Product Costing Program for Wood Component Manufacturers

Adrienn Andersch Urs Buehlmann Jeff Palmer
Janice K. Wiedenbeck Steve Lawser

Abstract

Accurate and timely product costing information is critically important for companies in planning the optimal utilization of company resources. While an overestimation of product costs can lead to loss of potential business and market share, underestimation of product costs can result in financial losses to the company. This article introduces a product costing program called WoodCite that was specifically developed for small and medium-sized hardwood dimension and components manufacturers. WoodCite is a Microsoft Access application that allows companies to determine product costs and to create competitive bids based on their company and product information. The program uses a regression model to estimate the overhead cost of a product based on historical cost information provided by the user. WoodCite was developed with input from members of the Wood Components Manufacturers Association. The application is available for free at Virginia Tech's Wood Products Web site (http://woodproducts.sbio.vt.edu/woodcite).

The North American hardwood dimension and components industry (in this article referred to as HDCI) consists of mostly small, family-owned businesses in the United States and Canada, generating roughly $4 billion of value in 2009 (Lawser 2010). Industry participants specialize in producing an array of customized wood products, such as edge-glued panels, solid and laminated squares, moldings, stair parts, cabinet doors and parts, turnings, bend components, and other products to serve the requirements of the furniture, kitchen cabinet, building products, and other manufacturing industries (Lawser 2010).

The North American HDCI plays a critical role in the hardwood forest products industry as the industry is a user of high-value hardwood lumber to create components. Customer expectations, global markets, and international competition, however, require hardwood dimension and components manufacturers to continuously improve their ability to manage their products and businesses. To survive and thrive, the North American HDCI must continuously adjust its business model to meet changes in customer expectations, rising foreign and domestic competition, and variable market and customer requirements with respect to quality, styling, performance, and costs (Schuler and Buehlmann 2003, Buehlmann et al. 2007, Buehlmann and Schuler 2009, Lawser 2012). To be successful in the long term in highly competitive markets, industry participants must be able to accurately estimate costs of products associated with orders. Accurate cost estimation and competitive bidding is complicated by the nature of custom manufacturing because each bid may involve unique specifications, products, processes, and terms. The underestimation of product costs results in financial losses, while overestimation leads to the loss of potential business and customers as well as a loss of bargaining power in the market (Niazi et al. 2006). Therefore, having an accurate and up-to-date product costing practice can help ensure the submission of winning (e.g., competitively priced yet profitable) bids to potential customers.

Many North American HDCI participants rely on cost accounting manuals created by the Wood Component Manufacturers Association (WCMA) to gain knowledge about product cost calculation (Kennedy and Noltemeyer 1965, Carroll 1985). These cost accounting manuals describe traditional product costing practices, namely, job order costing, standard costing, and direct costing. Results of a product costing survey conducted by Virginia Tech in 2010 reported that 74 percent of survey respondents of the HDCI use traditional product costing practices described in the WCMA cost accounting manuals (Andersch et al. 2011).

The authors are, respectively, Graduate Research Assistant and Associate Professor, Dept. of Sustainable Biomaterials, Virginia Tech Univ., Blacksburg (andersch@vt.edu [corresponding author], Buehlmann@gmail.com); Information Technology Specialist and Research Forest Products Technologist, Northern Research Sta., USDA Forest Serv., Princeton, West Virginia (jpalmer01@fs.fed.us, jwiedenbeck@fs.fed.us); and Executive Director, Wood Component Manufacturers Assoc., Marietta, Georgia (wcma@woodcomponents.org). This paper was received for publication in July 2013. Article no. 13-00060.

Forest Prod. J. 63(7/8):247–256.
doi:10.13073/FPJ-D-13-00060

Only 17 percent of survey respondents reported the adaptation of alternative product costing practices, such as activity-based costing or value stream costing (Andersch et al. 2011). Regardless of the type of product costing practice adopted (e.g., traditional costing, activity-based costing, or value stream costing), participants of the North American HDCI wish to have a product costing computer program that is easy to operate; provides accurate cost information for management purposes; provides easily available, up-to-date information for cost estimates; and is easily accessible and customizable (Andersch et al. 2011). Amazingly, the results of the product costing survey conducted by Virginia Tech in 2010 showed that 41 percent of the respondents do not possess any formal costing computer program to calculate product costs (Andersch et al. 2011). The lack of appropriate cost accounting knowledge and the lack of a reliable product costing computer program would likely result in calculation of unrealistic and unprofitable quotes for potential customers, thereby jeopardizing business survival.

To address this shortcoming, a product costing computer program called WoodCite 1.0, specifically created for hardwood dimension and component manufacturers, has been developed and is introduced in this article. The ''Literature Review'' section provides an overview of current accounting systems and the costing practices that are used with each of these accounting systems. The ''Methods'' section presents information on the sources of information utilized in gaining necessary intelligence for developing the WoodCite computer program. The ''Results'' section presents the structure of WoodCite 1.0 and its different functions. An example application of the WoodCite 1.0 computer program using real industry data is demonstrated in the ''Example and Discussion'' section. The ''Summary and Conclusions'' section draws conclusions and provides some suggestions for future research.

Literature Review

The recent global economic distress, especially the US housing crisis, negatively affected hardwood dimension and component manufacturers since their businesses are closely correlated with home construction and furnishing, such as furniture, cabinetry, flooring, molding, millwork, or staircases, among other things. Consequently, over the past 5 years, numerous industry participants closed their businesses, relocated their production offshore, or shifted to other business markets, including architectural millwork, store fixtures, nonresidential furniture and fixtures, gifts, or novelty items (Bumgardner et al. 2011, Lawser 2012, Buehlmann et al. 2013). Although for 2012 the hardwood dimension and component industry stopped declining, monthly shipments are still unpredictable (Lawser 2012, Alderman and Buehlmann 2013, Buehlmann et al. 2013). Until the market stabilizes and US housing construction fully recovers, industry participants are likely to cautiously invest in new technologies and equipment rather than planning on extending their businesses or rehiring laid-off employees (Lawser 2012).

Companies, in their efforts for survival, continuously adopt new manufacturing technologies, such as highly automated, computer-aided, flexible, and integrated manufacturing systems. (Myers 2009, Wiedenbeck and Parsons 2010). These investments enable more customization, shorter lead times, and a lower level of work in process and finished goods inventories, among other things (Fullerton and McWatters 2001). Besides technological advancements, new management practices, such as just in time, total quality management, and lean manufacturing, have also been widely accepted and integrated into manufacturing processes (Fullerton and McWatters 2001) and have improved productivity while reducing costs.

Because accounting is the financial reflection of business activities, each change in the business has to be reflected in its accounting (Gurowka and Lawson 2007). Thus, the two systems, business activities and accounting, have to be synchronized; otherwise, managers receive inaccurate cost information that can lead to erroneous decision making and, possibly, a decline in an organization's competitive edge in the market (Gurowka and Lawson 2007). Therefore, to keep up with an altered manufacturing environment, an array of new cost accounting systems has been developed over the past years. The selection of the most appropriate cost accounting system and product costing practice, however, can be challenging (Gurowka and Lawson 2007). Table 1 provides an overview of four of the most widely used cost accounting systems in manufacturing industries. These are, in particular, traditional cost accounting (the most used system), activity-based cost accounting, throughput accounting, and lean accounting (Lea and Fredendall 2002, Fullerton et al. 2013). Under each of these accounting systems, multiple cost calculation practices exist because they were designed to deal with different business problems, such as product cost calculation, product value determination, inventory valuation, and cost control, among others.

The traditional cost accounting system (Table 1, column 1) differentiates three categories for product cost calculations, namely, accumulation practices, cost control practices, and inventory evaluation practices (Lanen et al. 2011). Accumulation practices include job order costing, process costing, and operational costing (Rushinek 1983, Lanen et al. 2011). Cost control practices consist of actual costing, normal costing, and standard costing (Lanen et al. 2011). Inventory evaluation practices include absorption/full costing and variable/direct/marginal costing (Rushinek 1983, Lanen et al. 2011). An activity-based cost accounting system differentiates two product cost calculation practices (Table 1, column 2): activity-based costing and time-driven activity-based costing (Kaplan and Anderson 2004). A throughput accounting system (Table 1, column 3) relies on the theory of constraint costing practice to calculate product cost (DugDale and Jones 1998). Lean accounting systems (Table 1, column 4) differentiate between two product costing practices: value stream costing and target costing (Maskell and Baggaley 2003).

The activity-based, throughput, and lean accounting systems were created to resolve specific shortcomings of the original, still most widely used traditional cost accounting system (Cokings and Hicks 2007). While a particular product costing practice may resolve some shortcomings, however, it possesses others (Cokings and Hicks 2007). Thus, no product costing practice exists without shortcomings, and a company needs to select the practice that best fits the company's needs. According to Gurowka and Lawson (2007), selecting the right product costing practice requires constant review and evaluation of the organization's situation while being knowledgeable of all available product costing practices.

Table 1.—The array of cost accounting systems and product costing practice.

Traditional cost accounting	Activity-based cost accounting	Throughput accounting	Lean accounting
Job order costing	Activity-based costing	Theory of constraint costing	Value stream costing
Process costing	Time-driven activity-based costing		Target costing
Operational costing			
Actual costing			
Normal costing			
Standard costing			
Absorption/full costing			
Variable/direct/marginal costing			

Typically, the first step of the evaluation process is what Gurowka and Lawson (2007) call environmental scan, which includes the review of the organization's competitive landscape, leadership philosophy, strategic plan, technology platform, and budget. Then, according to Gurowka and Lawson (2007), an organizational review is executed because organizational size and diversity, level of centralization, product diversity, product complexity, customer diversity, channel diversity, and product manufacturing diversity affect the selection of the most appropriate product costing practice. Also, different types of organizations, such as manufacturing, service, nonprofit, or government organizations, have different needs and different criteria for what constitutes their most useful product costing practice. Once the organization has been evaluated, all available product costing practices (Table 1) should be reviewed and matched with the organization's needs before a choice is made.

Methods

A research team composed of a cross section of professionals from industry, associations, government, and academia was assembled to evaluate and develop a product costing computer program for wood components manufacturers. A thorough literature review was conducted to identify key characteristics of cost accounting and product costing practices relevant for this research, thereby providing a fundamental set of criteria for the computer program. Next, face-to-face interviews were conducted by the research team in collaboration with the WCMA to collect product costing information from hardwood dimension and components manufacturers relating to type, structure, and accuracy of product costing practices used. Interviews also sought to determine how product costing information is used by company managers and to identify the shortcomings of existing product costing practices. The initial face-to-face interviews were performed in early 2010 with six companies, all members of WCMA. Prior to the interviews, a set of interview questions was developed to guide the discussion, but interviewees were allowed to freely talk about the topics. During all interviews, detailed notes were taken, and following the interviews, a detailed report was provided to participants for double-checking the accuracy of what was discussed. The next step in the process after the face-to-face interviews was the execution of a mail survey addressed to the North American HDCI (Andersch et al. 2011). The goal of the mail survey was to learn about the industry's cost accounting systems and product costing practices from a broader industry group and to find out about common problems encountered. The mail survey, consisting of 34 questions, was sent to a total of 495 companies in the summer of 2010. The survey was addressed to a senior company manager, preferably the chief executive officer or president. Eight weeks after the initial mailing, in September 2010, the survey was closed, and a test for nonrespondent bias was completed. During the 8 weeks of the survey process, 74 valid responses were received, resulting in a response rate of 16 percent. Respondents to the mail survey provided valuable information about current industry practices, problems related to product costing practices, and characteristics of an imaginary ''perfect'' product costing practice that respondents seek.

All the information gathered from the literature review, expert consultations, and mail survey were consolidated into the following set of requirements for the computer program being developed:

- Should use traditional product costing methodologies
- Should be easy to operate
- Should provide accurate and useful cost information for management purposes
- Should provide easily available, accurate, and up-to-date information for fast and correct cost estimates
- Should be easily accessible
- Should be customizable

In the last phase, the research team engaged in a series of meetings, conference calls, and e-mail exchanges to develop the beta version of the computer program named WoodCite. Five companies, all members of the WCMA, volunteered to provide detailed information and insights about their product costing practices. Site visits to these five companies took place in early 2011. During the visits, specialists from the five companies elaborated on what they identify as the conditions and variables essential to best practices in product costing computer programs and allowed the research team to examine their product costing practices in detail. Combining all the information gathered, WoodCite was developed and tested through the first half of 2011. The resulting beta version of WoodCite was presented at the 2011 WCMA fall meeting, and the computer program was distributed for field-testing. A hands-on workshop to familiarize industry practitioners with the computer program was conducted at the Wood Education and Research Center in West Virginia in the spring of 2012. Feedback from workshop attendees provided further insights as to various elements and functions of the WoodCite computer program that could be enhanced. Those improvements have now been implemented in WoodCite Version 1.0. The final version of the computer program is available for free online at http://woodproducts.sbio.vt.edu/woodcite and can be run using Microsoft Access 2003, 2007, and 2010. Although WoodCite Version 1.0 was designed primarily for hardwood dimension and component manufacturers located in North

America, the costing program is not limited to a specific industry segment or country.

Results

WoodCite is a Microsoft Access–based product costing computer program designed for hardwood dimension and components manufacturers. The computer program is intended to calculate a company's product cost and to create competitive bids for quotes and is based on traditional costing principles using job order costing that allows companies to maintain separate records for each quote request that can be archived and recalled at a future date to assist in preparing quotes for similar products in the future. In job order costing, direct material, direct labor, and overhead costs are accumulated by individual products or jobs, and then the total sum of all the costs of the product or job is divided by the number of units produced to obtain an average cost per unit.

The structure of WoodCite consists of a menu bar, toolbar, navigator bar, and data entry tables, as displayed in Figure 1. The menu bar, identical to any Microsoft Access application, includes file, home, create, external data, and database tools. The toolbar consists of commands, such as tasks, tools and applications, references, and commands. The navigator bar includes selectable icons, such as save, add new customer, delete current customer, add new order, delete current order, search for customer, view charts, and view documentation. Finally, data entry tables allow users to enter information received from customers or information necessary for product cost calculation.

The data entry process consists of eight major steps. First, the user needs to enter historical data, such as customer information, employee information, product information, and overhead cost information, among others. Then the user can enter contact information for the potential customers and provide description(s) of requested product(s) and service(s). If a quote request includes several products, the computer program allows the user to input multiple products within a single quote. For each product, the user is able to assign a new product ID number, the product description, the requested quantity, the person responsible for providing the quote, and the date the quote was issued. Once all information provided by the potential customer is entered into the computer program, the user reviews the design(s) and starts identifying the material, labor, overhead, and other costs required to produce the product(s).

In a third step, direct material cost is calculated. The ''Materials'' data entry field enables the user to provide information about the (1) raw material type, (2) unit measure, (3) wood species, (4) size, (5) quality, (6) direct material cost per unit, (7) percent yield from raw lumber, (8) quantity, (9) freight cost, and (10) other costs, if applicable. In the HDCI, analyzing and controlling direct cost, a large part of which consists of lumber costs, is a complex task because yield in the rough mill varies widely by species, quality (grade), and component size (Buehlmann 1998). Several studies, charts, and computer programs exist to

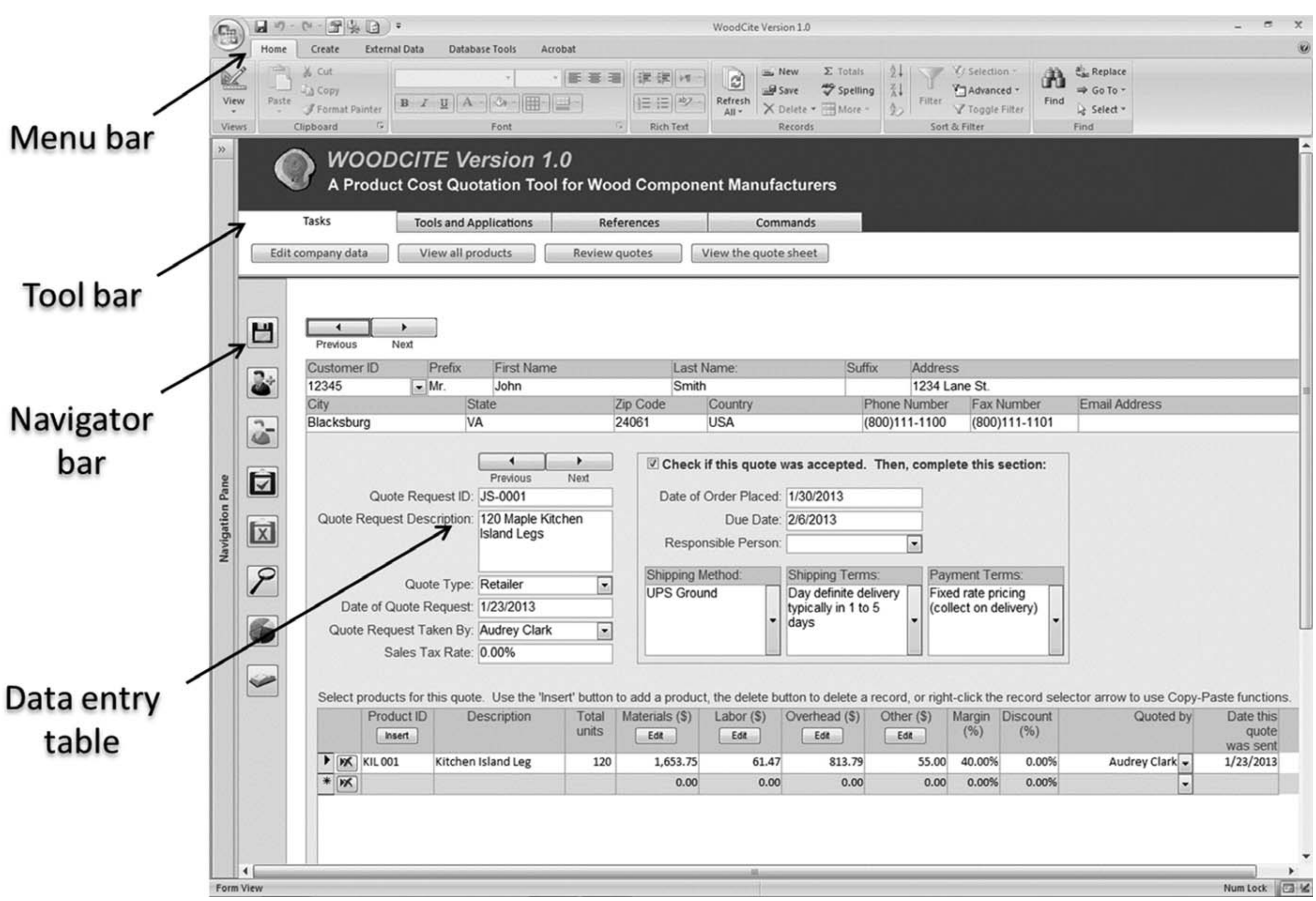


Figure 1.—Structure of WoodCite 1.0.

support lumber yield estimation. WoodCite relies on the USDA Forest Service's rough mill simulator ROMI 4.0 (Grueneberg et al. 2012; available for free at http://woodproducts.sbio.vt.edu/ROMI4), which allows testing scenarios to improve the rough mill's performance, to save costs, and to find the lowest-cost lumber grade mix to purchase. However, knowing that ROMI 4.0 typically is able to simulate higher yields than obtained in a real rough mill, the user needs to subtract between 4 and 6 percent from the assumed yield simulated by ROMI 4.0 based on the user's observations in her or his rough mill (Thomas and Buehlmann 2003). WoodCite enables the user to run ROMI 4.0 by clicking on the Run ROMI 4.0 button in the tools and applications command in WoodCite's toolbar.

In a fourth step, direct labor cost is calculated. The ''Labor'' data entry field enables the user to provide information about (1) the name of the employee(s) being responsible for each process step, (2) the hourly wage of the employee(s), and (3) the labor hours required to complete each process step. Since company-related information, including all process steps, all employee names, and all hourly wages, were entered into WoodCite in step 1, the computer program enables the user to select employees responsible to produce the requested product(s) or responsible to execute specific processes, including their hourly wages for each process step, from a preexisting table. To be able to assign labor hours for each process step, the user must have background knowledge on how long each step may take to process the requested material. Time study data or process control data that may be available through barcode tracking systems can provide the processing time per unit information. Once all data are entered, labor cost is calculated as the sum of each employee's hourly wages multiplied by the time required to perform each process step.

In a fifth step, overhead costs must be calculated. The ''Overhead'' data entry field requires the user to provide information about (1) labor hours and (2) machine hours required for producing the requested product (historical overhead costs, on a monthly basis, were entered into WoodCite in the first step). In overhead cost (e.g., indirect costs) calculations, the main challenge is to identify the relevant cost drivers. Historically, the most commonly used cost drivers are direct labor hours, units of products, and machine hours. It is the manager's job to identify variables that appear to have a significant effect on the level of indirect costs incurred. Based on the results of numerous plant visits and company interviews in the HDCI, direct labor hours and machine hours were selected as primary cost drivers for allocating overhead costs for WoodCite. WoodCite runs a multilinear regression model to investigate and define the relationship between the organization's total overhead cost (dependent variable) and its preselected major cost drivers—direct labor hours (independent variable) and machine hours (independent variable) together (Niazi et al. 2006). Multilinear regression is a widely used technique to estimate overhead cost based on historical data (Niazi et al. 2006). Achieving accurate estimates with the multilinear regression method requires properly recorded and maintained historical data in sufficient detail and on a periodic basis. Running a multilinear regression model requires a minimum of 20 observations (but 30 is better), which requires the collection of 20 to 30 months of historical overhead cost data (if overhead cost is collected on a monthly basis). Because data are collected during such a long period of time, it is necessary to consider changes in technology (e.g., purchasing a new machine can affect machine hours), unusual situations (e.g., reduced overhead cost due to a recession may affect historical data trends), and learning effects (e.g., experienced employees may work faster than new employees) to adjust the overhead cost levels accordingly. All information is processed by the computer program, including the multilinear regression model, which runs in the background. Only the results (overhead cost assigned) are displayed on the screen for the user.

In a sixth step, WoodCite allows the user to charge additional sums for costs incurred for making a given product beyond the total product cost calculated in the previous five steps. Allowing the listing of other cost charges for potential customers, such as engineering design costs, setup costs, kiln drying costs, or others, was explicitly requested by the companies interviewed. Such auxiliary costs are displayed in the ''Other'' data entry field as well as on the final quote sheet.

Once total product cost has been calculated based on the information entered into the computer program, in the seventh step, the user adds the desired margin to the product costs calculated so far. Most companies define a minimum level of margin (say, 20%) and strive not to accept any job that does not meet this minimum. WoodCite also allows the user to enter quantity discounts. Therefore, the last steps of the quoting process is to calculate the selling price by adding the margin to the total product cost, subtracting the discount(s), and sending the product quote to the potential customer. The final quote sheet displays the company's and the customer's contact information, the quote request number, product description(s), ordered quantity, unit price, discounts (if applicable), total price, shipping method, and delivery date. WoodCite enables the user to print the product quote or send it as a PDF file to the potential customer via e-mail.

Example and Discussion

To demonstrate the capabilities of WoodCite, an example based on information provided by one wood component manufacturer, referred to here as Wood Inc., is provided below. As a starting point, WoodCite was populated with historical data records of Wood Inc., including company information, workforce data, activity list, historical overhead costs, shipping and payment terms, material information, and a list of products produced. The customer in this example is represented by Mr. John Smith, a potential new client whose contact information was entered and saved into WoodCite with an assigned customer ID (12345; Fig. 2). Mr. Smith, purchasing agent of a major retailer business, placed his quote request (JS-0001; Fig. 2) of 120 maple kitchen island legs on January 23, 2013. The quote request was taken by Audrey Clark, administrative staff member of Wood Inc., as shown in Figure 2.

The product cost calculation starts with calculating the direct material cost (Fig. 3). To produce one kitchen island leg, Wood Inc. purchases a premade blank in the size of 3.5 by 3.5 by 36 inches, which is equivalent to 3.0625 board feet (calculated as 3.5 by 3.5 by 36 ft = 441 in^3 divided by 144 = 3.0625 board feet). The unit price of a premade blank varies by species; in this example, it is assumed that one board foot of maple costs \$4.50. Therefore, to produce 120 maple

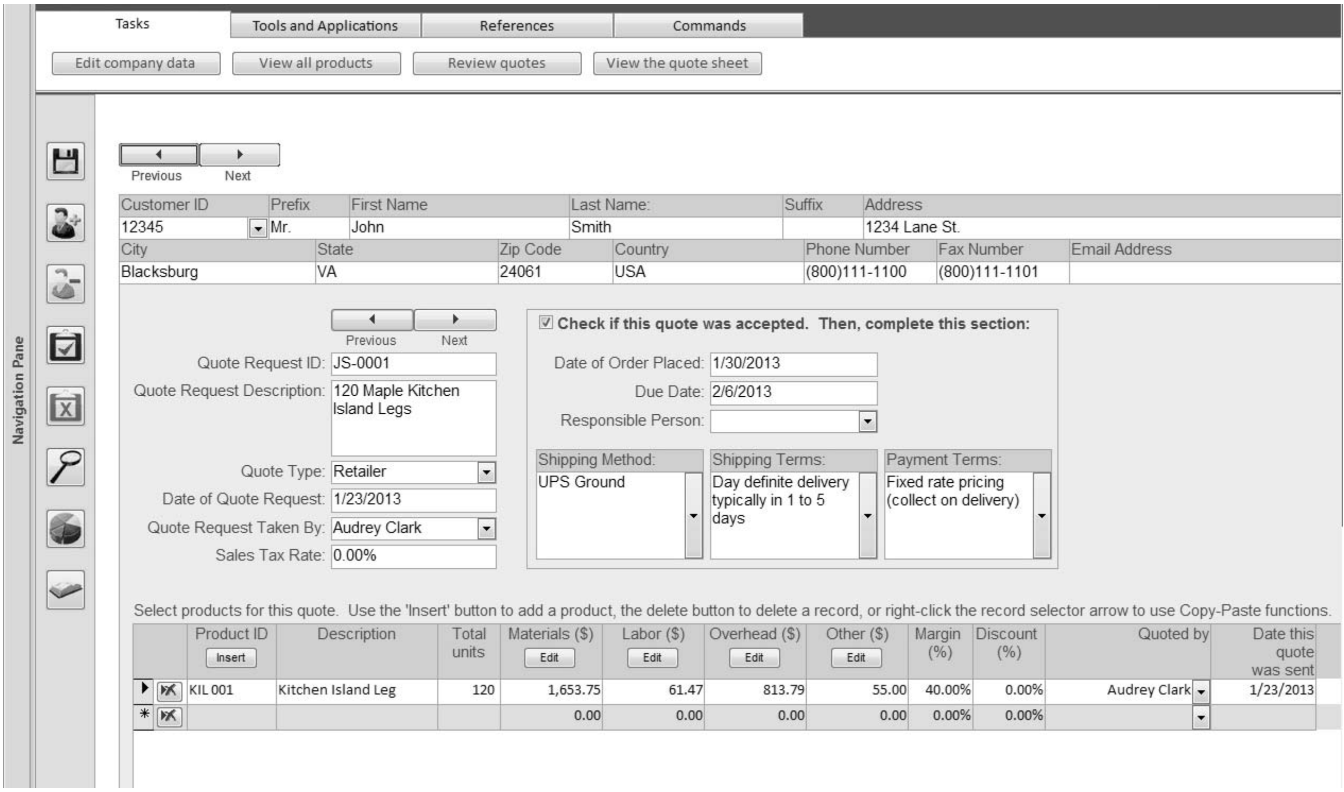


Figure 2.—Customer and product information sheet in WoodCite 1.0.

kitchen island legs, Wood Inc. needs to purchase 367.5 board feet (calculated as 3.0625 board feet multiplied by 120 kitchen island legs) of premade maple blanks. Notice that in this example, Wood Inc. purchases a dimension blank that already has costs attributed to the making of the blank; for example, no investigation into rough mill yield needs to be undertaken. If the company does not buy blanks, the yielded cost applies, and the costs to buy lumber and process it into squares need to be taken into account. The lumber cost per board foot for maple ($1.25 per board foot)

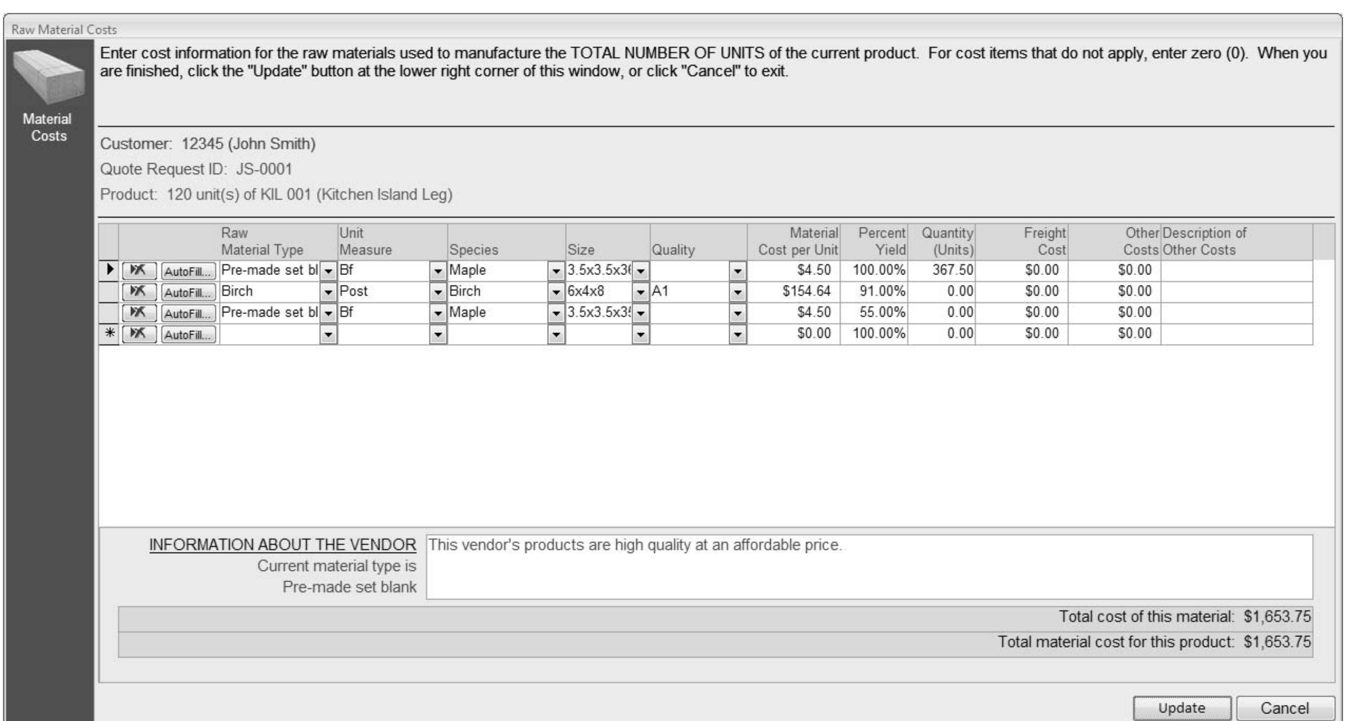


Figure 3.—Material cost calculation in WoodCite 1.0.

would be inexpensive, but the yielded price (approximately 55% yield) plus glue and labor costs would then raise the per board foot price of the dimensioned square accordingly. Also, no freight cost and/or other costs are charged by the supplier in this example. Consequently, the total material cost of the requested product is $1,653.75 (calculated as $4.50 multiplied by 367.5 board feet).

In the next step, direct labor cost is calculated (Fig. 4). To produce a kitchen island leg, the purchased premade maple blank must go through the following process steps: (1) lathe turning, (2) nash sanding, (3) sidestroke sanding, (4) hand sanding, and (5) packaging. Wood Inc. has an assigned employee for each of the above described tasks, and the company also recorded the time necessary to perform each task. The employee assigned to lathe turning processes 70 blanks per hour at an $8.50 hourly rate, resulting in a labor cost of $14.45 (calculated as $8.50 multiplied by 1.7 h of operation to produce 120 blanks). Figure 4 displays the labor cost window of WoodCite containing this information. Similarly, the employee assigned to nash sanding processes 120 blanks per hour at an $8.25 hourly rate, resulting in a labor cost of $8.25; the employee assigned to sidestroke sanding processes 45 blanks per hour at an $8.25 hourly rate, resulting in a labor cost of $22.02; the employee assigned to hand sanding processes 120 blanks per hour at an $8.25 hourly rate, resulting in a labor cost of $8.25; and, finally, the employee assigned to packaging is able to pack 120 blanks into a UPS box in 1 hour at an $8.50 hourly rate, resulting in a labor cost of $8.50. Consequently, the total labor cost of the requested product is the sum of each process step's labor cost, that is, $61.47 (calculated as $14.45 plus $8.25 plus $22.02 plus $8.25 plus $8.50).

The next step in calculating the cost of the requested product is calculating overhead cost (Fig. 5). Historical overhead cost data of Wood Inc. for the last 30 months were already entered into WoodCite. Entering the total number of labor hours (7.37 h) and the total number of machine hours (5.14 h) enabled WoodCite to automatically calculate the total overhead cost for the requested products (120 kitchen island legs), which was $813.79.

Wood Inc. has a policy of charging $55 setup charge for each project; therefore, this $55 was entered into the other cost field (Fig. 6). The company decided to put a 40 percent margin for its high-quality product and provide no discount to its customer. As shown in Figure 6, the quote was sent to the customer on the same day it arrived (January 23, 2013) by Audrey Clark.

The quote sheet displayed in Figure 7 shows that the quote Mr. Smith requested was sent on January 23, 2013, by Audrey Clark and is valid for 45 days. The quote sheet lists the contact information of the customer as well as the company information. Also, details about Mr. Smith's inquiry are documented in the quote sheet. The unit price of one maple kitchen island leg is listed as $35.97, and the total price of all 120 requested legs before sales tax is listed as $4,316.80. The quote sheet also shows that Wood Inc. proposes a UPS ground delivery, typically in 1 to 5 days, to the potential customer (Fig. 7).

Summary and Conclusions

The goal of this research was to develop a product costing computer program (WoodCite) for hardwood dimension and component manufacturers to support the industry's drive to improve its competitiveness and profitability. Although WoodCite has been developed for hardwood dimension and component manufacturers, other hardwood-related industries, both upstream and downstream in the hardwood value chain, can also benefit from the product costing computer program outlined in this article. In fact, WoodCite will prove helpful for a wide range of hardwood industry businesses, including the furniture, kitchen cabinetry, millwork, molding, and flooring industries, as their products are manufactured similar to wood components.

WoodCite Version 1.0 was developed by a research team consisting of academics, industry participants, association members, and government representatives as a Microsoft Access–based product intended to calculate a company's product cost and to provide solid data to assemble competitive bids. WoodCite calculates product costs on a traditional job order cost basis by accumulating direct

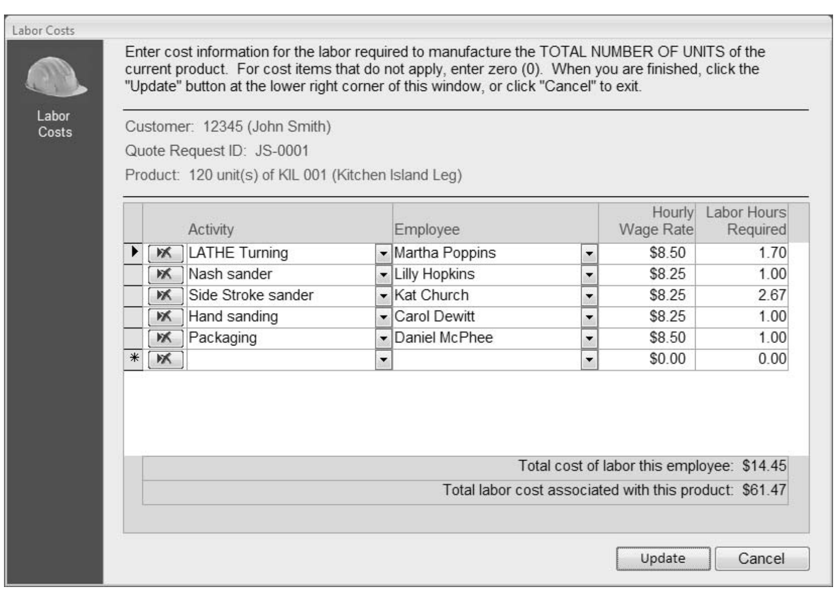


Figure 4.—Direct labor cost calculation in WoodCite 1.0.

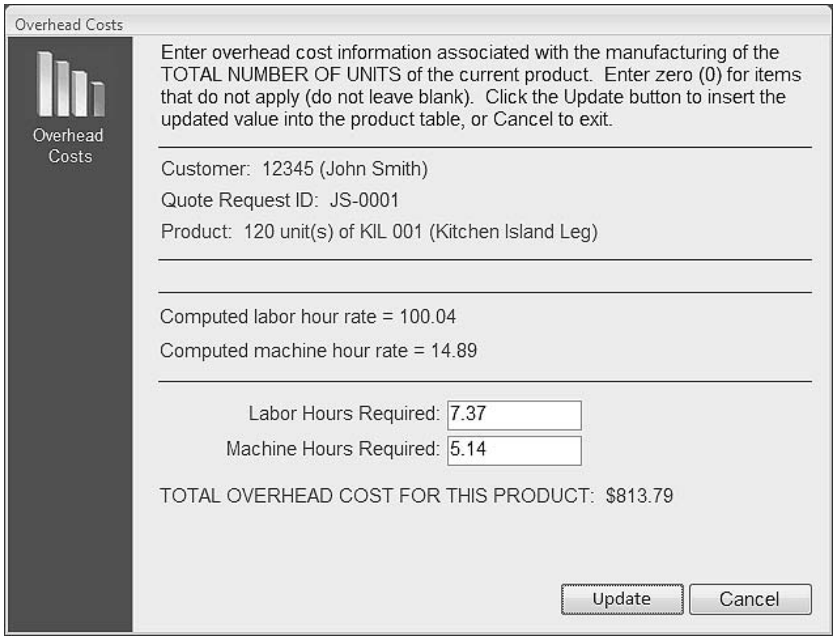


Figure 5.—Overhead cost calculation in WoodCite 1.0.

material, direct labor, and overhead costs by individual products. To calculate overhead costs, the computer program runs a multilinear regression model in the background to test whether there is a relationship between the organization's total overhead cost and direct labor hours and machine hours together and then assigns overhead cost to product(s) on a labor hour and machine hour basis.

WoodCite will continue to evolve and mature through maintenance by Virginia Tech and the US Forest Service as a result of user feedback. Expansions under consideration include an ''advanced'' user module that would allow the user to adjust the assumptions of the multilinear regression model and enable the user to select main cost drivers other than labor hour or machine hour to achieve more reliable correlations among variables. Also, some enterprise software producers are interested in applying WoodCite to their products. Ultimately, it is envisioned that WoodCite will become developed in such a manner that it is completely compatible and logically consistent with any integrated enterprise software.

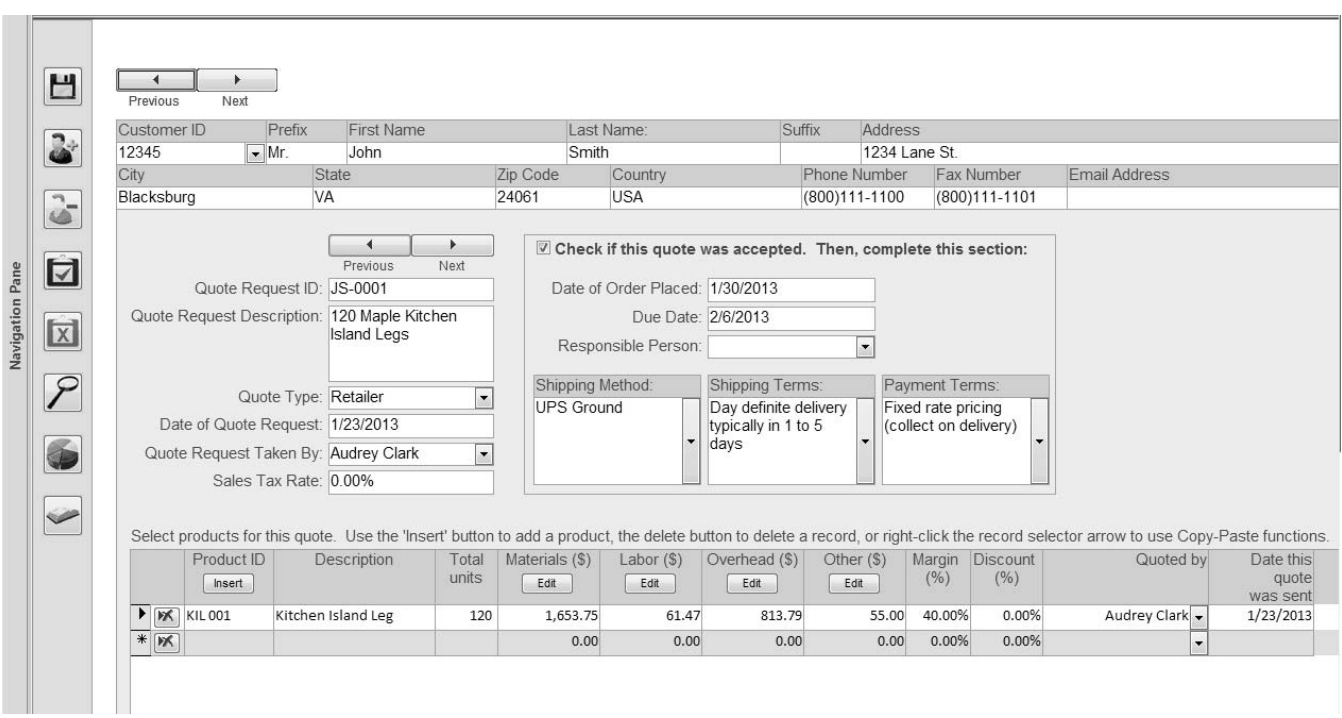
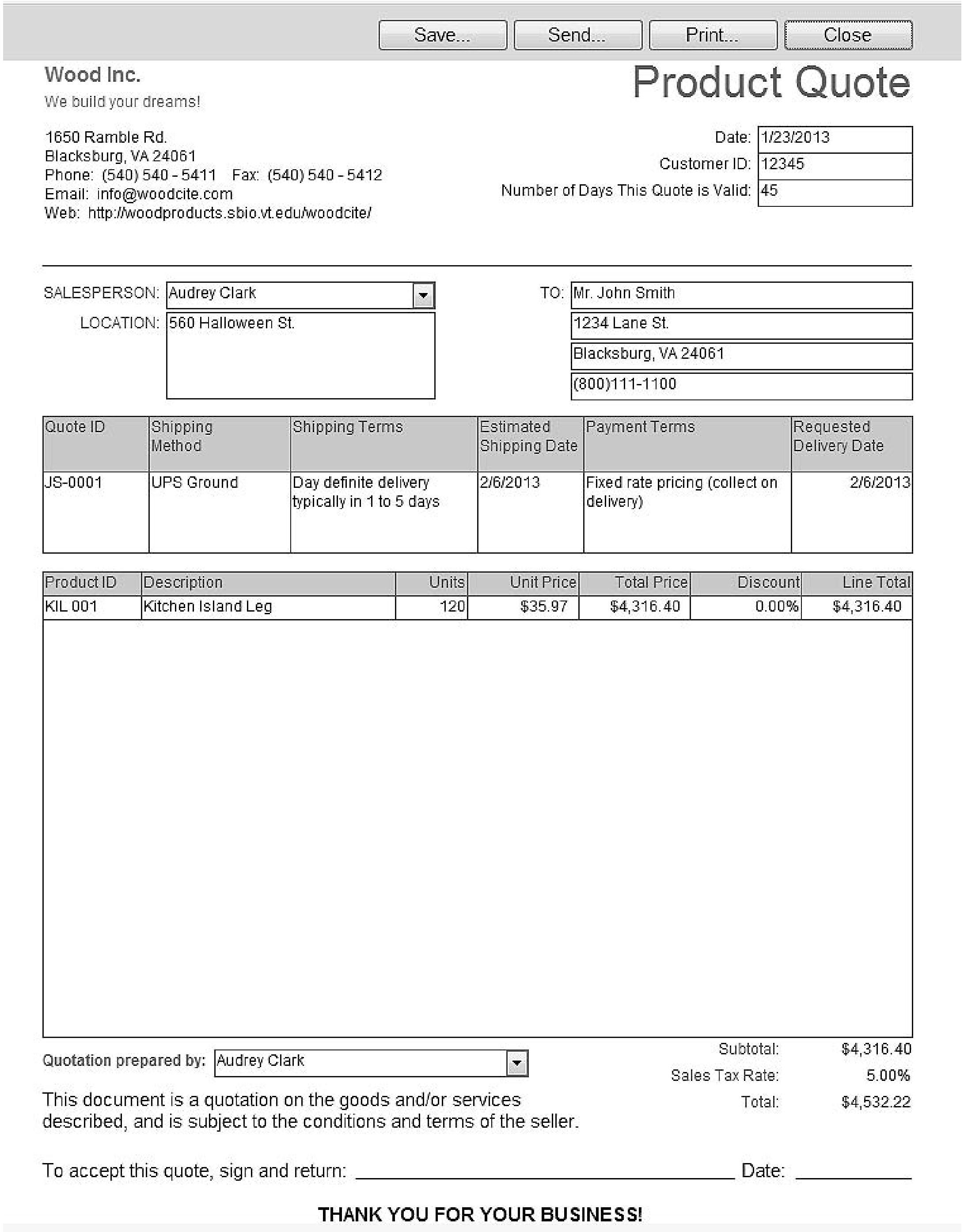


Figure 6.—Product cost information in WoodCite 1.0.


Save... Send... Print... Close

Wood Inc.
We build your dreams!

Product Quote

1650 Ramble Rd.
Blacksburg, VA 24061
Phone: (540) 540 - 5411 Fax: (540) 540 - 5412
Email: info@woodcite.com
Web: http://woodproducts.sbio.vt.edu/woodcite/

Date: 1/23/2013
Customer ID: 12345
Number of Days This Quote is Valid: 45

SALESPERSON: Audrey Clark
LOCATION: 560 Halloween St.

TO: Mr. John Smith
1234 Lane St.
Blacksburg, VA 24061
(800)111-1100

Quote ID	Shipping Method	Shipping Terms	Estimated Shipping Date	Payment Terms	Requested Delivery Date
JS-0001	UPS Ground	Day definite delivery typically in 1 to 5 days	2/6/2013	Fixed rate pricing (collect on delivery)	2/6/2013

Product ID	Description	Units	Unit Price	Total Price	Discount	Line Total
KIL 001	Kitchen Island Leg	120	$35.97	$4,316.40	0.00%	$4,316.40

Quotation prepared by: Audrey Clark

Subtotal: $4,316.40
Sales Tax Rate: 5.00%
Total: $4,532.22

This document is a quotation on the goods and/or services described, and is subject to the conditions and terms of the seller.

To accept this quote, sign and return: ____________________ Date: ________

THANK YOU FOR YOUR BUSINESS!

Figure 7.—Product quote sheet in WoodCite 1.0.

In the future, WoodCite could be enhanced by giving users options as to which costing approach (e.g., activity-based costing or value stream costing) they want to use. Also, a more advanced estimation of the relationship of the product and overhead using, for example, a neutral network approach instead of multilinear regression could be investigated. In any case, the North American wood industry can use WoodCite as needed and can make changes to the computer program as desired. The computer program can be downloaded for free at http://woodproducts.sbio.vt.edu/woodcite.

Literature Cited

Alderman, D. and U. Buehlmann. 2013. November 2012 housing commentary. USDA-FS/Virginia Tech Housing Reports. http://woodproducts.sbio.vt.edu/housing-report. Accessed January 10, 2013.

Andersch, A., U. Buehlmann, J. Wiedenbeck, and S. Lawser. 2011. Product costing practices in the North American hardwood component industry. *In:* Proceedings of the 3rd International Scientific Conference on Hardwood Processing, October 16–19, 2011, Blacksburg, Virginia; Virginia Tech University, Blacksburg. pp. 135–145.

Buehlmann, U. 1998. Understanding the relationship of lumber yield and cutting bill requirements: A statistic approach. PhD dissertation.

Virginia Polytechnic Institute and State University, Blacksburg. 221 pp.

Buehlmann, U., M. Bumgardner, A. Schuler, and M. Barford. 2007. Assessing the impacts of global competition on the Appalachian hardwood industry. *Forest Prod. J*. 57(3):89–93.

Buehlmann, U., M. Bumgardner, and M. Sperber. 2013. How small firms contrast with large firms regarding perceptions, practices, and needs in the U.S. secondary woodworking industry. *BioResources* 8(2):2669–2680.

Buehlmann, U. and A. Schuler. 2009. The US household furniture industry: Status and opportunities. *Forest Prod. J*. 59(9):20–28.

Bumgardner, M., U. Buehlmann, A. Schuler, and J. Crissey. 2011. Competitive actions of small firms in a declining market. *J. Small Bus. Manag*. 49(4):578–598.

Carroll, P. 1985. Cost accounting manual for dimension manufacturers. Hardwood Dimension Manufacturers Association, Marietta, Georgia. 62 pp.

Cokings, G. and D. Hicks. 2007. Where does ABC fit amongst the clutter of managerial accounting? *J. Cost Manag*. 21(2):21–28.

DugDale, D. and T. C. Jones. 1998. Throughput accounting: Transforming practices? *Br. Account. Rev*. 30(3):203–220.

Fullerton, R. R., F. A. Kennedy, and S. K. Widener. 2013. Management accounting and control practices in a lean manufacturing environment. *Account. Organ. Soc*. 38(1):50–71.

Fullerton, R. R. and C. S. McWatters. 2001. The production performance benefits from JIT implementation. *J. Oper. Manag*. 19(1):81–96.

Grueneberg, T., R. E. Thomas, and U. Buehlmann. 2012. ROMI 4.0: Updated rough mill simulator. *Forest Prod. J*. 62(5):373–377.

Gurowka, J. and R. A. Lawson. 2007. Selecting the right costing tool for your business needs. *J. Corp. Account. Finance* 18(3):21–27.

Kaplan, R. S. and S. R. Anderson. 2004. Time-driven activity-based costing. *Harv. Bus. Rev*. 82(11):131–138.

Kennedy, E. and V. Noltemeyer. 1965. Accounting and cost controls in the hardwood conversion industry. Hardwood Dimension Manufacturers Association, Nashville, Tennessee. 49 pp.

Lanen, W. N., S. W. Anderson, and M. W. Maher. 2011. Fundamentals of Cost Accounting. McGraw-Hill/Irwin, New York. 752 pp.

Lawser, S. 2010. Success in 2010: Today's Woodworking Industry. Weinig Technology Expo, Portland, Oregon; Wood Component Manufacturers Association, Marietta, Georgia.

Lawser, S. 2012. Market outlook for the wood component industry. Wood Component Manufacturers Association, Marietta, Georgia. 2 pp. http://woodcomponents.org/app/portal/mm/Component_Forecast_for_2013.pdf. Accessed January 10, 2013.

Lea, B. R. and L. D. Fredendall. 2002. The impact of management accounting, product structure, product mix algorithm, and planning horizon on manufacturing performance. *Int. J. Prod. Econ*. 79(3):279–299.

Maskell, B. H. and B. Baggaley. 2003. Practical Lean Accounting: A Proven System for Measuring and Managing the Lean Enterprise. Productivity Press, New York. 348 pp.

Myers, J. K. 2009. Traditional versus activity-based product costing methods: A field study in a defense electronics manufacturing company. *J. Bus. Account*. 2(1):160–170.

Niazi, A., J. S. Dai, S. Balabani, and L. Sereviratne. 2006. Product cost estimation: Technique classification and methodology review. *J. Manuf. Sci. Eng*. 128(2):563–575.

Rushinek, A. 1983. Cost accumulation for different costing systems and their computer applications. *Manag. Finance* 9(1):19–22.

Schuler, A. and U. Buehlmann. 2003. Identifying future competitive business strategies for the U.S. residential wood furniture industry: Benchmarking and paradigm shifts. General Technical Report GTR-NE-304. USDA Forest Service, Northeastern Research Station, Newtown Square, Pennsylvania. 18 pp.

Thomas, E. and U. Buehlmann. 2003. Performance review of the ROMI-RIP rough mill simulator. *Forest Prod. J*. 53(3):80–85.

Wiedenbeck, J. and J. Parsons. 2010. Digital technology use by companies in the furniture, cabinet, architectural millwork, and related industries. *Forest Prod. J*. 60(1):78–85.