Accounting Information for Product Costing – Case Study

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Abstract. *Cost management is a process that requires continuous improvement of managers' knowledge. There is economic theory of costs and revenues. However, in practice managers rely on accounting data in making business decisions. The main problem is that economists and accountants do not see the costs the same way.*

In this paper we explain the difference between the teachings of economic theory and its practical application in the accounting practices. We show how economic theory can be applied in practice and be a useful tool in the hands of managers. For the case study we use recent accounting data of a transport company.

Keywords: product costing, accounting, decision making

1 Introduction

Accounting is divided into financial and management accounting, where primary goal of financial accounting is producing information for investors and other interested external parties while the goal of management accounting is to produce information for internal purposes, supporting decision making and management control. Managers use information to find out: 1) how much some product or service would cost and 2) to control if something did cost too much. Between financial and managerial accounting there is a number differences, even though they often rely on the same underlying financial data [10]. Managerial accounting has a strong future orientation, in contrast to financial accounting which primarily summarizes past financial transactions. Financial accounting data should be objective, verifiable and prepared in accordance with a common set of ground rules. On the other hand, managerial accounting should be flexible enough to provide whatever data are relevant for particular decision. Managers set their own rules concerning the content and form of internal reports. Managerial accounting is not mandatory; a manager is completely free to do as much or as little as he wishes. Research that is carried out in this paper is related to the managerial accounting. The research in UK [5] showed that majority (84 %) of responding companies used the same rules and procedures for external and internal reporting purposes.

In this paper we start with the economic theory of cost and investigate how economic theory is related to an accountant's approach to product costing. The main research question is: how could accountants in the observed firm use mathematical procedures to come closer to economic cost function which enables improved decision making? In answering the research question we consider two methods: account analysis method and simple regression analysis method. The topic of estimating cost functions is widely elaborated in textbooks yet there is difficult to find case studies in the relevant journals. The probable reason is that firms are reluctant to give internal information about their costs. Our paper contributes to the literature since to the best of our knowledge there are no recent case studies available regarding this topic. The topic is especially interesting for countries like Croatia where management accounting practices in firms are less developed.

2 Economics vs. accounting

Terms like revenues, costs, income or profit used in accounting originate in economics. In an economist's world production function of a firm explains the functional relationship between the resources or factor inputs and quantity of output the firm produces using some production technology. Economists use production function and assumptions about factor and output market prices to get the answers about economic revenues, economic costs, economic income and profit and to come up with the decision how much to produce. It is not necessary to specify the cost function to arrive to the answer but framing the problem in terms of revenues and costs results in the well known condition for optimality of profit maximization problem: marginal revenues should be equal to marginal costs [4].

An economist and an accountant do not see the costs the same way. The economist's view of costs includes payments to all factors of production, which are usually simply divided into capital and labour. In

accounting, the payments to the owners for the capital invested are not considered as costs.

In a single period setting economic and accounting profit are the same in total. Since the firms are considered on a going concern basis the proper economic setting is a multi-period one. In such a setting the accrual accounting is being used since not all the transactions are related to cash inflows or outflows. In multi-period economic setting, which is just another version of multi-product setting, the only meaningful measure of product cost is marginal cost [4]. However, in the real world there is no available data assumed in the economic theory of cost and accountant cannot reproduce economic fundamentals. An accountant speaks about revenues, costs and income but uses particular procedures to come up with numbers and procedures that include consideration of rules that govern financial reporting. Therefore, an accountant cannot give precise answer to an economist's question: how much did the product cost? He gives an answer to the questions: "What was the cost of a product or service sold in some specific period and what were the period costs?"

The accountant does not know the cost function like the economist does, and uses aggregation, linear approximation and allocation to come up with product cost function [4]. Knowledge of cost function enables use of tools like break-even analysis and cost-volume-profit analysis which are very useful help for decision making. After a rather lengthy period of discord both the economist and the accountant became aware that only a scientifically founded compromise solutions would contribute towards a mutual progress. Certain concessions were made to that end by counterparties. The first point was the practical approximation on the linear functional dependency of the total costs movement in respect to the changes in the volume of activities, and the second compromise solution was that theoretically marginal costs, under certain conditions, may be substituted by the average variable costs. Both of these basic assumptions came to be regarded as the backbone of all the cost accounting management systems [9].

3 Product cost function based on accounting data

„For managers accounting information is the most important in decision making, but they should be combined with other relevant non-accounting information" [11].

One of the most important types of management accounting information is cost information. Kaplan [8] points that organizations use cost information for 4 main purposes: to make important product feature and product mix decisions, to develop competitive strategies, to guide their operations improvement activities and for evaluating performance.

For financial accounting purposes the costs are recorded on various cost accounts in the ledger in aggregate way. This cost accounts have to be classified into different cost classes or types. The division of cost classes is presented in figure 1. **Product costs** are the manufacturing costs that are considered to be a cost of a product. Product costs consist of direct and indirect product costs. **Period costs** are costs necessary to maintain business operations but are not a necessary or integral part of the manufacturing process.

Cost accountants have created categories called cost types as components of accounting control system to help them understand and communicate cost behaviours to management. Cost types often occur in pairs that reflect the wide range of organizational activities and cost behaviours. The most familiar of these pairs is fixed and variable cost.

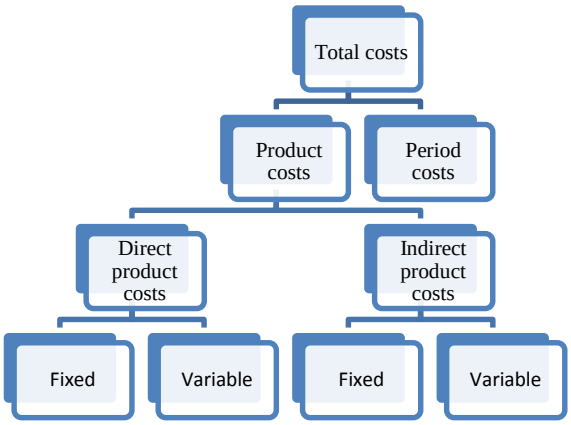

Figure 1. Cost classes

Direct product cost(s) usually include direct materials and direct labour, while indirect costs include items whose costs cannot be in an economically feasible way directly related to the product or service. Since costs are considered on a short-term basis, sorting into fixed and variable costs has to be done. The person analyzing cost accounts should be well acquainted with the firm's activities and have experience with the firm's costs [6]. Cugini et al. [3] on the case of rail transport company discuss the importance of accounting innovation in the cost measurement. A specific feature of rail transport companies are high fixed costs associated with the infrastructure.

To make decisions, managers have to know how costs behave, which is represented by cost functions. "When accountants deal with "cost behaviour", they actually attend to human spending behaviours as these are manifested in any given organizational environment; however, accountants sometimes really do believe that it is the costs that are behaving, or misbehaving, not the humans" [14]. Cost function can be defined as "a mathematical description of how a cost changes with changes in the level of activity relating to that cost" [7]. Estimating cost functions based on accounting cost data helps making more precise

predictions about future costs and therefore facilitates decision making. The method is called Account Analysis Method [7]. Accounting data serve as the basis for Regression Analysis Method where dependent variable is some cost variable. The independent variable(s) is (are) cost driver(s). As Roma'n [13] indicates in his case study of Continental Airlines, regression analysis is a useful tool for understanding cost behaviour and predicting future costs. In his paper Stout [15] emphasizes the importance of extensive coverage of material related to the cost-estimation process including regression analysis in accounting education.

"The application of mathematical and statistical methods in the analysis of costs is significant background in management decision making [12]. Radman-Funarić and Babler [12] in their paper perform the ordinary least squares method to determine the relationship between total costs and quantity produced.

Estimation of cost functions usually is based on two assumptions [1]:

- total costs of a cost-object vary because of variations in a single cost driver,
- cost behaviour is approximated by a linear cost function.

These assumptions will be applied on our case study. Since we look at the firm as a whole and the firm operates in road transportation of goods, the only cost object is service of transportation and the single cost driver we use are kilometres done on the firm level.

First, we will apply account analysis method and then regression analysis.

4 Case study

Account analysis method is done for the case of a medium size transport company from Croatia. The cost accounts summarize data by classes of costs. Total capacity of a firm is constrained by the number of vehicles. Costs accounts are divided into fixed and variable. Variable cost accounts are: fuel, toll and parking fees, daily allowances for drivers, freight costs, costs of phytopathologist and veterinarians, vehicles maintenance costs and costs of tyres. All of these costs are direct costs since they are directly related to the main business activity of the firm. Fixed cost accounts are: salaries of drivers, salaries of other personnel, amortization of vehicles, amortization of other fixed assets, insurance of vehicles, insurance of other assets, rent costs for vehicles, communication costs, office supplies and marketing costs. Salaries of other personnel, amortization of other fixed assets, insurance of other assets, office supplies and marketing costs are indirect period costs, all the other are product costs. Costs were recorded for a period of one year, month by month. In Table 1, variable, fixed and total costs of the transport company for the period from January to December are shown.

Table 1. Costs by months

Month	Q	VC	FC	TC
	kilometres	kn	kn	kn
January	277.525	1.071.738	1.047.169	2.118.906
February	299.296	1.187.699	1.104.946	2.292.645
March	333.374	1.303.370	1.150.294	2.453.665
April	363.329	1.372.002	1.213.245	2.585.248
May	390.542	1.488.558	1.139.279	2.627.838
June	380.647	1.570.289	1.124.453	2.694.742
July	378.789	1.595.673	1.110.492	2.706.165
August	350.796	1.545.412	1.105.125	2.650.537
September	420.537	1.851.441	1.169.704	3.021.145
October	384.885	1.724.697	1.166.406	2.891.103
November	427.927	2.009.276	1.207.587	3.216.864
December	383.539	1.733.979	1.538.944	3.272.923
Total	**4.391.186**	**18.454.134**	**14.077.645**	**32.531.779**

Total revenues in the base year were 30.314.804 kn so the firm realized operating loss in the amount of 2.216.975 kn.

The firm used the data presented in table 1 as a management report that should have served for management control purposes. However, such report cannot serve for planning or control purposes since it is based only on financial accounting convention for recording revenues or costs. The only divergence from pure financial accounting significance of this numbers is the separation into fixed and variable costs. In order to serve for management control purposes, these numbers should be, for example used to estimate cost function. Indirect period costs can be included in estimation (in 4.1), but further analysis can be done focusing only on product costs (in 4.2).

4.1. Estimating cost function I

The simplest, yet useful thing to do would be to calculate monthly cost function based on unit variable cost and monthly fixed cost taking into account all costs that were recorded. The unit variable cost is 4,2025 kn/km, and average fixed cost is 1.173.137 kn per month. Therefore, estimated monthly total cost function is:

$$TC = 1.173.137 + 4,2025 \cdot Q \quad (1)$$

If we assume that structure of costs will remain stable in the next period we can use break-even and cost-volume-profit analysis as a useful tool for planning purposes. Based on estimated data we can easily determine the break-even point. Break-even point (BE) shows the level of activity where revenues equal expenses, and can be calculated as follows:

$$BE = \frac{FC}{p - v} \quad (2)$$

where p is the unit price, and v is the unit variable cost. In our example price per kilometre in previous year was 6,9 kn, and BE quantity is 434.898 km. From Table 1, it can be seen that in the base year the company did not realize kilometers to break-even in a single months. If, when planning for new period, we assume that with

present business model the BE kilometers cannot be achieved, the major business restructuring is necessary. Operations that generate loss in the long run inevitably lead to bankruptcy.

Second analysis is cost-volume-profit analysis. It is necessary to consider whether the price is well set. If there is a possibility, the firm should raise the price per kilometre and see the impact on the break-even point. Before the decision to increase the prices it is important to conduct a market analysis to determine prices of competitors. If the price rises by 0,32 kn/km (about 5%) to 7,22 kn/km (assumed that the price increase will not significantly affect the demand), and the costs remain the same, then BE quantity lowers to 388.788 km per month. BE quantity decreased from the initial equilibrium quantity by approximately 10%. However, the table 1 shows that only in three months in previous period (May, September and November), kilometers which would achieve the break-even point were realized. Even with the price increase of 5% the company will not have profit on a yearly basis in the next period if the costs are not reduced.

4.2. Estimating cost function II

When estimating cost function, focus can be on product costs. All variable costs in our case are considered product costs. Since fixed costs in our case consist of product and indirect period costs, we subtracted period costs in calculations. Revised cost data are shown in Table 2.

Table 2. Costs by months – revised

Month	Q kilometres	Product fixed costs (kn)	Indirect (period) fixed costs	VC	Total product costs	Total costs
		kn	kn	kn	kn	kn
January	277.525	576.085	471.084	1.071.738	1.647.823	2.118.906
February	299.296	644.929	459.918	1.187.699	1.832.628	2.292.545
March	333.374	631.034	519.361	1.303.370	1.934.404	2.453.765
April	363.329	658.635	554.610	1.372.002	2.030.637	2.585.248
May	390.542	652.618	486.662	1.488.558	2.141.176	2.627.838
June	380.647	605.867	518.586	1.570.289	2.176.156	2.694.742
July	378.789	616.834	493.658	1.595.673	2.212.507	2.706.165
August	350.796	654.293	450.832	1.545.412	2.199.705	2.650.537
September	420.537	696.518	473.186	1.851.441	2.547.959	3.021.145
October	384.885	673.018	493.388	1.724.697	2.397.715	2.891.103
November	427.927	713.272	494.315	2.009.276	2.722.548	3.216.864
December	383.539	804.079	734.865	1.733.979	2.538.058	3.272.923
Total	**4.391.186**	**7.927.181**	**6.150.464**	**18.454.134**	**26.381.316**	**32.531.779**

The unit variable cost is again 4,2025 kn/km, and average fixed product cost is 660.598 kn per month. Therefore, estimated monthly total product cost function is:

$$TC = 660.598 + 4{,}2025 \cdot Q \qquad (3)$$

BE quantity now is 244.893 km per month. This was achieved in every month of base period. In average, 365.932 km per month were realized in base period. If we assume that in the next period we can count on that number of km on average, every km above 244.893 contributes to the coverage of indirect (period) fixed costs. With average price of 6,9 kn/km, maximal monthly amount of indirect fixed costs could be

$$IFC = (6{,}9\text{kn/km} - 4{,}2025\ \text{kn/km}) \cdot 121.039\ \text{km} \qquad (4)$$

which is 326.503 kn monthly. Comparing it with the base year where indirect fixed costs were 512.539 kn monthly, we can see that significant lowering of costs should be done on a monthly basis.

4.3. Possibilities for further analysis

We used revised cost data (table 2) and data from table 3 prepared on a monthly basis for regression analysis. Total product costs are the same in tables 2 and 3, but difference is in monthly total costs. In table 3 annual indirect costs were allocated to each month based on kilometers done in that month.

Table 3. Costs by months – IFC allocated based on km

Month	Q kilometres	Product fixed costs (kn)	Indirect (period) fixed costs	VC	Total product costs	Total costs
		kn	kn	kn	kn	kn
January	277.525	576.085	388.712	1.071.738	1.647.823	2.036.535
February	299.296	644.929	419.205	1.187.699	1.832.628	2.251.833
March	333.374	631.034	466.936	1.303.370	1.934.404	2.401.341
April	363.329	658.635	508.893	1.372.002	2.030.637	2.539.530
May	390.542	652.618	547.008	1.488.558	2.141.176	2.688.184
June	380.647	605.867	533.149	1.570.289	2.176.156	2.709.305
July	378.789	616.834	530.546	1.595.673	2.212.507	2.743.054
August	350.796	654.293	491.338	1.545.412	2.199.705	2.691.043
September	420.537	696.518	589.020	1.851.441	2.547.959	3.136.979
October	384.885	673.018	539.085	1.724.697	2.397.715	2.936.799
November	427.927	713.272	599.371	2.009.276	2.722.548	3.321.919
December	383.539	804.079	537.199	1.733.979	2.538.058	3.075.257
Total	**4.391.186**	**7.927.181**	**6.150.464**	**18.454.134**	**26.381.316**	**32.531.780**

In all regressions dependent variable was total costs (regressions 1 and 3) or total product costs (regression 2). The independent variable is the cost driver, where one or more cost drivers can be used based on what we distinguish simple and multiple regressions [2]. In our simple regression analysis independent variable was always quantity of kilometers. Results of regressions are presented in table 4 and statistics in table 5. Regressions line fit plots are shown in Figures 2, 3 and 4.

Table 4. Results of regressions

		Coefficients	*Standard Error*	*t Stat*	*P-value*
Regression 1	Intercept	234.724,81	436.891,88	0,54	0,60
	Q	6,77	1,19	5,71	0,00
Regression 2	Intercept	-157.306,78	330.765,42	-0,48	0,64
	Q	6,44	0,90	7,17	0,00
Regression 3	Intercept	-157.306,78	330.765,42	-0,48	0,64
	Q	7,84	0,90	8,73	0,00

Table 5. Regression statistics

Regression Statistics	*Regression 1*	*Regression 2*	*Regression 3*
Multiple R	0,874681714	0,91497913	0,940228541
R Square	0,7650681	0,837186808	0,88402971
Adjusted R Square	0,74157491	0,820905489	0,872432681
Standard Error	176019,6683	133262,3069	133262,3069
Observations	12	12	12

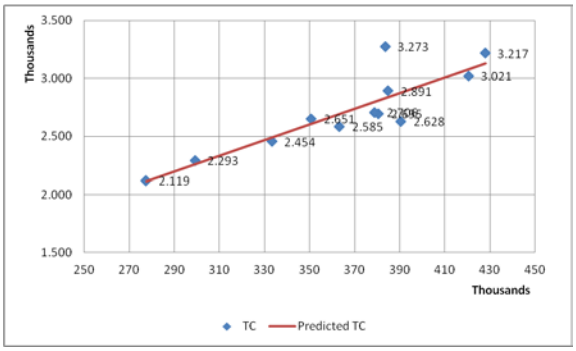

Figure 2. Regression 1 – Total costs include monthly indirect fixed costs

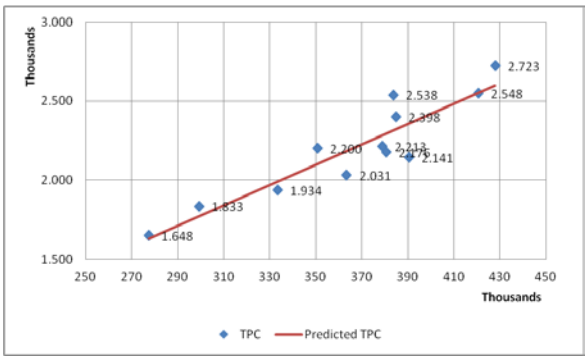

Figure 3. Regression 2 – Total product costs

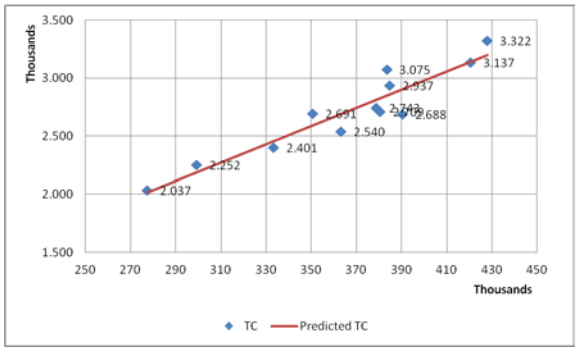

Figure 4. Regression 3 – Total costs include indirect fixed costs allocated using km as allocation base

R^2 is highest for regression 3, meaning that allocating indirect fixed cost based on km to each month proved useful. T-values for independent variable are higher than 2 in all the regression, with the highest value of t again for regression 3. P-values for independent variable are nearly 0 in all the regression. Significance-F values are lower than 0,05 in all regressions. All of these prove statistical reliability of regressions. The best fit is regression no. 3.

The total cost function defined as

$$-153.306{,}78 + 7{,}84 \cdot Q \qquad (5)$$

can be used for prediction of total costs in the future. Since this formula is the result of regression, the intercept should not be mistaken for fixed costs, like in linear cost functions estimated using account analysis method.

Our research was limited by the available data. Separate cost functions could be determined for different cost classes. Not every cost class is best determined by the only cost driver considered here, which were kilometres done. For example, the best cost driver for phytosanitary costs is the number of jobs that included need for such an expert. Cost system of a company could measure costs without significant investment more reliably– jobs could be differentiated into domestic, international, those that include special certificates or not etc. Of course the company did not charge the same price for every job, but more precise measuring of costs leads to better pricing decisions.

5 Conclusion

In this paper we show that there is a possibility to apply some parts of economic theory for management control purposes. We took a road transport company for our case study. Their cost accounting data are used to calculate cost functions that can be utilized for prediction of future costs and pricing decisions. We firstly applied linear approximation to come up with total cost function. Additionally we applied simple regression. Although limited by available data our case study shows how useful the application of economic theory in practice can be. With more detailed cost data the results can be significantly more valuable for internal decision making process.

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