thousand gallon to the customer. Other costs are really hidden in customer cost and capacity cost to some extent. The entire cost of processing and supplying water should be recovered from the commodity charges. The other charges (customer and capacity) should be used to pay the interest on long term debts and future capital expansion. The capacity charge portion of the revenue is currently being used for paying interest charges. However the customer charge is used to meet the operating cost. In the long run, the city may find it difficult to maintain its viability if the charges to the customers are not increased. This would need justification to the city council, which would mean the city has to understand the cost of providing the service.

Similarly the charges for the sewer facilities is computed on the basis of number of bathrooms. In interviews with the city officials it was clear that this basis has no relation to the cost of WWTP. In order to justify any increase in the sewer rate, the city will have to come up with some justification. This is where the cost for providing services will need to be determined, at least approximately right.

Research Design and Methodology

Extensive interviews were done with two senior officials of the city. The officials were explained the concept of ABC and the objective of the study. ABC exercise was not conducted formally. The identification of cost driver is based upon the experience of the two city officials. Both officials are in the finance department. Cost drivers originally considered were - water processed (in thousand of gallons); number of sprinklers; number of bathrooms; equivalent population; rainfall in inches; number of bills or accounts; influent in million of gallons; and number of employees.

Following cost drivers were considered as potential cost drivers. Description of all variables along with the hypothesized sign is given below:

1. **Number of Bills processed:** Number of bills processed was considered as an important variable. The various tasks involved in processing the bills are: manual reading of meters, punching the readings , processing, printing of bills, mailing of bills, receipt of cheques, and collection of bills. These would primarily be customer costs.

   The billing is done every other month. In a given month therefore only half the customers are billed, thus it was considered appropriate to use one lag model. Also the costs are incurred in one month and the billing may be done only next month. Sign for this coefficient was expected to be positive that means that if the number of bills processed increases the total cost is expected to go up.

   Other potential variables that were considered but not used in the model are given in the following paragraphs. The decision was based on other statistical tests done with the data. There is a potential problem of multicollinearity. For example as the equivalent population goes up the water processes will also go up. To the extent there is an increase in equivalent population there is a strong possibility of number of bills going up. The description of cost drivers not used and their hypothesized coefficients is described in the following paragraphs.

2. **Water Processed (in thousand of gallons)** was selected as the cost driver as many costs would vary directly with the water processed. The cost of pumping water from the wells will depend upon how much water is drawn. The water pumped up from the wells is then processed. The processing of water is more or less a chemical process. The cost of water processed is likely to vary directly with the units of water processed. The coefficient for water processed was expected to be positive. This was not used in the equation as it failed to explain the variability in total cost.

3. **Number of Sprinklers:** The consumption of water for the city of Paris residents is nearly double the national average. On an average a resident of the city of Paris uses up about 315 gallons of water per day. Nearly fifty percent of this water is used through sprinklers, to keep Paris green. Thus intuitively it would make sense that number of sprinklers in the city should have a direct relation to the cost. The coefficient for this variable is expected to be positive. This variable was not used, as there was a problem of assigning weights to the commercial and residential sprinklers. A house may have five sprinklers whereas an institution/ organization might have thousands of them, but for a city, the number of sprinklers is based upon how many bills they make for each unit.

4. **Number of Bathrooms:** The sewer charges are based upon the number of bathrooms in a household. This is the only basis on which city charges to the customer, in absence of any other logical basis. The problem is that influents from a residential unit may not depend upon the number of bathrooms, but on the number of residents in that house. Thus although this basis is used by city, it does not qualify as the cost driver. Also, surprisingly the data for the number of bathrooms, on a monthly basis, is not readily available.

5. **Equivalent Population:** The consumption of water is directly related to the number of residents in the city. To determine the number of equivalent residents, the city takes into consideration the visitors to the city and students who are there for part of the year. A student from outside the city is presumed to be living only for three months out of the year. The visitors are presumed to live half a year. As the number of equivalent residents increases, the cost of supplying water will increase. Thus the coefficient for equivalent population is expected to be positive. The variable could not be used as the equivalent population data is not updated on a monthly basis by the city.

The monthly data from October 1994 to September 1997 was manually collected for all the applicable cost drivers from the monthly activity reports, budget documents, and operations annual report for the city. Data for last three years has been collected on a monthly basis. Various cost items used are - Operating cost for the WTP; Operating Cost for the WWTP; General and Administrative Cost, allocated two-third to the WTP and one-third to the WWTP. The total yearly General and Administrative Cost has been equally divided over 12 months. Similarly the yearly interest and depreciation has been divided equally over 12-month period. Total cost refers to all the components of costs taken together, including general administration, interest, and depreciation. Data for the month of December 1994 was not usable. Monthly data from July 1995 to September 1995 was held back for the prediction purposes.

The following regression model was used:

$$Y_t = ? \ + ?_1 X_t + ?2X_{t-1} + ?_t$$

Where Y_t = Natural Ln of total Cost for the month t

$Y = e^{?}$ and represents unit fixed cost

X = Natural Ln of number of bills processed in the month

t = month 1 to 32, starting from October 92 to June 95 except December 1994.

To verify the predictive capability of the model, last three months data July 95 to September 95) was held back. The above model will be used to predict the cost and a comparison between predicted and actual total cost will be made to test hypothesis 2.

Results

Number of bills processed seems to explain a significant amount of variability in the total costs. Coefficients $1 and $2 are positive and significant. This implies that the number of bills processed in the current month and in the last month explains the variability in the total costs. The fitted equation along with coefficients and t-values are given below:

$$\underset{(4..313)}{Y^{\wedge} = 8.953514} + \underset{(2.572)^{*}}{0.324752\, X_t} + \underset{(2.087)}{0.260851\, X_{t-1}}$$

The co-efficient for X_t is 0.324752 and is significant at 1%. It implies that if the number of bills processed increases by 1% the total cost will increase by 0.32%. In case the number of bills increases by 1% in one month and then by another 1% in the second month, the total cost will increase by 0.58% over the period. The value of $2 is 0.260851 and is significant at 5% level. The value of a is 8.953514 and is highly significant even at the 1-% level. The F value of the coefficient of X_t, 3.823, is significant at 5% level. In case the number of bills increase by 1% in one month and then by another 1% in the second month, the total cost will increase by 0.58% over the period. Based on the above results it is certain that the number of bills processed is an activity that consumes significant resources. As the consumption of resources in terms of manpower and computing resources goes up, the total cost increases. In other words number of bills processed is a good cost driver. We reject the null hypothesis that change in cost driver activity does not change the cost. Thus using ABC we can identify the appropriate cost driver and use it for the prediction purposes.

The last three months (July to September 1995) costs were predicted. The comparison of the predicted against actual shows encouraging results for two out of three months. The comparison of actual with predicted is shown in table 1 below.

Table 1: Predictions For the Month of July August & September 1995 Based on Lag Model

Month	Total Cost (Actual)	Predicted Cost (in $)	Residual Cost (in $)	Residual Cost (%)
July 95	$2,199,739	2,245,965	(46,226)	-2%
Aug 95	$2,201,653	2,294,778	(93,125)	-4%
Sep 95	$2,141,583	2,363,925	(222,342)	-10%
		Total	**($361,692)**	

Although at this stage, we are not in a position to make any conclusion about the second hypothesis, (because of the lack of availability of monthly budgeted data), however we can still draw some inferences about the predictive capability of the model. It is expected that the predicted variance will be less than the budgeted variance. The predicted cost for July to September 1995 were compared to the actual cost for those months. The model is showing a slight tendency to over-predict the total cost. The prediction error for the month of July was about 2% and for August it was 4%. The prediction error for the month of September was about 10%. The high error may be due to the fact that it is the last month of the financial year and there may be some artificial cuts in the expenditure to avoid extra allocation from reserves, which requires permission of the city council. Another logical reason is that farther you go in time the prediction error increases. However overall the model seems to predict the total cost close to the actual. It implies that if the forecasted number of bills is available on a monthly basis, the budgeted forecasts can also be made on the monthly basis. This forecast will need revision from time to time. Capital expenditures are taken into account, to the extent possible, through the depreciation figure. Presumably the future capital expenditure will have some relation to the number of customers to be served and the impact will be captured by the same equation.

To measure the impact of reduction in number of bills, the total costs were predicted for the three months. This recommendation should be implemented after further analysis, of potential avoidable costs due to decrease in number of bills processed.

Conclusion

By reducing the number of bills by 20% in each of the three months, total operating costs would be reduced by $845,749. The net savings when compared to the actual spending for the last three months were $484,000. Based on the above analysis, it is recommended that the water department should look at the possibility of billing once every four months for single family homes, and once every three month for the duplexes and condominiums. To offset the revenue collection loss, commercial clients or high value client may be billed every month.

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