

**ERROR RATE IMPACTS ON DECISION EFFICACY:  
ACTIVITY-BASED COSTING SYSTEMS IN SMALL BUSINESS**

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**ABSTRACT**

Activity-based costing (ABC) systems research has extensively studied and theorized the benefits of implementing ABC in comparison to traditional costing systems. ABC systems can improve firm profitability by the use of sophisticated cost drivers, improved cost pool measurement, and through the ability of capturing the cause/effect relationship of product costing and firm pricing decisions. However, the accounting literature often lacks empirical evidence through firm level data. This paper fills this gap by testing the customer profitability differences between complex and simple ABC system using two-years of disaggregated, product cost information in the small to medium sized distributors in the fine paper service industry. The outcome shows that increases in measurement error for activity cost drivers and cost pools using a simplistic ABC system appear to demonstrate robustness in decision usefulness for these firms. Therefore, evidence is provided that a complex system may not outweigh the time and cost required to implement a successful system in smaller firms.

*Keywords:* Activity-based costing, measurement error, decision efficacy

**INTRODUCTION**

**ABC Sophistication**

The tenets of activity-based costing (ABC) as a vehicle for attaching indirect costs to cost objects (such as products or customers) have been well-researched in the cost management literature as a premier method for producing accurate product costs in both the manufacturing and service industries (Babad & Balachandran, 1993; Englund & Gerdin, 2008; Maiga & Jacobs, 2008; Soin, Seal, & Cullen, 2002; Wegmann, 2009). ABC has now become one of the most prolifically researched and employed methodology of cost allocation over a traditional allocation method [see for instance Cooper (1988a; 1988b; 1989a; 1989b) for an example of this discussion].

Much of the prior literature in product costing has centered on the two issues of comparing ABC systems to traditional costing systems, and to comparing the efficacy of greater sophistication in the design and use of ABC systems. In comparing the effectiveness of ABC systems to traditional costing ones, Brierley (2008) broadly delineates these systems as being either sophisticated (ABC)

or unsophisticated (traditional). While the entire literature does not make this specific delineation, it is a widely accepted distinction (Al-Omiri & Drury, 2007; Bjørnenak, 1997; Brown, Booth, & Giacobbe, 2004; Joshi, 1998; Schoute, 2009). Later papers in this research stream have criticized this distinction as being either too narrow (Al-Omiri & Drury, 2007; Drury & Tayles, 2006) or being an incompatible comparison (Dugdale & Jones, 1997).

In comparing the efficacy of the greater sophistication afforded by the use of ABC systems, several pieces of research have considered alternative or escalating forms of sophistication (also sporadically referred to as *complexity*) in the design or use of those systems (Abernethy, Lillis, Brownell, & Carter, 2001; Al-Omiri & Drury, 2007; Brierley, 2008; Drury & Tayles, 2005).

The main objective of any costing system is to provide both relevant and timely information to managers (Babad & Balachandran, 1993), though it is dependent upon the accuracy of the resulting allocations (Labro & Vanhoucke, 2007). Several studies have indicated that even modest distortions of product costs can be linked to inaccurate decision making (Drury & Tayles, 1994). Errors in product costs have been found to result from time-driven estimates (Cardinaels & Labro, 2008), the level of heterogeneity (Gupta, 1993), and the interaction among these various errors (Labro & Vanhoucke, 2007).

The level of decision usefulness for users of ABC systems depends upon their ability to both understand and contextualize the output for actual cost based decisions (Briers, Chow, Hwang, & Luckett, 1999; Drake, Haka, & Ravenscroft, 1999; Gupta & King, 1997; Waller, Shapiro, & Sevcik, 1999). Several experiments have found mediating factors on decision usefulness such as prior cost accounting knowledge (Cardinaels, 2008), asymmetric information (Drake & Haka, 2008), and market feedback effects (Gupta & King, 1997).

The purpose of this paper is to link the analytical findings of cost system efficacy with the real world needs for decision useful information for managers using these systems. One gap in the literature is a lack of empirical studies based upon actual firm data. This study attempts to fill this gap by attempting to test the robustness of theoretical and experimental postulates using actual firm data. While the results suggest an advantage of using a simple ABC model over a traditional allocation, subsequent reductions in decision usefulness appear to be relatively small for large variation in measurement error. These results are relevant for designing optimal levels of costing sophistication for decision makers.

### **Small v. Large Business Models**

Successful implementation of ABC systems in small businesses can yield a wealth of benefits, both tactical and strategic. The use of ABC can help identify which products are being sold at a profit and which ones at a loss. This information is useful to management in developing marketing and pricing strategies. According to Baxendale (2001), products and services that produce high profits should be pushed more than those being produced at a lower profit or loss. Additionally, management can use the information on the unprofitable products to pursue longer-term goals of making those products profitable through continuous focused process improvements. It is important to note that unprofitable products should not just be eliminated, as this will shift the associated fixed costs to the other products (Emerson, 2016). It is better to either improve or

replace the product. Hall and McPeak suggest that the use of ABC “alleviates managers’ concerns regarding the accuracy of cost allocations, the cause-effect relationship between allocations and resources consumed, the timeliness of cost/profit information, and the capability to update systems” (2011, p. 12). With this information, management can make better decisions regarding finances, operations and strategy. This includes, but is not limited to, decisions about product mix, budgets, pricing, special orders, product development, outsourcing, marketing and process improvements. Ultimately, this will increase the company’s competitiveness in the market (Rundora, Ziemerink, & Oberholzer, 2013). Jänkälä and Silvola (2012) note a very important characteristic of the benefits received by ABC- their lagging effects. According to their study, “the effects of ABC may not be visible in financial performance immediately after adoption, and it may take even several years before any improvements in financial performance are achieved” (Jänkälä & Silvola, 2012, p. 517). The wealth of information that ABC provides is well worth the justification of the one-time cost of implementation (Bharara & Lee, 1996).

Although prior studies suggest that smaller businesses actually have an advantage in implementing ABC systems in that they are more flexible due to their small size and simple organizational structure ( Jänkälä & Silvola, 2012), when implementing ABC, it is important to realize that small businesses are not simply scaled down versions of larger companies, but that they are unique and require different methods of implementation (Needy, Nachtmann, Roztock, Warner, & Bidanda, 2003, p. 6). One important characteristic of many small businesses is a high proportion of fixed versus variable costs (Needy et al., 2003). “The high ratio of fixed to variable cost combined with variation in sales and cash flows restricts small manufacturers to limited financial freedom” (Needy et al., 2003, p. 7). Implementation of ABC systems allows small businesses to carefully consider the implications of the high proportion of fixed versus variable costs and to better align the performance drivers into the model in order to avoid the unintended consequences (Emerson, 2016). Another unique characteristic of many small businesses is their skewed customer distribution when a few primary customers generate a significant amount of sales (Needy et al., 2003). Accurate product costing through ABC will help prevent business owners from giving into customers trying to take advantage of this situation by demanding low prices.

An additional major difference in the implementation of ABC is the complexity of the system (Bharara & Lee, 1996). When designing a costing system, managers should avoid using “an inappropriate number of activities (usually too many) and unnecessarily complex systems” (Needy et al., 2003, p. 7). In addition, data availability and the need for updating should be taken into consideration (Woutersa & Stechera, 2017). Roztock, Porter, Thomas, and Needy agree that “standard implementation of ABC is too expensive and complex” for small businesses (2004, p. 19). They recommend using a flowchart to identify main activities and drivers. Needy et al. (2003) note that the simplicity of the system is not important just financially, but also for managers to easily understand ABC developments and results. It is better to start with a small number of activities and cost drivers and to later improve the system by either introducing more or splitting up existing activities, if necessary. As with any project or change in a company, management support and commitment is an essential aspect to the success of an implementation of an ABC system. Roztock et al. also note that successful implementation “requires organizational changes, employee acceptance, investment in software and hardware, (and) equipment for data collection” (2004, p. 26). Hall and McPeak list factors that influence the success of implementation as

“organizational readiness, financial impact, workflow productivity and overall business environment” (2011, p. 17).

Due to an increasingly globalized and competitive business environment, it is no longer suitable for small businesses to overlook the concept of activity-based costing. According to Jänkälä and Silvola, “the use of ABC is related to the managerial needs of the organizational life cycle stages rather than firm size only” (2012, p. 500). If the managerial and organizational needs require ABC, small business owners should make the long-term investment, providing a base for the company’s future development and an avenue for the generation of financial benefits over time through improved tactical and strategic decision-making. Bharara and Lee suggest that the “most important factor for competitiveness, profitability and success of a company, big and small, is the control over their processes” (1996, p. 1128). Implementation of an ABC system provides accurate product costing in order to attain this control. Empirical evidence also demonstrates that the management accounting system with activity based costing implementation results in a better performance, even for enterprises operating in an uncertain and dynamic environment (Elhamma, 2015).

## **RESEARCH METHODOLOGY**

### **Data Collection**

The researchers conducted a case study with a group of U.S. based volunteer distributors in the fine paper industry to determine the feasibility of upgrading their costing systems from a traditional allocation methodology towards activity based costing standards. The companies fall into the Standard Industrial Classification (SIC code) 5111 Printing and Writing Paper. The distributors averaged sales volumes of five to seven hundred million dollars annually, and on average warehoused approximately 2,500 separate inventory items.

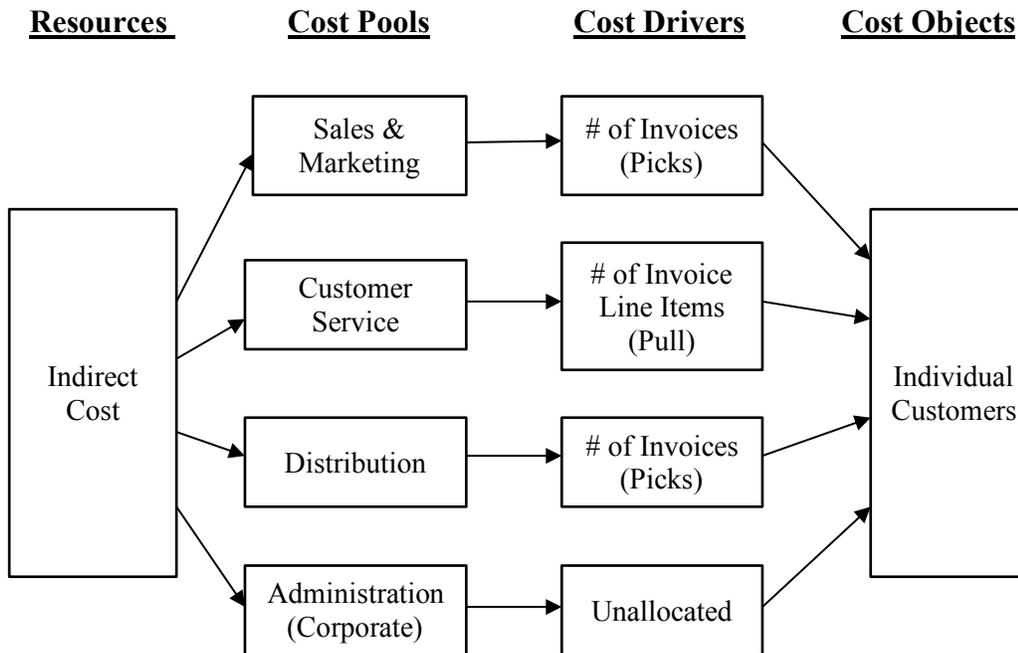
Product level cost data were collected on 100% of the sales volumes of the firms in an attempt to accurately assign costs on a customer level with the end goal to assess individual customer profitability. The data were collected across a two year period ending with fiscal year 2009 for each firm, and the cost-to-serve was attached to 100% of the distributor customers. With an average 14,000 customers each, the distributors’ customers drove, on average, sales of \$38,000 and generated allocated overhead of \$4,000. These figures have been rounded and blended across years and between volunteer distributors. They are presented for the purpose of contextualization only. Figure 1 illustrates the contribution income statement approach used to calculate an individual customer’s profitability when expenses are grouped into cost pools and then allocated to customers as cost objects.

Figure 1. Customer Profitability Computation

	Customer X	Customer Y	Customer Z	etc...	Total
Sales	xxx	xxx	xxx	xxx	xxx
Less: Commission	xxx	xxx	xxx	xxx	xxx
Net Sales	xxx	xxx	xxx	xxx	xxx
Less: COGS	xxx	xxx	xxx	xxx	xxx
Gross Margin	xxx	xxx	xxx	xxx	xxx
Less: Allocated Overhead	xxx	xxx	xxx	xxx	xxx
Sales & Market Costs	xxx	xxx	xxx	xxx	xxx
Customer Service Costs	xxx	xxx	xxx	xxx	xxx
Distribution Costs	xxx	xxx	xxx	xxx	xxx
Administration Costs	xxx	xxx	xxx	xxx	xxx
Net Income	xxx	xxx	xxx	xxx	xxx

Figure 2 illustrates graphically the typical ABC allocation approach used in this study. This indicates what cost pools were specified in the study, and what drivers were assigned in which to distribute those pools to the study’s cost objects (individual customers).

Figure 2. Activity-Based Costing Allocation Approach



Prior to this study, the subject firms used a traditional, firm-wide overhead allocation process when determining product profitability, and secondarily, customer profitability. One example of this methodology was to simply allocate overhead costs to a given customer based upon a percentage of sales attachment process. For example, if customer A generated xx% of sales, then xx% of corporate-wide overhead (including sales & marketing, customer service, distribution, and

administration) would be allocated to customer A. Table 1 provides descriptive statistics representing customer profitability, in dollars.

Table 1.  
Descriptive Statistics of Customer Profitability

Mean	\$ 1,370.20
Median	\$ (66.91)
Quartile 1	\$ (443.11)
Quartile 3	\$ 224.78
Standard Deviation	\$ 16,070.48
Observations	N = 13,563

As can be seen from Table 1, while the mean customer drives profitability of about \$1,370 each, there is a large standard deviation. The median customer generated a net loss to the companies. This reaffirms the literature indicating that 20% of customers drive 80% of profitability (i.e. the 80/20 rule of profitability).

As an outcome of the ABC study, three activity cost pools representing distribution, customer service, and marketing were constructed (a fourth pool called Administration was collected but could not be allocated on any rational cost driver other than percentage of sales). Each pool was assigned a cost driver based on the output of the initial case study using typical methods including interviews, researcher observation, and statistical analysis. Once overhead costs were allocated to products and added to direct costs, the profitability of customers was calculated using the following model:

*Customer Profitability*

$$\begin{aligned}
 &= \text{Sales} - \text{Commission} - \text{COGS} - \text{Allocated Distribution Costs} \\
 &\quad - \text{Allocated Customer Service Costs} - \text{Allocated Marketing Costs} \\
 &\quad - \text{Administrative Costs}
 \end{aligned}$$

Where sales is the total sales for an individual customer. COGS is the total cost of goods sold for an individual customer. “Distribution” is the distribution costs associated for the same customer. Distribution costs can include costs to ship product from the firm to the customer, costs associated directly from the manufacturer to the customer, and costs of the customer picking up the goods at the firm’s warehouse including picking, packing, and shipping. Customer service costs include all telephone, in person, or onsite customer interaction. Marketing costs are associated with the sales staff and all communication to complete the sale.

## **Initial Data Analysis**

As an initial exercise, the subject firms' customers were ranked ordinally by profitability as calculated utilizing the traditional overhead allocation based upon sales volume. Second, utilizing the aforementioned ABC customer profitability model, the firms' customers were again ranked ordinally using this more sophisticated calculation of customer profitability.

### ***Cost pool construction***

Cost pools were constructed entirely through the researchers' interviews with corporate process owners and their related expertise in the area of costs pools. Financial statement traditional expenses were constructed by process owners (corporate CFO's for instance), and through the interview process these income statement expenses were then stratified into four cost pools. For instance, "Distribution" costs were aggregated to include all costs of receiving, off-loading, warehousing, picking, packing, and shipping costs.

### ***Cost driver construction***

Cost drivers were similarly first identified through a cross-comparison of the literature and interviews with corporate management. As an example, *Customer Service* costs were determined to be most predictive through the measurement of inventory *line item pulls*. A simple weighting model was constructed assuming that, based on corporate experience, smaller customers require more service time and effort than larger customers per pull, given that larger customers have greater ordering sophistication, dedicated salespersons, and greater predictability in order patterns. Customers were quartiled based upon size (as measured by sales), and customer activities (line item pulls) were weighted with a simple 2, 1.5, 1.5, or 1. For example, a customer's activities in the lowest size quartile were weighted twice as burdensome as a customer categorized in the highest size quartile for the same activity level to reflect a more realistic view of the differential time-and-motion between the two types of customers for the same type of activity.

### ***Customer profitability estimation***

Customers' profitability was estimated twice. The first ranking was computed just as currently done by the subject firms in the traditional costing model using traditional financial statement expenses. The customers were then allocated costs of each cost pool as illustrated in figures 1 & 2, and were again ordinally ranked from highest to lowest.

To determine if there is a significant difference in customer profitability ranking between the traditional overhead allocation and the ABC customer profitability model, a Wilcoxon Signed Rank Test was used to compare between the two samples. With a sample of 13,563 observations we observe a student's *t* of 75.6711 (*p* value = <.0001) and signed rank of 3,489.5 (*p* value = <.0001). These results (untabulated) lend evidence that there is significant difference in the apparent profitability of the customers as measured by the differential rankings.

## Research Questions

In the tradition of Datar and Gupta (1994) this study sets out to determine the level of specification error in both cost pools and activity drivers that is necessary to affect the level of decision usefulness. For purposes of this exercise we assume that significant changes in customer profitability as measured by the Wilcoxon Signed Rank Test are indicative significant changes in decision usefulness. Two research questions are investigated in this study.

**RQ 1:** What level of activity cost pool specification error is required to affect the decision usefulness of customer profitability ranking?

**RQ 2:** What level of activity driver specification error is required to affect the decision usefulness of customer profitability ranking?

## RESULTS

### Activity Cost Pool Error

In designing the ABC to allocate overhead to customers, the three cost pools of distribution, customer service, and sales and marketing represented 77%, 6%, 17%, respectively of overhead that can be allocated using cost drivers. A sensitivity analysis was conducted to estimate the amount of specification error that could be introduced into the formation of the activity cost pools without affecting the decision usefulness of the customer profitability information. Error was introduced into the model at levels of 1%, 2%, 5%, 10%, and 20% of misallocation between pools. An example of introducing specification error into the pools involved the researchers randomly selecting one cost pool, (e.g. distribution), and reducing the cost pool's overhead dollar amount by 1% and increasing the other two pools (e.g. customer service and sales and marketing) by a corresponding dollar amount. After this error was introduced customers were again ranked on profitability and compared to the original ABC rankings. As shown in table 2, using a two-tailed test, there is no significant change in profitability rankings until the level of error approaches 10%, and does not actually become significant until exceeding that error level and approaching 20%.

Table 2  
Cost Pool Allocation Error  
Wilcoxon Signed Rank Test

	Sign	P-Value
1%	-38.5	0.1295
2%	-117	0.2108
5%	-231	0.5428
10%	-1,527.5	0.0892
20%	-6,860.5	0.0117*

\*Significant at the .05 level.

## Activity Driver Error

Utilizing the original cost pool allocations the activity driver weightings were then introduced with escalating levels of specification error. Rather than using percentage changes as conducted in the activity pool portion of the experiment we increased (decreased) the level of complexity of the drivers and their weighting. Specifically the three levels of complexity are:

- (1) Simple – a single minor change in the calculated activity weighting such as a shift from a variably weighted, time driven variable to an equally weighted variable which affects only one cost pool,
- (2) Moderate – two relatively minor changes in the calculated activated weightings, and
- (3) Complex – three or more changes in the calculated activated weightings sufficient to affect the allocation of all three cost pools.

As shown in Table 3, a simple specification error in activity driver weightings did not produce a considerable effect on the customer profitability rankings. However, in both the moderate and complex categories a significant effect was found in these rankings.

Table 3  
Cost Driver Allocation Error  
Wilcoxon Signed Rank Test

	<b>Sign</b>	<b>P-Value</b>
Simple	-4,978.5	0.5075
Moderate	1,758	0.008*
Complex	94,671	<.0001*

\*Significant at the .05 level.

This result implies that model misspecification error may be more sensitive to cost driver allocation errors than those introduced into the cost pools.

## Discussion and Analysis

The methodology employed was meant to take real small to mid-sized organizational data and determine the extent that ABC model misspecification error would cause changes in decision efficacy. Small organizations tend to avoid using ABC modelling due to their relative lack of financial sophistication and talent pool. The results of this paper lend evidence to two outcomes: (1) ABC analysis does appear to differentially and positively affect decision usefulness over traditional costing when using data from small to mid-sized organizations. (2) Even if a user in this size organization does misspecify either cost pools or cost activity drivers, the resulting decision usefulness of using ABC modeling still has a robustness that exceeds traditional costing until misspecification errors become egregious.

## CONCLUSION

This study addressed the two research questions to determine the extent of error that must be introduced into an ABC system in order to differentiate the effect of decision usefulness. As shown in Table 2, there is little evidence that errors imposed into cost pools differentially affect decision usefulness until those errors approach a ten percent deviation from the optimal cost model. Similarly, Table 3 illustrates that specification errors in cost drivers do not influence decision making until at least two or more cost pools are affected.

Interpretation of these results may be limited due to the number of firms tested in this study, as well as size, industry and nature of the firms. However, we believe these results mark a good first step at empirically validating theoretical and experimental research in this field. Future work in this area would benefit from extended firm and industry data.

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