# Status and Opportunities Associated with Product Costing Strategies in Wood Component Manufacturing

**Adrienn Andersch, Urs Buehlmann, Jan Wiedenbeck, and Steve Lawser**

**Abstract:** Product costing systems are critically important for businesses because they help reduce costs, price products at competitive prices, and enable strategic decisionmaking. This article reports the results of a survey designed to collect information about practices used by the North American hardwood dimension and components industry to calculate the cost of their products. Among other things, the study examined the type and reliability of cost accounting and product costing systems used by the industry, the purpose of the systems used currently versus an envisioned "perfect" system, problems associated with current systems, and ideas for costing system improvements. Results showed that two-thirds of respondents' companies are using traditional costing methods, whereas one-third are applying more modern costing practices, such as activity-based costing or lean accounting. The five main uses of cost accounting systems reported by respondents are 1) financial reporting, 2) tax reporting, 3) inventory valuation, 4) product costing, and 5) target costing. The most common problems associated with current product costing systems are missing links to management initiatives, lack of resources, lack of interfaces with enterprise software, failure to understand the three uses of costing systems (financial, operational, and strategic), and lack of costing data. FOR. SCI. 59(6):623–636.

**Keywords:** hardwood dimension and components industry, product costing, traditional costing, activity-based costing, lean accounting

ACCORDING TO THE WOOD COMPONENT MANUFACTURERS ASSOCIATION (Lawser 2010), the North American hardwood dimension and components industry generated a total value of shipments of roughly $4 billion in 2009. The industry, consisting of mostly small, family-owned businesses, faces intensive foreign competition, high customer expectations, and ever-changing market conditions (Kline et al. 1992, Buehlmann et al. 2007, Buehlmann and Schuler 2009, Floor Covering Weekly 2010). To survive and prosper, wood component producers have to accurately calculate product costs to submit winning (i.e., competitively priced) bids to potential customers while assuring profitability. However, empirical evidence exists that not all companies competing in the hardwood dimension and components industry use a reliable product costing system that consistently produces meaningful pricing decisions. Industry participants claim that bids from competitors with imperfect costing data often underprice more realistic bids, thereby capturing business at prices that are unprofitable and unsustainable over time.

Over the last few decades, cost accounting and its underlying discipline, product costing, had to adapt to remarkable changes in manufacturing and business practices, a process that is ongoing (Cheatham and Cheatham 1993). For example, new cost accounting techniques have been developed to cope with highly automated, computerized manufacturing systems (Myers 2010), to respond to changes in the competitive environment caused by altered customer preferences, and to accommodate transformations in the organizational structure of companies in which pull systems, balanced production, and flat and horizontal organizational structures were introduced (Burns and Vaivio 2001). Indeed, numerous researchers claim that traditional cost accounting practices, which are still widely used (Brierley et al. 2006), have limitations and do not account for the cost of, for example, product diversity or operational complexity present in today's organizations (Johnson and Kaplan 1987, Berliner and Brimson 1988, Kaplan 1988, Bromwich and Bhimani 1989, Johnson 1994, Cokins 1998, Burns and Vaivio 2001, Lukka and Shields 2001, Gupta and Baxendale 2008, Myers 2010). There is a consensus that existing limitations of traditional cost accounting systems used in the industry create product cost distortions, which not only lead to erroneous pricing decisions but can also lead to inappropriate financial, operational, and strategic decisions. To resolve these problems, an array of new approaches to cost accounting and product costing have been developed during the last few decades. Examples include activity-based costing (ABC), throughput accounting (TA), and lean accounting (LA) (Cokins and Hicks 2007, Gurowka and Lawson 2007). These new costing concepts were created to solve specific problems yet all put high emphasis on business processes and the adaption of relevant manufacturing characteristics (Boons 1998).

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This article investigates cost accounting and product costing practices applied by the American hardwood dimension and components industry. The second section provides an overview about today's cost accounting and product costing practices and compares them with costing practices currently applied by the industry, the third section presents the research goals, the fourth section describes the research methodology using a mail survey, the fifth section presents and discusses the survey results, and the final section draws conclusions and provides some suggestions for further research.

## Literature Review

The main goal of accounting is to provide information by "… Collecting, recording, summarizing, analyzing, and managing data…." (Hansen et al. 2009, p. 4) to help managers, investors, regulators, and government employees make decisions. Accordingly, accounting systems can be divided into three categories; managerial, financial, and tax accounting based on who uses the information and for what purpose (Green 1995, Williams et al. 2002, Alley and Simon 2005). Thus, the three types of accounting serve different purposes (Heitger et al. 1992, Green 1995, Alley and Simon 2005), but they all rely on the same "database" to record, measure, and report information about costs (Heitger et al. 1992). A schematic representation of the alignment of the three types of accounting is displayed in Figure 1. The central database is provided by the cost accounting system, which comprises information about costs of activities accomplished, such as, for example, products produced, services provided, or departments operated (Drury 2007). Because this article focuses on costing practices used by manufacturers of discrete products (e.g., wood dimension and components), specific aspects related to costing services will not be discussed further herein.

Internal reports prepared by management accountants use cost accounting systems to provide cost information to evaluate the efficiency of production and/or services as well as additional information for pricing and strategic decision-making by management (Fleischman and Tyson 1993, Hoque 2005). Furthermore, cost accounting systems provide data for external reports prepared by financial accountants to value inventories and to help determine the costs of goods sold (Hansen et al. 2009). In addition, the same cost accounting systems help companies to determine gains and losses on sales during the current tax year (i.e., tax accounting; Figure 1).

Accurate accounting ultimately allows an assessment of the profitability of an entity. Companies usually report costs based on product cost incurred, which traditionally comprises direct material cost, direct labor cost, and overhead cost. Because cost accounting primarily provides reliable data to measure the cost of products and helps in determining the selling price (Fleischman and Tyson 1993), accurate, up-to-date, and readily available cost information is critical to running businesses successfully (Cokins and Hicks 2007, Gupta and Baxendale 2008, Myers 2010). However, several authors contend that many of today's cost accounting systems are not able to provide reliable cost information for companies to manage their manufacturing processes (Johnson and Kaplan 1987, Berliner and Brimson 1988, Goldratt 1990, Cokins and Hicks 2007). Johnson and Kaplan (1987) are the most notable critics of traditional cost accounting, which is still by far the dominant system used in industry (Brierley et al. 2006). One of the main criticisms of traditional cost accounting is the failure of the system to reflect today's reduced importance of direct labor in manufacturing, leading to the misappropriation of overhead costs for individual products (Brierley et al. 2001, 2006).

Given the shortcomings of traditional cost accounting systems, several alternative cost accounting models, such as ABC (Cooper and Kaplan 1988), TA (Galloway and Waldron 1988), and LA (Maskell and Baggaley 2003) have been developed and implemented.

ABC (Cooper and Kaplan 1988) accumulates overhead costs for each organizational activity and allocates these costs to particular products based on consumption of resources during the activities required (Roztocki et al. 2004, Culler and Burd 2007). Successes of ABC systems have been reported (Cooper and Kaplan 1988, Turney 1990, Cooper and Kaplan 1991, Kaplan and Atkinson 1998, Kaplan and Anderson 2003, Brierley et al. 2006), but problems with the implementation of ABC processes can reduce or eliminate tangible benefits (Morrow and Connolly 1991, Johnson 1992, Player and Keys 1997, Sharman 2003).

Throughput accounting (TA), another new accounting

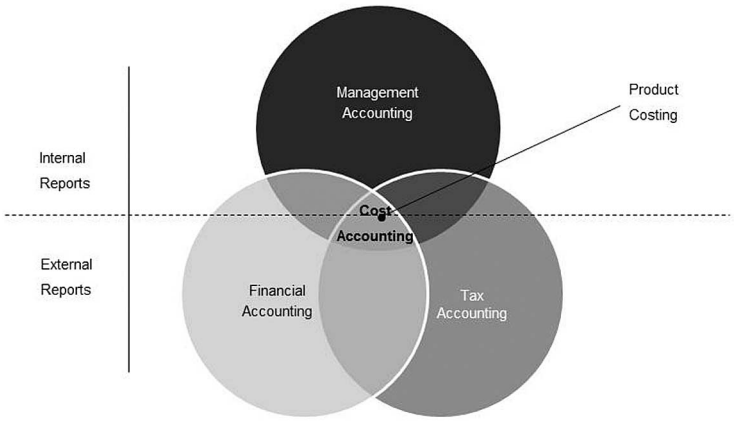


**Figure 1. Cost accounting as a central database.**

system developed to address shortcomings of traditional accounting systems, aims to increase profitability by measuring throughput, inventory, and operating expenses (Noreen et al. 1995). As opposed to traditional systems which focus on reducing costs in all accounts (material, labor, and overhead), TA aggressively attempts to diminish constraint(s) such as physical, policy, and behavioral constraints to make more money for the firm (Mabin and Balderstone 2003, Blackstone and Cox 2005). Actual examples of such physical, policy, and behavioral constraints include equipment bottlenecks, management rules and regulations, and attitudes, in which policy constraints play a more considerable role than physical ones (Sheu et al. 2001). Although the benefits of TA are well documented (Low 1992, MacArthur 1996), some authors (Bakke and Hellberg 1991, Holmen 1995) are questioning its applicability and effectiveness and suggest that TA should be used for short-term decisions and ABC for long-term decisions. TA is not addressed in the current study because there is a lack of an established set of techniques or accounting system that can be described as a self-standing throughput accounting system (Dugdale and Jones 1997).

Lean accounting (LA), the third accounting system introduced recently in response to shortcomings of traditional accounting, was developed to support lean improvements on financial statements and to support lean thinking in an organization. LA uses a single-cost collector, called a value stream (Van Der Merve and Thomson 2007). A value stream combines all activities involved in the manufacture of the product from the product's conception to the final sale to the consumer, including designing, manufacturing, purchasing, transportation, and money collection (Carnes and Hedin 2005, Van Der Merve and Thomson 2007). LA thereby provides quick and accurate cost information. Because LA is a fairly new field of accounting, no prior research studies that investigated experiences from implementing and using lean accounting systems were found.

The North American hardwood dimension and components industry, a traditional industry with a long history, relies mostly on cost accounting manuals specifically written for the industry for the creation and operation of their cost accounting activities (Kennedy and Noltemeyer 1965, Carroll 1985). These cost accounting manuals describe traditional product costing practices, namely job order costing, standard costing, and direct costing. Scant evidence about the adaptation of alternative cost accounting methods by the wood component and dimension industry exists. Although empirical observations confirm that selected progressive companies make use of such systems, the literature does not provide much evidence of the use of these alternative systems. However, limited information about the use of these modern cost accounting systems by related industries, such as, for example, timber harvesting and sawmilling exists. Rappold et al. (2009) and Korpunen et al. (2010) applied ABC to the sawmill industry. Rappold et al. (2009) used ABC in the sawmill industry by allocating raw material costs to lumber products to provide more precise information on how raw material costs are consumed by given lumber products. Findings by Korpunen et al. (2010) support the fact that ABC can be a useful tool in controlling costs at sawmills. In another project, Nurminen et al. (2009) applied ABC to the timber harvesting and trucking industry by using the cut-to-length method in which the logistic costs are assigned to timber assortments and lots. A study conducted in New Zealand by Adler et al. (2000) reported that respondents from the wood processing and paper industries ($N = 22$) are primarily using traditional cost accounting techniques.

## Research Goals

Whereas the benefits and drawbacks of current industry practices in cost accounting and product costing are well researched and documented in general, little or no information exists about studies that examined the type, accuracy, or effectiveness of product costing systems used by the North American hardwood dimension and components industry. Anecdotal observations indicate that the industry relies mainly on a costing manual created by the Wood Component Manufacturers Association (WCMA) dating from 1985 (Carroll 1985), with no updates since. In addition, knowledge about the status of industry product costing practices is limited, resting on observations from industry practitioners.

This research was conducted to address this lack of understanding by investigating the type and structure of product costing practices used by the North American hardwood dimension and components industry. A survey, mailed to a subset of the North American hardwood dimension and component industry, asked exploratory questions about the type, structure, and reliability of the costing systems used; the purpose of the current versus an imaginary "perfect" costing system; and problems with the current costing system. The survey also asked about ideas for improvements to the industry's costing systems.

## Materials and Methods

A mail survey, addressed to a subset of the North American hardwood dimension and components industry, asked questions pertinent to companies' product costing practices and systems.

### *Questionnaire Design*

The total design method as described by Dillman et al. (2008) was used to collect data for this research. The questionnaire consisted of a total of 34 questions, of which 9 questions related to company information, 15 questions related to the characteristics of product costing systems, and 10 questions addressed products and markets. Questions included closed-ended inquiries, both categorical (nominal and ordinal scale) and numerical (five-point Likert scale and ratio scale); partial open-ended inquiries, such as nominal scale multiple choice questions with "other" as an option; and open-ended inquiries with short answers. The questionnaire was reviewed initially by university and federal scientists with survey research expertise and subsequently sent to five randomly chosen WCMA members to test for overall quality, clarity, and understandability (Rea and Parker 1997). Once all five responses were obtained,

minor changes to the questionnaire were implemented. Results from the pretest were included in the final analysis of this study.

## Data Collection

An address list of all members of the WCMA containing 137 companies and a second list of contact data for 232 nonmember firms operating in the hardwood components production sector were obtained from WCMA (2010). In addition, the membership list of the Wood Product Manufacturers Association (2010) contained 114 companies; of these companies, 45 were already listed on one of the previous two databases and thus were removed, yielding a total of 69 additional companies from the Wood Product Manufacturers Association. Finally, addresses for 57 millwork companies were obtained from the 2009 Virginia Industry Directory (D&B 2009) and from manta.com, an online industry directory (Manta 2010). Thus, the survey address database contained a total of 495 addresses of North American hardwood dimension and components producers, 447 in the United States and 48 in Canada.

The final version of the mail survey, which was identical for all survey participants, was sent to all remaining 490 companies (excluding the five pretested respondents) on July 16, 2010. The survey was addressed to a senior company manager, preferably the CEO, the president, or the owner. Each potential respondent received a package containing a personalized cover letter, the questionnaire on colored paper with a tracking number, and prepaid return postage on the questionnaire's backside. Two weeks after the initial mailing, a follow-up postcard reminder was sent out to those potential respondents who had not replied yet. Four weeks after the initial mailing, a second, identical mail survey, was mailed to all nonrespondents. Two weeks later, another follow-up postcard reminder was sent out to nonrespondents (Rea and Parker 1997). Eight weeks after the initial mailing, on Sept. 10, 2010, the survey was closed.

## Response Rate

From the initial contact list, 7 companies refused to participate in the research and an additional 37 surveys could not be delivered because the businesses were closed or there was an address discrepancy. Thus, the adjusted survey population was 451. During the 8-week-long duration of the survey, 74 valid responses were received, for a response rate of 16%. However, because not all questions were answered by all respondents, the number of responses obtained for a given question varied.

## Data Analysis

Descriptive statistical analysis, including frequency counts, means, median scores, and SDs were mainly used to analyze the data. In addition, nonparametric statistical analyses were performed to test for differences among responses and to test for nonresponse bias ($\alpha = 0.05$). Kruskal-Wallis nonparametric tests were used to establish significant differences among responses based on company size (1–19 employees, 20–49 employees, 50–90 employees, and more than 100 employees) and main product category (sawmills and wood preservation, household/institutional furniture, veneer/plywood/engineered wood products, office furniture including fixtures, kitchen/bath cabinets and countertops, millwork, and other). Pearson $\chi^2$ tests were run to test for nonresponse bias based on five questions asked to both respondents and nonrespondents. In addition, all data were analyzed for potential outliers to avoid skewing the results. However, no such outliers were found.

## Nonresponse Bias

To test for nonresponse bias, selected answers from respondents were compared with answers from nonrespondents (Malhotra 1996). Thirty-one nonrespondents were contacted by phone and fax and were interviewed using five questions from the survey. These five questions included questions about the company's characteristics, e.g., the main product category, geographical location, and sales volume in 2009. In addition, more subjective questions about the costing system (Armstrong and Overton 1977), e.g., satisfaction rate for the information provided by the costing system and how often conflicts/problems arise from erroneous information provided by the costing system also were asked. Verbal responses to these questions were recorded and entered into the database. A Pearson $\chi^2$ test was run for each of these five questions. A significant difference was found in the main product category ($P = 0.025$) between respondents and nonrespondents. Significantly more ($z = 2.195$) nonrespondents than respondents belonged to the other category, and significantly fewer ($z = 2.101$) nonrespondents than respondents belonged to the millwork category. One explanation for the difference is that the North American Industry Classification System does not categorize the component industry as an individual industry segment; therefore, component manufacturers classify themselves either as millwork or other manufacturers. No significant differences were found for other company characteristics between respondents and nonrespondents in geographical location ($P = 0.906$) and sales volume in 2009 ($P = 0.214$). Furthermore, results for the question addressing the respondents' level of satisfaction with their current costing system with regard to the information it provided turned out to be nonsignificant ($P = 0.448$). However, a significant difference was found between respondents and nonrespondents for the question on how often conflicts/problems arise from erroneous information provided by the costing system ($P = 0.026$). Further analysis of this significant difference using a $z$ test of two proportions showed that significantly more ($z = 2.454$) nonrespondents than respondents reported that problems never arise from erroneous information provided by their costing system. Significantly fewer ($z = 2.070$) nonrespondents than respondents reported that problems occasionally arise from erroneous information provided by their costing system. No statistically significant differences ($z = 0.018$) were found between respondents and nonrespondents who reported that problems regularly arise from erroneous information provided by their costing system.

### *Company Characteristics*

Wood dimension and components manufacturing is not separated as an individual category under the North American Industry Classification System (US Census Bureau 2010a) but is folded into other industry subsegments. Survey participants classified their business activity as wood dimension and component manufacturing making products for 1) millwork manufacturing, 43% (North American Industry Classification System [NAICS] 32191); 2) kitchen, bath cabinet, or countertop manufacturing, 12% (NAICS 33711); 3) household and institutional furniture manufacturing, 11% (NAICS 33712); 4) sawmill and wood preservation manufacturing, 7% (NAICS 32111); 5) veneer manufacturing, 1% (NAICS 32121); 6) office furniture manufacturing, 1% (including fixtures, NAICS 33721); and 7) other, 24% (NAICS 32199). The other category included 12 component manufacturers, 3 wholesalers, and 3 art and design companies.

The majority of respondents (72%) run a manufacturing business, 23% are in trading or brokering, and 5% are involved in both activities. Most respondents' companies belonged to the micro and small company categories (European Commission 2003) based on their numbers of employees reported. Thirty respondents (41%) reported having fewer than 20 employees, 21 respondents (28%) employ between 20 and 49 individuals, 14 respondents (19%) employ between 50 and 99 individuals, and the remaining 9 respondents (12%) reported having more than 100 but less than 499 employees. These results are similar to the average company size in the US millwork industry in 2009 as reported by the US Bureau of Labor Statistics (2010).

Seventeen companies reported total annual wood products sales volume in 2009 to be between $5.1 and $10 million. For 2007, the US Census Bureau (2010b) reported an average sales volume of $5.9 million for the US millwork industry. Eighty-five percent of the respondents reported that their total annual wood products sales volume in 2009 was smaller than that in 2006, before the recession, 7% stated that their sales volume was the same in 2009 as in 2006, and only 8% reported increases in sales volume.

Most responses were received from the Midwest region (31%) followed by facilities located in the northeast (30%), the south (27%), and the west (5%). Seven percent (5) of the respondents have facilities outside of the United States.

### *Limitations of the Study*

Results from this mail survey have limitations that must be considered when reading, interpreting, and applying the results (Alreck and Settle 2003). Only one respondent from each company was contacted to answer the survey (although this person was probably a member of the senior management team), possibly creating single-response bias (Blair and Burton 1987). Furthermore, respondents may have different perspectives on and motives for a costing system either as users or preparers. Thus, findings reported may be biased based on these differences in perspectives. Because the vast majority (68%) of the respondents were owners or CEOs of the company, their involvement in and knowledge of current product costing practices may be limited. In these cases, the respondent could have obtained input from a company expert to answer the questions specific to the product costing system. In addition, because only a subset of the industry was contacted for this survey, results cannot be generalized beyond the targeted industry segments. Finally, results may have been affected by the severe recession affecting the industry during the period in which the survey was conducted, and the relatively low number of respondents (response rate of 16%) warrants caution in generalizing the results reported from this study.

## Results

First, an overview of the cost accounting and product costing systems currently used by North American hardwood dimension and components manufacturers and the purpose of these systems are given. Then, problems that arise from the use of these systems are discussed. Finally, characteristics of a "perfect" system are listed, and systems improvements are addressed. Nonparametric tests were conducted among responses by company size and main product category to detect significant differences ($\alpha = 0.05$).

### *Structure of Total Product Cost*

Figure 2 provides an overview of the average distribution of total product costs of responding companies active in the North American hardwood dimension and components industry. Survey results show that 41% of the product cost derives from direct material cost and 21% from direct labor cost. Manufacturing overhead cost (e.g., utilities, health insurance, and property tax, among others), represents 18% of the total average product cost. General and administrative expenses (e.g., travel expenses, executive salaries, and general support and associated taxes, among others) cover 14%, whereas sales expenses make up 6% of the total average product cost. The Kruskal-Wallis test did not indicate significant differences in the distribution of total product costs of responding companies by company size or by main product category. A majority (50%) of the respondents

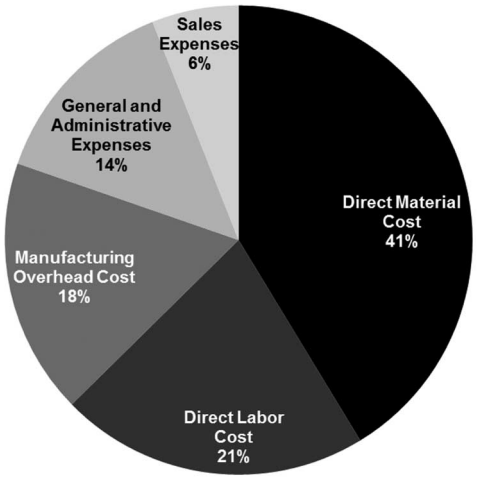


**Figure 2. Average distribution of total product costs of North American hardwood dimension and component manufacturers in 2010 ($N = 64$).**

reported that they calculated overhead cost on a monthly basis, 26% calculated overhead costs on an annual basis, 14% calculated overhead costs infrequently (mostly quarterly), and 10% calculated overhead costs weekly.

## *Purpose of the Costing System*

Survey participants were asked to categorize the purpose of their costing system. Results shown in Figure 3 illustrate that the vast majority of respondents gather financial information from their current costing system (average overall response rate in the financial information category [current] is 70%, 49 responses divided by 70 respondents; Figure 3). Respondents use this financial information to create financial reports (current system, 84%, 59/70; Figure 3), tax reports (67%, 47/70), inventory valuations (69%, 47/68), and to calculate the cost of their products (60%, 41/68).

A smaller proportion of responding firms indicated that they use their cost accounting system to gain operational information in support of their operational decisionmaking (average overall response rate in the operational information category [current] is 24%, 16 responses divided by 68 respondents; Figure 3). Respondents use this operational information to prepare performance indicators (current system, 33%, 23/69), define and measure value-added and nonvalue-added processes (22%, 15/68), improve processes (13%, 9/68), and measure quality (24%, 16/68).

Respondents indicated they use their current cost accounting system for strategic information with about the same frequency as they use it for operational information (average overall response rate in the strategic information category [current] is 28%, 19 responses divided by 68 respondents; Figure 3). Respondents use this strategic information to calculate target cost (current system, 46%, 31/68), justify investment decisions (21%, 14/68), calculate life-cycle cost (13%, 9/68), and decide on make or buy decisions (31%, 21/68).

Most respondents believe that a perfect costing system should meet, first and foremost, the financial information needs of the organization (average overall response rate in the financial information category [perfect] is 91%, 62 responses divided by 68 respondents; Figure 3), including product costing (perfect system, 97%, 65/67; Figure 3), inventory valuation purposes (96%, 64/67), financial purposes (90%, 62/69), and tax purposes (83%, 57/69).

The perfect system, according to the respondents to this question, should provide operational information more effectively than current systems do (average overall response rate in the operational information category [perfect] is 78%, 53 responses divided by 68 respondents; Figure 3). Respondents would also like to use this operational information to prepare performance indicators (perfect system, 82%, 56/68), define and measure value-added and nonvalue-added processes (78%, 52/67), measure quality (78%, 52/67), and improve processes (75%, 50/67).

Respondents also indicated that the perfect system should provide strategic information (average overall response rate in the strategic information category [perfect] is 72%, 48 responses divided by 67 respondents; Figure 3). Respondents would like to use this strategic information to calculate target cost ("perfect" system, 85%, 57/67), decide on make or buy decisions (75%, 50/67), justify investment decisions (69%, 46/67), and calculate life cycle cost (57%, 38/67). The Kruskal-Wallis test detected significant differences ($P = 0.042$) in responses for the perfect system for using target costing to gain strategic information among companies in different main product categories. Nonparametric comparisons for each pair were then conducted using the Wilcoxon method. Results show that significantly more ($P = 0.016$) household/institutional furniture manufacturers than millwork manufacturers reported that they would use target costing to gain strategic information in a perfect system. In addition, significantly more ($P = 0.004$, $P = 0.045$) office furniture (including fixtures) manufacturers than millwork or other manufacturers, respectively, reported

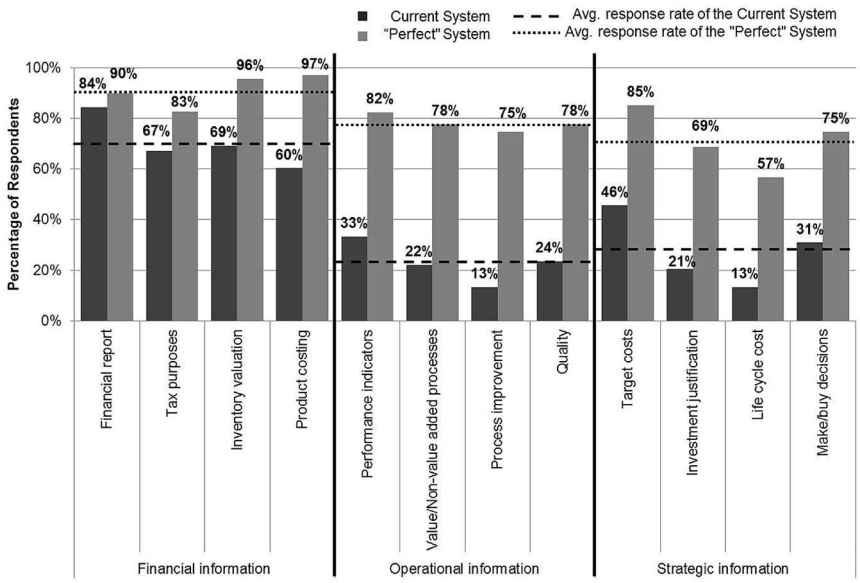


**Figure 3. Information provided by respondent company's current costing system and preferences for capabilities of the "perfect" costing system.**

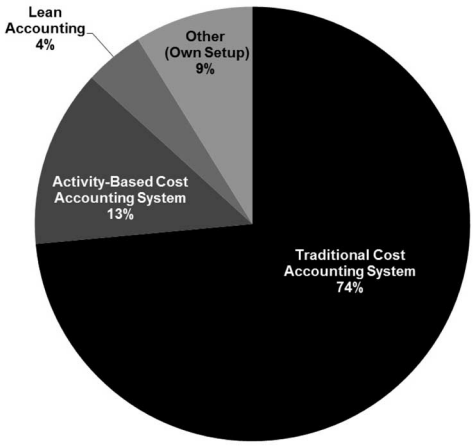


**Figure 4. Type of cost accounting system used by respondents ($N = 68$).**

that they would use target costing to gain strategic information in a perfect system.

## *Type of Costing Systems Used*

Survey participants were also asked what type of cost accounting system they are using (Figure 4). A total of 68 responses were received for this question. Seventy-four percent of respondents (50 responses divided by 68 respondents) reported using a traditional cost accounting system, 13% (9/50) an ABC system, and 4% (3/50) an LA system, whereas 9% (6/50) use their own, unspecified, setup. The Kruskal-Wallis test did not show any significant differences in the type of costing systems used by responding companies by company size or by main product category.

Related to their current costing system, survey participants were asked "Have you ever realized that high volume products carry too much of the overhead burden and become overpriced while the low volume products are underpriced?" (Figure 5A). Forty-six percent of the respondents (23/50) reported to have a traditional cost accounting system experienced the aforementioned problem, whereas 67% of the respondents (6/9) who claimed to have an ABC system identified the same problem. Thirty-three percent of the respondents (1/3) with an LA system reported the same issue, and 67% of the respondents (4/6) with their own setup indicated that high-volume products often carry a disproportionately high overhead burden.

Next, participants were asked "Do you think that your costing process (in general) is too expensive and/or too time-consuming?" (Figure 5B). Thirty-two percent of the traditional cost accounting users (16/50), 44% of the ABC users (4/9), and 50% of the respondents (3/6) using their own costing setup indicated that their costing process is too expensive and/or too time-consuming to maintain. Zero percent of the LA users (0/3) perceived this issue to be a problem.

The results for the last question of this section "Do you use visual performance measures (e.g., hourly production, days of inventory, operational equipment efficiency, etc.) on a performance board on the shop floor?" are shown in Figure 5C. Forty percent of traditional cost accounting users (20/50) apply performance measures on the shop floor; 44% of ABC users (4/9), 100% of the LA users (3/3), and 50% of the respondents (3/6) with their own system do so.

## *Reliability of the Costing System*

Respondents were asked to rate the quality of the information provided by their costing system. Results for this question are displayed in Figure 6. A total of 72 respondents answered this question. Eleven percent (8 responses divided by 72 respondents) claimed that their costing system provides "outstanding" information. Thirty-nine percent of the survey participants (28/72) rated the information provided by their costing system as being "good," 24% of respondents (17/72) rated it as "adequate," 24% (17/72) indicated the information provided by their costing system "needs improvements," and 3% (2/72) rated the information provided as "poor." The percentages listed above may not add up 100% because of rounding issues. No significant differences were found by the Kruskal-Wallis test by type of costing systems used by responding companies regarding company size or main product category.

Respondents were also asked whether they realized that problems arise from erroneous information provided by their costing systems. A total of 71 respondents answered this question. Six percent of the respondents (4 responses

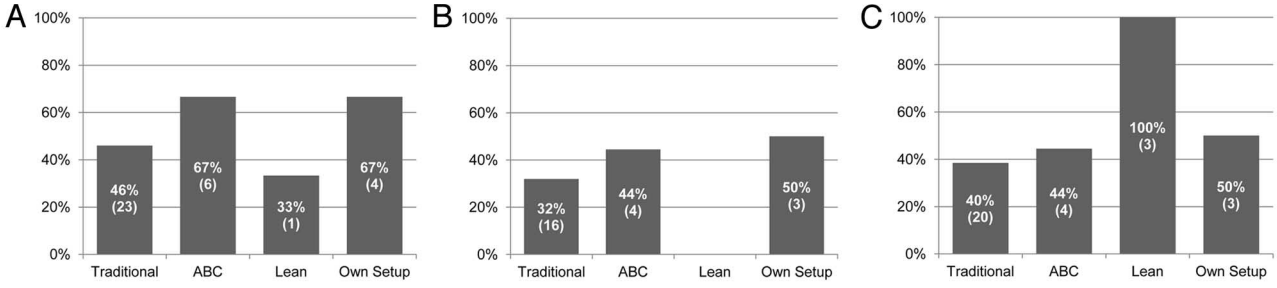


**Figure 5. Problems reported by users by type of costing system used. A. Percentage of respondents who realized that high-volume products carry too much of the overhead burden and become overpriced, whereas the low-volume products are underpriced, categorized by the type of their product costing system. B. Percentage of respondents who think that their costing process (in general) is too expensive and/or too time-consuming, categorized by the type of their product costing system. C. Percentage of respondents who use visual performance measures (e.g., hourly production, days of inventory, operational equipment efficiency, etc.) on a performance board on the shop floor, categorized by the type of their product costing system.**

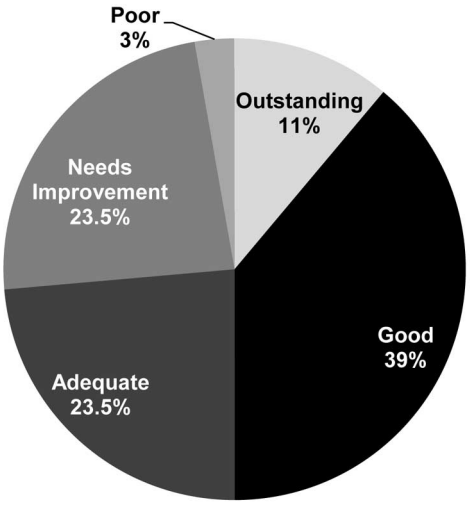


**Figure 6. Respondents' rating of the quality of the information provided by their costing system ($N = 72$).**

divided by 71 respondents) reported that this issue arises frequently, and 77% of the respondents (55/71) claimed that it happens occasionally, whereas 17% of the respondents (12/71) stated that they never experienced the problem.

Results show that even respondents who indicated high levels of satisfaction with their costing system (i.e., respondents who rated their costing system as outstanding and good), reported occasional problems stemming from erroneous information provided by their system. However, only respondents from the three rankings indicating the lowest level of satisfaction (i.e., adequate, needs improvement, and poor) stated that problems frequently arise from erroneous information provided by their costing systems. Three of the 17 respondents who reported that their costing system needs improvement also reported that they never have problems arising from erroneous information provided by their costing systems.

## *Challenges with the Costing System*

To gain a deeper understanding of the challenges that respondents face with their costing system, survey respondents were asked to provide more details about any problems associated with their costing system. Results are shown in Figure 7. The five highest-ranked problems were listed as "lack of resources" (average response 3.08 on a Likert scale from 1 [never occurs], 3 [seldom occurs], to 5 [always occurs]), "no link to other management initiatives" (3.07), "no interface to enterprise software" (2.78), "failure to understand the three (financial, operational, and strategic) uses of costing system" (2.77), and "lack of data" (2.76). Respondents also could indicate "other" options in the questionnaire to list problems that were not mentioned in the original table. Respondents listed the following additional problems they encounter with their systems: "human error typing data in," "product costing is not part of the accounting system," "regulations (local, federal)," "redundancy," and "managers do not use the data." Testing the results about problems associated with respondent's costing systems using the Kruskal-Wallis nonparametric test showed significant differences among responses provided based on company size in respect to "redundant data" ($P = 0.022$), "erroneous data" ($P = 0.032$), and "lack of data" ($P = 0.037$), and based on main product category in respect to "no interface to enterprise software" ($P = 0.041$). Nonparametric comparisons for each pair were then conducted using Wilcoxon tests. Results showed that significantly more companies in the size group of 50–99 employees tend to complain about redundant data than do companies with 1–19 employees ($P = 0.004$) or companies with 20–49 employees ($P = 0.035$). In addition, significantly more companies in the size group of 50–99 employees tend to complain about erroneous data than do companies with 1–19 employees ($P = 0.008$). Moreover, significantly more companies in the group of 50–99 employees complained about a lack of data than did companies with 20–49 employees ($P = 0.029$) or companies with more than 100 employees ($P = 0.015$). Furthermore, results also showed that significantly more sawmills and wood preservative manufacturers reported problems arising from no interface to enterprise software than did veneer/plywood/engineered wood products manufacturers ($P = 0.009$) or millwork manufacturers ($P = 0.013$).


**Figure 7. Problems of respondents' costing systems (error bar depicts ± 1 SD).**

### *Desired Improvements in the Costing System*

Survey participants were asked to provide their insights as to which objectives of a costing system are the most important. Participants also were asked to compare their desired objectives with objectives that their current costing system already possesses. Responses received for each question are illustrated in Figures 8 and 9, respectively.

The five highest-ranked objectives of a desired costing system were listed as "easy to operate" (average response 4.52 on a Likert scale from 1 [not important], 3 [moderately important], to 5 [very important]), "provide accurate cost information for management purposes" (4.44), "provide easily available, up-to-date information for cost estimates" (4.38), "easily accessible" (4.36), and "easily customizable" (4.30). An "other" option was also provided for respondents for which they were able to list what kind of objectives they believe would add the most value to a costing system. Respondents listed the following additional objectives: "build custom reports," "display historical unit cuts and trends," "handle multiusers," and "not time-consuming to maintain." Testing the results to determine the importance of certain objectives of respondents' costing systems for statistically significant differences using the Kruskal-Wallis nonparametric test resulted in significant differences in the objective of "be an individual system" ($P = 0.009$) in regard to company size. The Wilcoxon method used for nonparametric comparison for each pair showed that significantly more companies in the size groups of 1–19 employees ($P = 0.003$) and 50–99 employees ($P = 0.036$) rated the objective of be an individual system more important than companies with more than 100 employees.

Respondents were also asked to indicate which objectives they believe are being met by their existing costing software on a three-point Likert scale (1 [not met], 2 [partially met], and 3 [fully met]; Figure 9). Respondents ranked the five highest objectives that their current costing systems they believe are being met as "easily accessible" (average response 2.44), "inexpensive to buy" (2.35), "maintenance cost is low" (2.31), "be an individual system," (2.29), and "easy to operate" (2.27). No significant differences were found regarding the objectives respondents believe are being met by their existing costing software between companies of different sizes or companies belonging to different main product categories.

## Discussion

Traditional cost accounting systems were developed at the beginning of the 20th century when mass production had revolutionized human society's productive capacities, labor costs were cheap and stable for long periods, and labor efficiency and machine-utilization rates were the focus of managements' attention (Plossl 1990, Carnes and Hedin 2005). During this time, technological development was slow, and major design changes were unusual, which allowed for long product cycles and setup times (Plossl 1990). Direct labor from mainly low-skilled workers comprised a large percentage of the total product costs; overhead costs were relatively small and closely related to direct labor. Thus, distortions arising from inappropriate overhead allocations were not substantial. Today, companies produce a wide range of customized products, labor cost represents a smaller part of total costs, and overhead costs play a more considerable role.

### *Structure of the Total Product Cost*

This research's survey results reflect the decreasing importance of labor costs, which now make up only 21% of total costs on average of all respondents (Figure 2). The WCMA's cost of doing business survey (WCMA 2009) shows slightly different results than were reported by respondents to this survey: 60% direct material cost (versus 41% here), 12% direct labor cost (versus 21% here), 14% manufacturing overhead cost (versus 18%), 9% general and administrative expenses (versus 14%), and 5% sales expenses (versus 6% from this survey). The 19% difference in direct material cost and the 9% difference in direct labor cost between these two studies were found not to be significant ($z$ test of two proportions: $z = 1.205$ and $z = 0.582$).

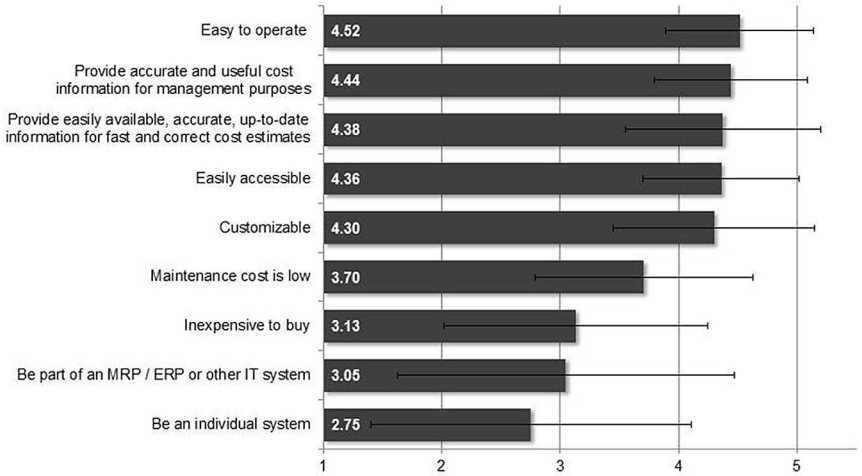


**Figure 8. Objectives of costing software important to respondents (error bar depicts ± 1 SD).**

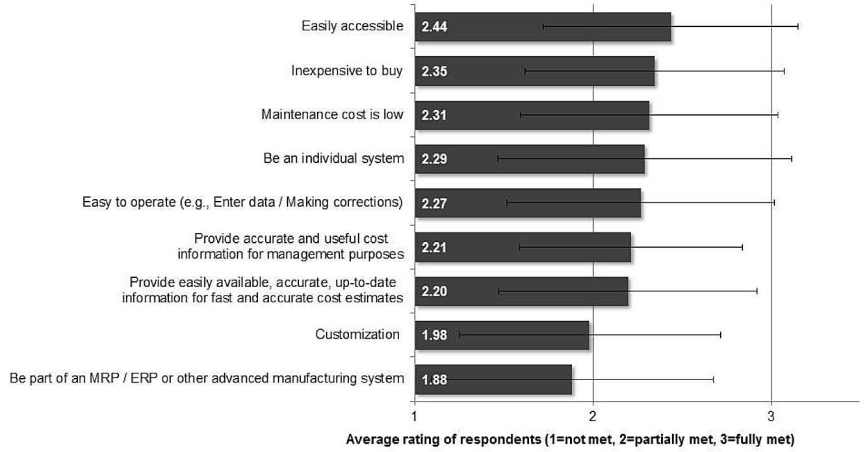


**Figure 9. Objectives of costing software respondents believe are being met by their existing costing software (error bar depicts ± 1 SD).**

Whereas these differences cannot be unambiguously explained with the information available, such differences can arise when cost data from a wide variety of companies are collected. Different products carry different cost allocations. For example, companies producing low-value-added products typically have higher direct material costs and less labor costs as a percentage of total costs than companies producing higher value-added products. As an example, a company producing custom-made, high-end solid hardwood furniture doors incurs higher labor costs as part of its total cost than a company that produces solid hardwood blanks for use in the manufacture of upholstered furniture. Therefore, the difference in the distribution of costs can be explained by the activities in which respondents of the two studies engage.

## *Purpose of the Costing System*

The purpose of cost accounting systems is to provide financial, operational, and strategic information for decisionmakers (Player and Keys 1997). Satisfying all three purposes is difficult for a single system because different levels of aggregation, reporting frequency, and measures are required. For instance, for financial reporting requirements, it may not be necessary to accurately measure resources consumed by individual products, but for strategic decisionmaking, accurate product costs are necessary to distinguish between profitable and unprofitable products and activities. Survey results show that respondents are using their cost accounting system primarily to gain financial information instead of gaining information for management or strategic decision purposes. This finding is somewhat surprising because basic financial data can be obtained from very basic systems. A way to address the need for more operational information from an accounting system is the use of LA (Maskell and Baggaley 2003, Crandall and Main 2007). LA uses information generated from the shop floor on a frequent basis, e.g., by the day, and, often, by the hour. LA performs costing, variable reporting, overhead allocation, and budgeting at the value-stream level (Maskell and Baggaley 2003), providing accurate, real-time operational information. If LA is aligned with lean practices, waste from all financial and nonfinancial transactions can be removed by applying visual tools, lean training, and employee empowerment. Companies using LA also are likely to use target costing methods (Maskell and Baggaley 2003), primarily for product development rather than for accounting reasons (Dekker and Smidt 2003). The use of target costing allows companies to create products that meet market demands while also achieving profitability and competitiveness (Horngren et al. 2000). Interestingly, our study resulted in respondents from the household, institutional, and office furniture categories emphasizing the importance of target costing for a "perfect" costing system more frequently than did millwork or other manufacturers. However, whereas target costing as part of a perfect costing system is widely seen as necessary, only a limited number of respondents are currently using this practice.

Indeed, numerous cost accounting systems can serve all three purposes (financial, operational, and strategic). However, no-cost accounting systems can serve all three purposes equally well because partially conflicting requirements of different users (e.g., financial controllers, line managers, and strategic planners), purposes (e.g., financial accounting, activity analysis for process improvement, and make or buy analysis), levels of aggregation (e.g., company-wide data, detailed data, and plant or product line aggregation data), reporting frequency (e.g., periodic, immediate, and ad hoc), and types of measures (e.g., financial, physical, or both; Player and Keys 1997) exist. Because each choice involves trade-offs, businesses need to clearly understand how they will use the information from their cost accounting system to be able to lay out their system to serve their most critical purposes best.

## *Type of the Costing Systems*

A majority of respondents (74%) reported using a traditional cost accounting system rather than its newer substitutes, such as, for example, ABC (13%), LA (4%), or TA or their own setup (9%). Given that most US accountants and managers have been educated to use traditional volume-based cost accounting systems that use either machine hours or direct labor hours as an allocation base, it is likely that

these proprietary systems (i.e., "own setup") are built according to traditional cost accounting philosophy. The high rate of use of traditional cost accounting practices (74%) may also be a function of the size of responding companies. Because most responding companies are small (88% of respondents report having less than 100 employees), they are unlikely to invest in sophisticated or in unfamiliar costing systems.

A frequent critique of traditional cost accounting systems is that these systems do not accurately allocate all costs to individual products because high-volume products carry too much of the overhead burden and become overpriced, whereas low-volume products are underpriced (Johnson and Kaplan 1987). For instance, product A produced in small volume requires activities such as engineering, testing, and several machine setups, whereas product B produced in large volume requires little attention and no additional activities such as engineering, testing, and several machine setups. If the company uses traditional overhead cost allocation based on machine hours, only a small amount of overhead cost is allocated to product A because it did not have many machine hours (even if it required lots of engineering, testing, and setup activities), whereas a large amount of overhead cost is allocated to product B because of all the machine hours needed to produce the large quantities of product B (even if it required little overhead activity). This results in a miscalculation of each product's cost. Survey participants were asked to provide feedback on whether they faced this particular problem with their costing system. Only 23 of 50 respondents (46%) who reported having a traditional cost accounting system indicated having this cost allocation problem. This number is relatively low, given that experts consistently claim that this misallocation problem is the central weakness of traditional cost accounting systems (Johnson and Kaplan 1987, Berliner and Brimson 1988, Goldratt 1990, Cokins and Hicks 2007). However, defenders of traditional cost accounting systems maintain that traditional cost accounting methods may not significantly distort information provided for decision-makers because many volume-related measures of output (e.g., direct labor and machines) are highly correlated with manufacturing overhead (Drury and Tayles 1994). We also speculate that, because 4 of 6 companies who reportedly use their own setup (67%) reported the same problem, these companies' proprietary cost accounting systems are based on traditional cost accounting principles. However, 6 of the 9 respondents (67%) who indicated having an ABC system also described the cost allocation problem. Because ABC systems were specifically designed to eliminate this problem, suspicions that respondents may not have implemented or are not using their ABC system properly exist.

The severest critique of ABC systems, as discussed in the literature, is that the costing process (in general) is too expensive and/or too time-consuming (Roztocki et al. 2004). However, our study showed that 16 of the 50 traditional cost accounting users (32%) responding to our survey also addressed this issue, which is surprising because traditional costing systems are considered to be the simplest and easiest to maintain. Only 4 of 9 ABC users (44%) reported the same problem. No one from the LA users indicated that their system is expensive or time-consuming, whereas 3 of 6 respondents (50%) with their own setup mentioned this problem.

Survey participants were asked whether they use visual performance measures (e.g., hourly production, days of inventory, or operational equipment efficiency) on a performance board on the shop floor, which is one of the traits of a lean company (Parry and Turner 2006). However, our survey found that visual performance measures are widely used by companies with a variety of cost accounting systems and are not restricted to lean companies.

### *Reliability of the Costing System*

A survey conducted by Howell et al. in 1987 about management accounting in the changing manufacturing environment indicated that 54% of respondents were unsatisfied with their product costing system (Drury and Tayles 1994). Today, 23 years later, a wide range of cost accounting systems and product costing practices are available for industry participants, and improvements to existing systems have been made, but 27% of survey respondents are still unsatisfied with their product costing system (Figure 6). However, 23% of respondents reported that they obtain adequate information from their costing system. Another noteworthy observation is that all respondents who rated the information obtained from their product costing system as "outstanding" (11%, Figure 6) had a traditional system. These results suggest that traditional cost accounting systems can be useful and adequate if they are properly designed, whereas newer systems, such as ABC or LA systems, can provide misleading and unreliable data if they are not correctly implemented and/or used.

### *Challenges with the Costing System*

Problems with costing systems used can be classified into three categories: management-related problems, people-related problems, and costing systems-related problems. The most often cited problem was "lack of resources" (Figure 7). Most cost accounting systems require significant investments for software packages, outside expertise, and employee training, as well as considerable efforts to maintain the system's data. Thus, the balance between resources invested in cost accounting systems and the quality and extent of the information provided by the system is always challenging.

The second most common problem mentioned by respondents was "no link to management initiatives." This problem can be categorized as a costing system-related problem (Figure 7). It is expected that this problem is at least partially attributable to companies' costing systems having been created to provide information not exactly targeted to what the management needs.

The third most common problem listed by the respondents was "no interface to enterprise software" (Figure 7). In particular, sawmill and wood preservation manufacturers cited the problem of no interface to enterprise software significantly more frequently than companies in other main product categories. Today, cost accounting systems are doomed to fall short of their optimal utility if implemented

in isolation. Linkage to other enterprise software and management initiatives, such as, for example, enterprise resource planning (ERP) systems provides valuable cost information with the largest positive impact. Such links are essential because cost information provided by the cost accounting system can encourage or discourage actions related to other enterprise software and management initiatives.

Although "redundant data," "erroneous data," and "lack of data" were not the most commonly cited problems in regard to respondents' product costing system, findings show that companies with 50–99 employees experience these problems more often than either smaller or larger companies. Reasons for redundant data, erroneous data, and lack of data are often found in disjoint networks and/or when databases are insufficiently integrated. Although this research has not produced any evidence for the reasons behind this observation, one could speculate that smaller companies are less reliant on enterprise software than larger ones and they, thus, are not affected by such problems. Larger enterprises, conversely, although being more reliant on enterprise software, also have the financial resources and the manpower to assure functioning software. It is, thus, the medium-sized enterprises with 50–99 employees that struggles the most with the problem of redundant data, erroneous data, and lack of data.

### *Desired Improvements of the Costing System*

Although the survey results indicated that respondents possess a costing system that is easily accessible and inexpensive to buy and maintain (Figure 9), these systems do not necessarily provide the level of accuracy and up-to-date cost information that some survey participants are seeking (Figure 8). The need for more accurate cost information may suggest that product costing systems used by respondents require an update with more modern cost calculation and allocation techniques. Another need stated by respondents was having an easily available, up-to-date, and easy to operate (Figure 8) product costing system. Product costing information is created by a relatively small group of professionals, but it can affect the work of other groups within the organization as well; appropriate product costing information must be made available to all people involved, directly or indirectly, in the costing process. Anecdotal evidence exists that large companies are using customer relationship management and ERP systems to calculate product costs; therefore, they do not need a stand-alone system for product costing purposes, whereas small companies, which represent the majority of this study's respondents, are using Microsoft Excel spreadsheets for product costing because they are easy to create, operate, and customize. The sophistication of these spreadsheets varies considerably among companies and although some may deliver information that is exactly in line with the needs of the company, others may be less sophisticated and/or less reliable in their information delivery.

## Summary and Conclusions

The North American hardwood dimension and component industry faces intensive foreign competition, high customer expectations, and eroding market conditions. To survive, North American wood component and dimension manufacturers have to be able to accurately calculate product costs to submit winning bids to job competitors while assuring profitability. However, empirical evidence exists that not all companies competing in the industry have a reliable product costing system and others do not have a system design that consistently provides meaningful pricing decisions.

To better understand current practices, a survey designed to gain information about cost accounting and product costing practices used in the North American hardwood dimension and component industry was undertaken. Results from the survey showed that the distribution of total product cost reported by survey participants was 41% direct material cost, 21% direct labor cost, 18% manufacturing overhead cost, 14% general and administrative expenses, and 6% sales expenses.

Results obtained from 74 participants (adjusted response rate of 16%) show that the majority of respondents (84%) are using their cost accounting system to gain financial insights, as opposed to operational and strategic information. For this purpose, more than two-thirds of the survey respondents (74%) rely on traditional cost accounting practices, whereas only a minority use more modern cost accounting systems, such as ABC or LA. Even fewer industry participants use systems that they declare as "proprietary" but are most likely based on traditional costing systems.

This study has shown that opinions are divided among respondents as to which costing system is most effective and reliable. Sixteen percent of the respondents using a traditional cost accounting system ranked their system as "outstanding" and another 36% indicated that their system was "good," indicating a relatively high degree of user satisfaction. Only one respondent claimed that their system works "poorly." Users of ABC systems (13% of all respondents), LA systems (4%), or proprietary accounting systems (9%), were, on average, not more satisfied with their systems. However, the small number of respondents using ABC and LA does not allow us to conclude whether these systems are more or less effective and reliable than are traditional systems.

Overall, the three most common problems reported by survey participants related to their cost accounting system were missing links to management initiatives, lack of resources to build and maintain costing systems, and missing links to ERP software. Significantly more sawmills and wood preservative manufacturers cited the problem of "no interface to enterprise software" than did veneer/plywood/engineered wood products manufacturers or millwork manufacturers. In addition, companies with 50–99 employees reported significantly more "erroneous data," "redundant data," and "missing data," that did companies with either fewer or more employees.

Prior research has provided limited information on the type, structure, and accuracy of cost accounting and product costing systems used in the forest products industry. Findings of this study fill the gap and enable practitioners to address shortcomings of their cost accounting and product costing practices and help them identify opportunities for

improvements. Further research is needed to explain why more sophisticated costing practices are refused by industry participants. In addition, more information about the characteristics of companies who adopted such sophisticated systems may help support the transformation of the rest of the industry. As a future step, a product costing software package based on these results can be developed that will assign overhead cost to products accurately, at low cost and in a short time, while creating competitive bids for external customers.

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