Decision Sciences Institute

The Impact of Choice of Costing Method on Project/Product Profitability

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ABSTRACT

Since the 1970s, activity-based costing has enabled companies to identify the true costs of processes and products and to make sound decisions related to the profitability and expense of the products they produce, as well as the effectiveness of their manufacturing and business processes. This paper explores the relative advantages of activity-based costing vs. traditional costing systems. Issues related to the implementation of ABC are discussed. The authors explore a real-life implementation of ABC through analysis of the difference in costs resulting from the use of ABC vs. traditional costing for projects completed by a tower manufacturer.

KEYWORDS: Activity-based costing, traditional cost accounting, and accounting

INTRODUCTION

From the beginning of the industrial revolution until the second half of the 20th century, most manufacturers produced large amounts of a small number of products, with most cost stemming from direct costs such as materials and labor. Traditional cost accounting considered direct materials and direct labor in product cost and only estimated overhead costs, ignoring the increasing role of various types of overhead. As industrial capabilities evolved over the past 75 years, manufacturers were able to produce many types of products, in varying amounts, with each producing a different amount of overhead. Sophisticated machinery for producing customizable products to order and information systems added even more overhead. By the 1970s, information and communication technology made it possible to gather and process more accurate information about the activities that go into producing a product. In 1971, George Staubus' book, Activity Costing and Input-Output Accounting introduced the idea of activity-based costing, which identifies the activities required to produce a product and assigns cost to each product based on the cost of the activities required to produce it (Staubus,1971). The Consortium for Advanced Management –International further refined this new concept and formulated the principles of what is now called activity-based costing (ABC) (Miller, 1995). In the

1990s, Cooper & Kaplin's (1991) *Harvard Business Review* article called for increased use of activity-based cost accounting to identify the true costs of processes and products, so that companies can make sound decisions related to the profitability and expense of the products they produce. ABC has also been strongly advocated in important articles by Kaplan and Bruns (1987), Johnson & Kaplan (1987), Drucker (1999); Drury (2005), Johnson (1990), and Ness & Cucuzza (1995).

ABC was originally conceptualized as an effective costing method for manufacturers, but it has been used by numerous other industries, such as hospitals and related healthcare facilities (Kaplan & Porter, 2001; Gentili, 2014; Dwivedi & Chakraborty, 2015), by the US Postal Service (USPS; Carter, Sedaghat & Williams, 1998), the restaurant and hotel industry (Horgren, 1995; Raab & Mayer, 2007), the life insurance industry (Adams, 1996), universities (Krishnan, 2006; Cox, Downey & Smith, 1999), the accounting profession (Cagwin & Bouwman, 2002), the banking industry (Innes, Mitchell & Sinclair, 2000), the energy sector (Wang et al., 2010; Rof & Capusneanu, 2015), and the food production industry (Faraji, Maghari & Mirsepasi, 2015). Large companies like Chrysler (Ness & Cucuzza, 1995) and United Parcel Service (UPS) have also benefited from using ABC, particularly in the area of supply chain management (Binshan, Collins & Su, 2001). Mahal & Hossain (2015) provide a review of a number of articles about ABC.

This paper explores the relative advantages of activity-based costing vs. traditional costing systems. Issues related to the implementation of ABC are discussed. The authors explore a real-life implementation of ABC through analysis of the difference in costs resulting from the use of ABC vs. traditional costing for projects completed by a tower manufacturer.

LITERATURE REVIEW

Activity-based costing (ABC) assists companies in more accurately costing their products. While traditional costing systems rely on a simple measure for the allocation of overhead, activity-based costing relies on cost pools and cost drivers to assign cost in accordance with overhead usage. The most important component of activity-based costing is the cost driver used (Gilligan, 1990). Cost drivers are the factors that determine the number of activities that will be consumed by a given product. Examples of cost drivers include machine hours, size, complexity, type, and any other product attribute that can determine its cost. This method is utilized in the allocation of overhead expense in managerial accounting. Although researchers differ on the exact steps in ABC costing, it basically calls for the following procedures, which are also illustrated in Figure 1:

1. Determine the activities that go into producing each product and the cost drivers for measuring them.
2. Determine the costs associated with each activity.
3. Determine the percentage of time employees spend on these activities for each product—through interviews, observation, or logs.
4. Calculate activity cost driver rates.

5. Assign costs to products or customers by dividing these activity costs by the output of each activity.

Figure 1: Traditional Product Costing and Activity-Based Product Costing

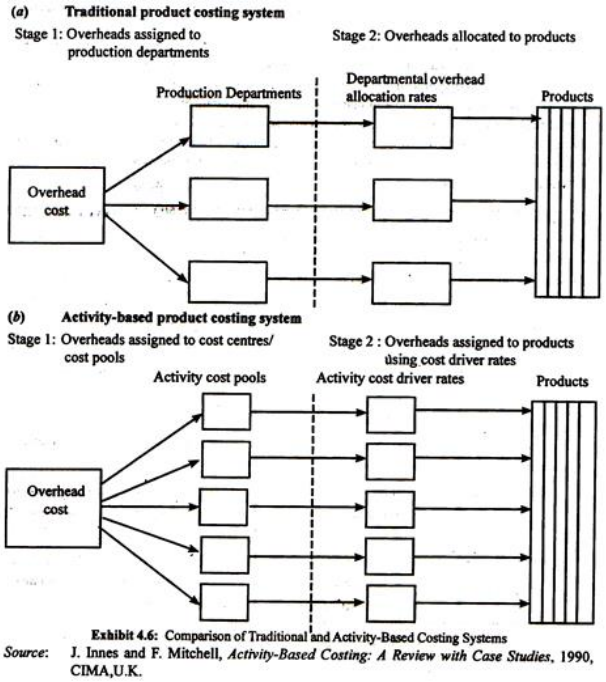


Exhibit 4.6: Comparison of Traditional and Activity-Based Costing Systems

Source: J. Innes and F. Mitchell, *Activity-Based Costing: A Review with Case Studies*, 1990, CIMA,U.K.

Why Use Cost Accounting?

The main purpose of cost accounting (as opposed to financial accounting) in management is to provide data for managers. Managers can use cost data to make decisions that will ultimately improve the company's financial performance. Many of these decisions have to do with which products to advertise for, which to expand, and which to discontinue. Other decisions attempt to improve operations, lower cost, or allow more competitive pricing. Because all of these decisions rely heavily on cost accounting data, having accurate data is essential for a company in order to identify their sources of profit as well as maximize their potential profitability (Hughes & Paulson Gjerde, 2003; Wiersema, 2007).

As product lines have become more complex and markets have become more segmented, companies have developed more products for smaller markets. Sales and profits for these markets are smaller than for the previously massed produced products. This change in the competitive environment has made the need for more accurate costing information even stronger (Stevenson, Barnes & Stevenson, 1996; Cagwin & Bouwman, 2002).

Overhead Allocation Accuracy

Activity-based costing does a better job of allocating overhead expense because it does not group costs that are spread out across many different activities (Arney & Sorice, 1994). Critics of traditional cost accounting systems argue that overhead expenses are being allocated incorrectly, leading to poor management decisions regarding product continuation and pricing. In situations where a competitive bid or cost-plus pricing is required, the actual cost of the product is essential for pricing of a product or service. Decisions based on inaccurate cost data

can have a direct impact on the profitability of the company in these situations (Hughes & Paulson Gjerde, 2003; Cooper & Kaplan, 1988).

When indirect cost is a large portion of the overall cost of the product, activity-based costing is superior to traditional costing in providing data for proper pricing decisions (Cheatham & Cheatham, 1996; Škoda, 2009). In past decades, direct labor has been approximately 25-50% of the total cost of a product, but since the 1960s, it has fallen dramatically. The dominant product cost is now indirect cost (Stevenson, Barnes & Stevenson, 1996).

Traditional costing systems tend to use a single rate multiplied by a single factor to determine the overhead allocation for a product, service, or project. This can lead to inaccurate costing, specifically when the incurrence of overhead cost is not proportional to that factor. In a situation where an employee sets up a machine and lets it run while doing other work, using direct labor as the factor for allocating overhead would lead to inaccurate costing. The machine hours, which are typically overhead intensive, are basically ignored, while other activities, assembly for example, are charged high amounts of overhead while using very few resources apart from direct labor. Using a single rate for allocating overhead based on one factor will misallocate overhead because the different operations within a single shop vary widely. Overhead-intensive projects in particular, tend to be underpriced (Wiersema, 2007).

Traditional cost systems have been criticized for over-costing simple products that are produced in large batches as well as products that rely on high usage of the allocation base, but lower usage of other significant factors such as machine hours (Hughes & Paulson Gjerde, 2003). Standard costing systems also tend to show the cost of special or custom products lower than they actually are (Gilligan, 1990). Inaccurate costing can create losses because difficult work will tend to be underpriced. The costing system may not account for special characteristics or special expertise. As these difficult, complex projects are under-bid, the company will win more and more unprofitable work. At the same time, simpler projects will be over-priced and subsequently, less of these more profitable projects will be sought and won by the company. This phenomenon can be concealed by inaccurate or insufficient costing systems, leading to erosion of profit margins and causing damage to the company's financial viability (Wiersema, 2007). When special/difficult projects are priced correctly, there are fewer orders for them, and more orders for standard products. Because special projects require much more support from office staff, a small reduction in the percentage of special orders versus the percentage of standard orders can have a significant impact on the staff resources required for the same level of order activity (Gilligan, 1990).

Representation of Idle Capacity in Total Cost

One issue facing companies is how to deal with idle capacity in product costing. Traditional costing systems tend to distribute the cost of idle capacity across products manufactured, essentially concealing its true cost and artificially inflating product cost. Activity-based costing systems do a better job of separating the cost of idle capacity from the true cost of the manufactured products. Including excess capacity in product cost raises the perceived cost of those products without adding value to them. This increase in costs can influence managers to want to raise the prices of these products to increase profitability. This price increase, in the absence of any product improvement or enhancement, can lower sales, causing an increase in idle capacity. As this new idle capacity is reallocated to even fewer products than before, upward pressure on pricing will continue, driving down sales further. This "death spiral" can be avoided by removing the cost of idle capacity from product costs. To avoid this entirely, some costing systems will only allocate overhead expense to products in proportion to the amount of utilized capacity—excluding idle capacity from product cost. Typical costing system users do not feel that their system sufficiently shows the cost of idle time, but users of activity-based

costing systems have indicated that they feel that their systems do a much better job of this when compared to traditional or variable cost systems (Hughes & Paulson Gjerde, 2003). When excluding idle capacity cost from product cost in internal cost accounting, the overall cost stays the same, but the product cost is more accurately represented. This provides a clearer picture of what is making money and what is costing money. Having the idle capacity as an expense directly impacting the bottom line also draws attention to its cost to the company. This could motivate managers to more actively pursue opportunities to utilize excess capacity in order to minimize this cost. When it is distributed among the manufactured products, it is much less obvious and consequently, must less urgent.

Product and Process Improvements through Costing

Aside from showing the cost of products, a cost accounting system can highlight or conceal possible process and product improvements. Traditional cost accounting systems do not provide a basis from which management can improve (Arney & Sorice, 1994). Costing systems that merely show the cost do not show where excess costs may have been incurred. Managers may either conclude that everything is fine, or they may want to make improvements, but feel that they lack the information necessary to make the needed improvements. Managers who feel that their cost systems accurately compute the product cost also feel that these same systems help them reduce costs, measure performance, and enhance revenue (Hughes & Paulson Gjerde, 2003).

Decisions to outsource can be highly influenced by this faulty thinking. Eventually, as more and more operations are outsourced, the margins become razor thin while the production facilities become idle, allocating even more overhead cost to the remaining manufactured products. Survival in this situation is very difficult for a company (Wiersema, 2007). Activity-based costing works the same way management thinks so that improvements can be made using the costing data produced (Arney & Sorice, 1994). The pioneers of ABC specifically designed it to create more accurate information regarding production processes, costs, and product support activities for the purpose of equipping managers to make improvements that will ultimately increase the profitability of the company. Decisions regarding product design, product mix, marketing, and product price all can be better analyzed through accurate product costing data. In other words, the whole point of activity-based costing is to provide management a way to drive continual improvement and ultimately enhance company profitability (Stevenson, Barnes & Stevenson, 1996). ABC can help identify important cost-and-profit enhancement opportunities through the repricing of unprofitable customer relationships, process improvements on the shop floor, lower-cost product designs, and rationalized product variety (Kaplan & Anderson, 2004).

Choosing a Costing System

Without overhead, product costing would be simple. Direct labor and direct materials can be traced directly to products. Overhead is much more difficult to assign correctly and can be a significant portion of product cost. Cost accounting systems (variable, traditional, or activity based) should not be viewed as good or bad, but rather should be chosen based on the appropriateness for the company and the data required (Hughes & Paulson Gjerde, 2003). Traditional costing systems are most appropriate when a company or a shop only makes a single product (Gilligan, 1990). Generally, using a mix of standard costing and ABC will help most companies. Some companies use standard cost systems to allocate direct labor and direct materials and activity-based costing to allocate overhead. Other companies use a standard cost system for financial accounting and activity-based costing for internal accounting. Combining the systems can allow companies to retain the advantages of both systems—

superior control for standard costing and superior overhead allocation for activity-based costing (Cheatham & Cheatham, 1996).

Numerous researchers have outlined internal factors a company should look at closely in determining if it would benefit from implementing ABC. The more of the following factors that exist in the company, the more beneficial it would be to implement ABC (Hicks, 1992; Swenson & Barney, 2001; Škoda, 2009):

1. Direct labor operations have been replaced with automated equipment since the costing system was lastly revised, but overhead is still applied to cost objects based on labor hours.
2. Indirect costs are becoming a much larger percentage of total costs.
3. Only one or a few overhead application rates are in use in the company.
4. The organization finds that one end of its product line is very competitive, while the other is not; but does not understand why.
5. Operations or machinery are used that do not require the same number of operators.
6. Many operations are set up, started, and then run with little or no human intervention.
7. Accounting personnel do not set a priority on determining how to provide relevant information for day-today decision making.

Some caveats remain regarding the implementation of ABC (Bhatti, 2012; Lombardo, 2015; Roztocki & Schultz, 2003). In some cases, high implementation costs result from bringing in experts, a significant amount of time can be involved in gathering relevant information throughout the company, and data flaws can occur while gathering information from various departments. Employees can sometimes resist detailed analysis of their activities (Ness & Cucuzza, 1995). Management must strongly support the decision to implement ABC. The design and implementation of ABC should be the responsibility of a cross-functional team of technicians, including staff from the accounting, finance, IT, marketing, production and engineering departments. Implementing ABC system requires a big budget initially. After implementation, the maintenance of the system is costly, since data concerning numerous activity measures must be collected, checked, and entered into the system on regular basis. ABC system generated data can be misinterpreted and must be used with care when applied in making decisions. Reports generated by ABC system do not conform to Generally Accepted Accounting Principles (GAAP); therefore, an organization using ABC should have two cost systems – ABC for internal use and a traditional system for preparing external reports. Another issue that researchers have found is that some smaller companies, in which expertise lies in only a couple of individuals and there are no formalized business practices, implementation of ABC can be significantly challenging (Cannavacciuolo et al., 2012; Bharara & Lee, 1996; Roztocki et al.,1999; Needy, Bibandi & Gulsen, 2000; Hicks, 1992,1999, 2002).

It is possible to use software like Excel to collect and analyze data for ABC, but companies can receive help in implementing ABC from a number of companies who offer consulting and software. (See Table 1.)

Table 1: ABC Solutions Consulting/Software Companies (Source:Bhatti, 2012; PSC Consulting)

Name of Company/Software	**Website**
Ignite Technologies	(http://www.ignitetech.com/
SAS ® Activity-Based Management	(www.sas.com
ABC Focus activity based costing software	http://www.cashfocus.com
Activity Based Costing For EXCEL	http://www.mrdashboard.com

Activity Based Costing – Workforce Software	http://www.workforcesoftware.com
SYSPRO Activity Based Costing	http://africa.syspro.com
Activity Based Costing/Management	http://www.business.com
ABC/M systems	http://www.algsoftware.com.au
CostPerform, UK	http://www.costperform.co.uk
ACTIVITY BASED COSTING ANALYSIS	http://www.xjtek.com
Enlighten Software	http://www.enlighten-software.com
Prodacapo ABM	http://www.prodacapo.com/abm
Oracle's Hyperion Profitability & Cost Mngt.	http://www.oracle.com/us/solutions/business-analytics/performance-management/profitability-cost-management/overview/index.html)
proDacapa's Performance Management suite	http://www.abmsystems.com/index.php/solutions-home/prodacapo/pdc-activity-based-costing)
SAP's Profitability & Cost Management	http://go.sap.com/product/financial-mgmt/profitability-cost-mgmt.html
3C Software's Impact:C	http://www.3csoftware.com/
CostPerform	https://www.costperform.com/

METHODOLOGY

The authors studied costing at a medium-sized company that designs, manufactures, installs, and services television and radio broadcast towers throughout the United States and in various parts of the world. The company has other products, but the focus of this paper is the tower division.

There are two basic types of towers—guyed and self-supporting. Guyed towers are typically narrow structures that are supported by a series of wires connected to various points on the tower. Self-supporting towers are towers that stand on their own without the aid of guy wires. Typically, self-supporters are heavier, more expensive towers, but do not require as much land. Guyed towers can be much taller than self-supporting towers, but require a larger piece of land. Both types of towers can be designed to broadcast AM radio, where the tower itself is essentially the antenna.

Both guyed and self-supporting towers can be either weld-together or bolt-together towers. The primary difference is the face size of the towers—the distance from one tower leg to the other.

The company's tower manufacturing operation is relatively simple. There are multiple welding stations, cutting stations, a burn table, an angle processing unit, a milling machine and a painting area. Other machines, such as a metal punch, drill presses, and a solid rod bender are present. Most of these machines/stations are labor intensive, requiring an employee to operate the equipment 100% of the time. The angle processing unit is the largest exception to this. The milling machine, the cutting stations, and the burn table also have a portion of operating time that does not require direct labor. A drafting department creates all the required drawings for the manufacturing of the towers.

Because of the highly custom nature of broadcast towers, the company only has a couple standard product lines that are manufactured and inventoried. The majority of the rest of the

inventory is raw materials or standard components for custom products. Most products manufactured are done on a per project basis.

The Current Costing System

The company's financial cost accounting system is based entirely on actuals. There is no separate costing system for managerial accounting. As employees work on projects, they scan into the job that they are working on, and scan out when they are done. All direct material is charged directly to the job when it is purchased or pulled from inventory. Aside from error introduced when employees do not scan into and out of projects promptly, there is little to be improved as far as recording the amount of time and materials charged to projects.
There are three main divisions within the company that absorb overhead. Each of these three departments has a certain portion of the overall overhead expense, and from these numbers, each division is given a single burden rate—typically around three (for every dollar of the allocation base approximately $3 of overhead expense is added to the cost). The allocation base for overhead for the entire company is direct labor.

Application of ABC to the Company's Project Costing

Because other divisions within the company use the structural division facilities, it is difficult to estimate the appropriate amount of overhead to be absorbed by these eighteen projects (see Table 3 for project descriptions). For comparison sake, the total amount of overhead absorbed among the projects was held constant across costing systems. The activity based model essentially reallocated the existing overhead more appropriately based on overhead requirements for the activities consumed as opposed to using labor hours.
The Cost Flow Diagram (CFD) for the model indicated that there are four key factors that drive the cost of a tower. These factors are the complexity or level of customization of the tower, the type of tower, the size of the tower, and the cross bracing pattern of the tower.
The complexity or level of customization of a tower can be measured in the number of drawings required for the tower. This is an indication of how much time engineering staff, management staff, and other individuals had to be involved with the project.
The size, type, and cross bracing of the tower can be measured using four factors. The size and type of tower can be measured using number of bolt-together tower sections and number of weld-together tower sections. The number of sections (each is typically 20 feet long) accounts for the height of the tower and the type of sections accounts for the different processes required in manufacturing each section. The cross bracing pattern determines how many welds will be required per section as well as how many angle diagonals will need to be manufactured for a bolt-together section. These can be measured using the number of solid round diagonals for weld-together tower sections and the number of angle diagonals for bolt-together sections.
After researching the operations and overhead cost flow of the company, the approximate cost of each cost driver was determined (See Table 2.) 'Drawing Cost' is the overhead required to produce one tower drawing. While some drawings take longer than others, most towers tend to have a very similar set of drawings, so an average per drawing cost will sufficiently represent the cost of a drawing. 'WT Section Cost' is the overhead expense required to process one weld-together tower section through welding, painting, and milling. 'SR Diagonal Cost' is the overhead cost to measure and cut one solid round diagonal for a weld-together tower section. These solid round diagonals are then welded to the weld-together section tower legs. Once the section is welded, it is processed as a single unit. 'BT Section Cost' is the overhead expense required to process one bolt-together tower section—including welding, painting, and fit-up. 'Angle Diagonal Cost' is the overhead expense required to process one steel angle diagonal.

These are cut to length, punched on each end and in the middle so they have bolt holes, then galvanized and painted.

Table 2: Cost Drivers	
Drawing Cost	$73.94
WT Section Cost	$833.13
SR Diagonal Cost	$5.82
BT Section Cost	$833.13
Angle Diagonal Cost	$6.65

Using these factors for costing, eighteen towers were reviewed. Table 3 shows the projects and their general characteristics.

Table 3: Project Descriptions				
Project	Height	Type	Face	Weight
1	445’	Guyed	42"	30,100
2	13’	Self-Supporting Bolt-Together	72"	6,500
3	60’	Guyed	15”	1,300
4	297’	Guyed	36"	10,200
5	346’	Guyed	42"	18,800
6	348’	Guyed	24"	11,900
7	391’	Guyed	24"	11,300
8	199’	AM Guyed	30"	5,800
9	75’	Guyed	48"	5,100
10	296’	AM Guyed	36"	13,600
11	496’	Guyed	36"	25,300
12	862’	Guyed	48"	72,000
13	496’	Guyed	42"	27,000
14	1293’	Guyed Bolt-Together	73"	218,400
15	50’	Self-Supporting Bolt-Together	24"	2,700
16	140’	Self-Supporting	48"	37,900
17	250’	Self-Supporting	Taper	40,000
18	76’	Self-Supporting	36"	4,600

The face size and weight of the towers were not used as cost drivers. This is because these two attributes are accounted for in the both the direct material charged to the job (weight) and in the section processing cost (face size). The difference in the number of welds and amount of time demanded for welding different face size towers is not significant. The only real difference is in the length of the diagonals, only changing the direct materials and leaving the required number of cuts and welds unchanged.

The quantities of activities for each project can be seen below in Table 4. Not all towers have bolt-together sections. Most towers are completely weld-together, but it was still necessary to include separate cost drivers for bolt-together towers because of the differences in the types of activities required in their production.

Table 4: Quantities of Activities for Each Project					
Project	Drawings	WT Sections	SR Diagonals	BT Sections	Angle Diagonals
1	42	23	1,491	0	0
2	23	0	90	2	14
3	36	11	429	0	0
4	40	16	1,013	0	0
5	38	19	1,237	0	0
6	64	21	1,731	0	0
7	52	21	1,845	0	0
8	33	10	670	0	0
9	33	5	283	0	0
10	51	16	1,244	0	0
11	46	26	1,744	0	0
12	68	45	2,906	0	0
13	66	26	1,744	0	0
14	192	5	9,270	45	2,016
15	26	10	330	0	0
16	165	7	189	0	0
17	167	5	270	8	306
18	23	4	404	0	0

Using the costs and quantities for each activity from tables 3 and 4, the overhead allocation can be calculated for each project.

Table 5 shows the amount of overhead that should be allocated for each project based on the quantities and costs of each project.

Table 5: Amount of Overhead for Each Project based on Quantities and Cost of Each						
Project	Drafting OH	WT Section OH	SR Diag. OH	BT Section OH	Ang. Diag. OH	Total OH
1	$3,105.41	$19,162.06	$8,673.80	$0.00	$0	$30,941.26
2	$1,700.58	$0.00	$523.66	$1,666.27	$93	$3,983.55
3	$2,661.78	$9,164.46	$2,496.10	$0.00	$0	$14,322.34
4	$2,957.53	$13,330.13	$5,891.15	$0.00	$0	$22,178.80
5	$2,809.65	$15,829.52	$7,194.47	$0.00	$0	$25,833.65
6	$4,732.05	$17,495.79	$10,071.68	$0.00	$0	$32,299.51
7	$3,844.79	$17,495.79	$10,734.98	$0.00	$0	$32,075.56
8	$2,439.96	$8,331.33	$3,898.34	$0.00	$0	$14,669.63
9	$2,439.96	$4,165.66	$1,646.61	$0.00	$0	$8,252.24
10	$3,770.85	$13,330.13	$7,238.11	$0.00	$0	$24,339.08
11	$3,401.16	$21,661.45	$10,147.32	$0.00	$0	$35,209.93
12	$5,027.80	$37,490.98	$16,908.32	$0.00	$0	$59,427.09
13	$4,879.92	$21,661.45	$10,147.32	$0.00	$0	$36,688.69
14	$14,196.14	$4,165.66	$53,936.72	$37,490.98	$13,399	$123,188.54
15	$1,922.39	$8,331.33	$1,920.08	$0.00	$0	$12,173.80

16	$12,199.81	$5,831.93	$1,099.68	$0.00	$0	$19,131.42
17	$12,347.69	$4,165.66	$1,570.97	$6,665.06	$2,034	$26,783.17
18	$1,700.58	$3,332.53	$2,350.64	$0.00	$0	$7,383.75

Table 6 shows the results of the activity-based costing compared to the current costing estimates.

Table 6: Results of the ABC Costing Compared to Current Costing Estimates

			Original Gross Profit		ABC Gross Profit		
Project	Original Overhead	ABC Overhead	$	%	$	%	Change in Gross Profit
1	$28,764	$30,941	$19,309	14.87%	$17,132	13.20%	-$2,177
2	$6,888	$3,984	$30,129	63.76%	$33,033	69.91%	$2,904
3	$8,476	$14,322	$1,116	6.56%	-$4,730	-27.79%	-$5,846
4	$18,254	$22,179	-$3,869	-8.54%	-$7,794	-17.20%	-$3,925
5	$23,342	$25,834	$5,524	8.48%	$3,032	4.65%	-$2,492
6	$28,107	$32,300	$8,285	10.08%	$4,092	4.98%	-$4,193
7	$18,218	$32,076	$3,617	6.86%	-$10,241	-19.41%	-$13,858
8	$9,094	$14,670	$11,379	23.51%	$5,803	11.99%	-$5,576
9	$8,573	$8,252	$5,593	20.13%	$5,914	21.29%	$321
10	$28,699	$24,339	$14,870	15.18%	$19,230	19.62%	$4,360
11	$29,582	$35,210	-$1,054	-0.86%	-$6,682	-5.47%	-$5,628
12	$64,994	$59,427	$16,143	6.43%	$21,710	8.64%	$5,567
13	$36,372	$36,689	$33,453	23.54%	$33,136	23.32%	-$317
14	$115,320	$123,189	$43,220	8.25%	$35,351	6.75%	-$7,869
15	$9,435	$12,174	-$1,151	-7.58%	-$3,890	-25.61%	-$2,739
16	$46,585	$19,131	$54,344	33.71%	$81,798	50.75%	$27,454
17	$38,556	$26,783	$10,304	9.35%	$22,077	20.02%	$11,773
18	$9,623	$7,384	$26,879	59.40%	$29,118	64.35%	$2,239

Because total sales prices and direct costs do not change regardless of which system is used, they are not shown in Table 6. The differences in overhead calculated as well as the differences in gross profit clearly show the disparity between traditional and activity-based costing systems. Figure 2 shows a visual representation of the original gross margin of the project and the final gross margin as percentages. Direct labor and direct materials were held constant for each project—only the overhead cost was recalculated. This chart shows the difference in perceived profitability of each project. The projects that changed from a positive gross margin to a negative gross margin (projects 3, 4, and 7) are of particular significance.

Figure 2: Original Gross Marin of the Project and Final Gross Margin as Percentages

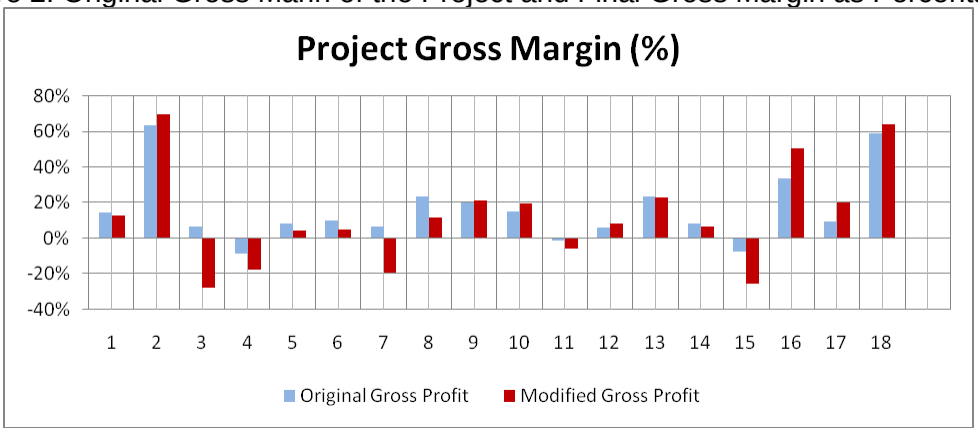
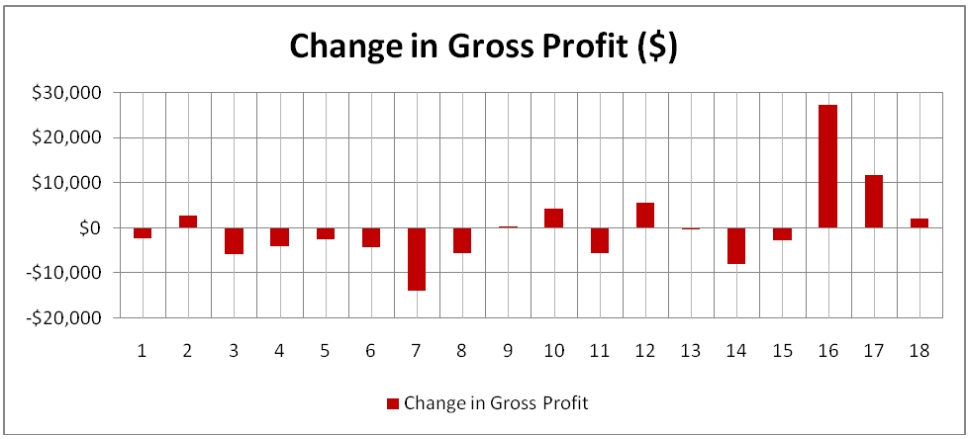


Figure 3 shows the change in gross margin (in dollars) between the two costing methods. The baseline used was the original gross margin, so a small amount indicates very little change between the two costing methods. A large amount, positive or negative, indicates a substantial difference in cost allocation.

Figure 3: Change in Gross Margin (in dollars) between the Two Costing Methods



DISCUSSION OF RESULTS AND CONCLUSIONS

As shown in Table 6, significant improvements can be made through the use of an activity-based costing model. Fortunately, much of the company's operations are relatively homogenous—welding, cutting, etc.—and require similar types of labor. This allows their traditional costing system to be relatively accurate on some projects. The large exceptions are the projects that require significant usage of the few machines that can run semi-autonomously, such as the angle processing machine.

The lack of detailed information may still be concealing some valuable data. The company should consider collecting higher quality data before attempting any costing system changes. This will give them a better picture of the current state of their manufacturing operation and identify possible starting points for future improvements in product cost. Collecting higher quality data and performing more data analysis can lay the foundation of a much more effective costing system. This can lead to process, product, and management improvements that ultimately enhance the profitability of the company.

It is very difficult to determine the present capacity of their manufacturing operation without any kind of standard costing figures to compare these numbers to. Currently, the company can only tell what they think a project cost the company, but not what it should have cost. There is no real way to tell if a project took more time than had been estimated or if someone forgot to scan out of the job and was charging hours to it in error.

Using this incomplete data to base important decisions on is problematic to say the least. The seemingly random nature of the results shown in figures 2 and 3 demonstrate that using a costing system based on actuals alone is not sufficient for optimizing operations. Comparing ABC—what the product should have cost based on the operations required to complete it—and the company's current costing—what was charged to a project regardless of the type of work or level of efficiency used in completing it—is not an "apples to apples" comparison.

Understanding the limitations to a costing system is extremely important when attempting to enhance the profitability of your company.

As demonstrated in the discussion section of this paper, accurate costing is critical in effectively managing a manufacturing operation. Furthermore, as shown in the analysis section of this paper, the differences in perceived profitability observed when using different costing systems are significant. Whether or not ABC is the best costing system for the company depends on the cost of implementation, its practicality, and the information obtained through future data collection. A standard costing system combined with a more sophisticated traditional overhead allocation system may be more practical for the company and will still yield accurate enough data where it is not significantly different from ABC. The key is for management to understand the advantages and the limitations of their costing system; basing critical decisions on faulty or incomplete information is more likely to undermine the company's current position than it is to improve it. Companies who adopt activity-based costing will find that it is not only past-focused. It can facilitate future planning by pointing out inefficiencies and waste that lower profits and impact a company's competitiveness (Roztocki, 2001; Škoda, Sláviková, & Lajčin, 2014; Jeyaraj, 2015).

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