

Empirically Derived Dimensions of Quality for Softwood Lumber

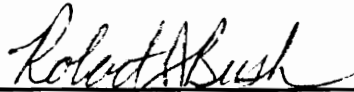
by

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in
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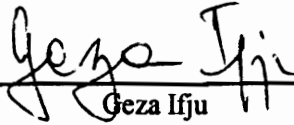
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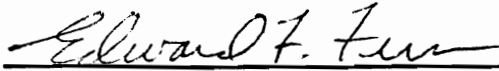
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(ABSTRACT)

Quality perceptions of three major softwood lumber consumers: wood treaters, truss manufacturers, and home centers were investigated to determine their definition of softwood lumber quality. Data was gathered through a mail survey of buyers in each of the three groups. In total, 867 responses were received.

Respondents rated the importance of product and service characteristics to quality. These characteristics were based on dimensions of product quality developed by Garvin (1984) and dimensions of service quality developed by Parasuraman et al. (1988). A total of 80 product and service quality characteristics were assembled to represent, or measure, twelve dimensions of total product quality.

Analysis indicated that the twelve dimension model, derived from previous work, was not applicable to softwood dimension lumber. Thus, exploratory factor analysis was used to assess the underlying dimensions of quality and a five dimension model resulted. The dimensions, ranked in order of importance, were: **Lumber Characteristics, Supplier/Salesperson Characteristics, Lumber Performance, Supplier Services, and Supplier Facilities.** These findings share few similarities with past research. In fact, they suggest that the concept of quality as a higher order abstract (i.e., dimensions of quality are similar regardless of product) may be flawed.

Respondent groups differed in the importance they placed on three of the five dimensions. No difference in importance levels were found for **Supplier/Salesperson Characteristics** and

Lumber Characteristics. However, truss manufacturers perceived **Lumber Performance** to be more important than treaters or home centers and **Supplier Services** was perceived to be more important by home centers than the other two groups. Finally, **Supplier Facilities** was perceived to be most important by treaters.

Data gathered in a follow-up questionnaire indicated that the model developed in this study was understood by buyers of softwood lumber and that they buy from suppliers who perform well on dimensions of quality. Buyers also indicated that they pay more for better quality lumber and better service. This evidence indicates that suppliers of softwood dimension lumber can differentiate themselves based on quality and in turn command a higher price. Given these findings, strategies for utilizing quality, and the model developed in this study, to gain competitive advantage are discussed.

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PREFACE

This document is comprised of five sections. The first section outlines the study, its methods, and its objectives as well as an investigation of the relevant literature. This section concludes with a discussion of the demographic findings in the study. The three subsequent sections of the document are manuscripts targeted toward specific academic journals. The disadvantage of this method is that it requires a considerable amount of information replication. As the reader progresses through the document he or she will notice this replication. While this is not an ideal situation it was necessary for the writing format chosen. The final section of the document discusses the benefits of the research and where future research may be of benefit. Happy reading!!

**EMPIRICALLY DERIVED DIMENSIONS OF QUALITY FOR
SOFTWOOD LUMBER: BACKGROUND, METHODS, AND
DEMOGRAPHIC CHARACTERISTICS**

Introduction

Justification and Objectives

Many wood products are sold as commodities under a standard set of voluntary grades (Seward and Sinclair 1988). The first published grading rules, for Scandinavian pine, were completed in Stockholm in 1754. Much later (1922), with the help of Secretary of Commerce Herbert Hoover, United States industry instituted basic standards for softwood lumber species of commercial importance (Horn 1951). In 1924 the American Lumber Standards were completed (Horn 1951). These standards evolved into generally accepted regional commercial grading rules.

Clearly, standardization has created efficiencies in marketing activities and in building construction. However, such a system of voluntary product standards tends to drive quality to the lowest common denominator (i.e., just high enough to be within the grade) (Keating 1986). This tendency to just make grade may have resulted in a damaging mentality for many companies in the industry. Bishop (1990 p. 30) explained the situation when he said, "Some companies believe that acceptable quality is never losing a reinspection." However, the necessity of reinspection may cause the company to lose a favorable quality perception by that customer even if the reinspection is decided in its favor.

A factor compounding this potential quality problem is the industry's evolving resource base. North America may soon be characterized entirely by users of second-growth timber which is often of lower quality than virgin timber and may result in lower finished product quality (Widman 1991).

Thus as the industry is experiencing two phenomena which tend to decrease quality, quality has seen a dramatic increase in importance in American industry, even the softwood lumber industry. According to Bishop (1990 p. 29),

"Quality can no longer be considered a 'bonus' or 'selling point.' Wood products is now a global market. Extraordinarily high quality must be as much a 'given' as adhering to the acknowledged order amount or species."

Annual reports of wood products corporations claim commitment to quality. For example, Weyerhaeuser will reach its vision by, "Making total quality the Weyerhaeuser way of doing business" (Weyerhaeuser 1992) and Boise Cascade claims a commitment to total quality (Boise Cascade 1992). Many companies talk of quality but it is unclear if they truly understand it from the perspective of the customer. Current literature indicates that management and customer perceptions of quality are often considerably different. A study by Kaspar and Lemmink (1989) compared customers' perceptions of service quality to what management thought those customer perceptions were and found large differences. They advocate monitoring and comparing the perceptions of these two groups because,

"The advantage of such a comparison will be that managers' assumptions about customers may appear to be wrong. In turn, the appropriate steps and measures can be taken to correct the prevailing policies to the market place and/or adjust the internal marketing strategy" (Kaspar and Lemmink 1989 p. 201).

Given the importance of quality to the performance and success of a business, Ross and Shetty (1985) found the size of the gap between the perceptions of executives and customers to be

surprising. Takeuchi and Quelch (1983) outlined results from several surveys that indicate differing perceptions concerning quality between executives and consumers. Bradley T. Gale, managing director of the Strategic Planning Institute, Cambridge, Massachusetts states that approximately 20 percent of U.S. companies "understand customer-perceived quality as a strategic issue" (Bertrand 1987 p. 59).

The following authors explain the importance of understanding customer perceptions to produce a quality product.

"In doing business, it is important for a company to know what the customer exactly wants and how they perceive the company's offer. So, the customer's perceptions of the company, as well as the way in which the company views the customer and its perceptions, are important issues in shaping corporate strategy and marketing strategy" (Kaspar and Lemmink 1989 p. 200).

"Monitoring available information, both internal and external, through normal market research methods is part of the answer for keeping a finger on the pulse of the market" (Ross and Shetty 1985 p. 57).

"We know of no other way than to collect and analyze internal data and to monitor publicly available information" (Takeuchi and Quelch 1983 p. 141).

"The characteristics that connote quality must first be identified through market research (a user-based approach to quality); these characteristics must then be translated into identifiable product attributes (a product-based approach to quality); and the manufacturing process must then be organized to ensure that products are made precisely to these specifications (a manufacturing-based approach to quality). A process that ignores any one of these steps will not result in a quality product. All three views are necessary and must be consciously cultivated" (Garvin 1984b p. 29).

The consensus of the above authors is that the customer, and his or her perceptions, is key to producing a quality product. The importance of quality should not be underestimated. Cravens et al. (1988) stated that no matter whether one is concerned with goods or services, developing an effective quality strategy is one of the most important challenges top management faces. It is essential for the wood products industry to understand the wants, needs, and perceptions of its customers. As customers change, it is essential to maintain a user-based definition of quality, something the softwood lumber industry presently lacks. In an attempt to address the needs of the wood products industry this study sought to accomplish the following objectives:

- 1) Define quality in softwood lumber, as a total product, from the perspective of the marketplace (customer).
- 2) Determine if the definition of lumber quality differs among various user groups.
- 3) Determine if buyers seek out suppliers that display the quality characteristics they perceive to be most important.

Literature Review

North American wood products are sold primarily as commodities with a standard set of voluntary grades (Seward and Sinclair 1988). Bishop (1990 p. 29) described commodity products as follows:

"As a rule, commodity products are uniform, are used by a known (usually domestic) market and are marketed almost exclusively on price. The lowest-cost producer--cheap logs, fewest or lowest-paid employees, fancy machines--usually wins the contest."

While this statement may contain some truth, it is very limiting. Levitt (1986 p. 72) states that, "There is no such thing as a commodity. All goods and services can be differentiated and usually are. The only exception to this proposition is in the minds of the people who profess that exception." Differentiation through quality is a competitive option available to producers of softwood lumber.

At a Southern Forest Products Association meeting in the late 1980s, product quality emerged as a top issue and problem affecting business in the lumber industry (SFPA 1987). The industry, through its various trade associations, has initiated a major push to focus their products on specific end uses and to emphasize quality. Despite the above mentioned efforts, Bishop (1990 p. 30) claims, "Some [forest products] companies instruct their employees about quality by simply never mentioning it--until a complaint or claim shows up."

Quality as a Strategy

According to Cravens et al. (1988), developing an effective quality strategy is one of the most important challenges top management faces. O'Neal and La Fief (1992 p. 134) state that, ". . . quality is increasingly cited as a primary strategic variable for effectively competing in the global marketplace." Garvin (1987) feels that quality is not a problem to be solved, rather a competitive opportunity. In recent years pursuing a quality strategy has become the norm in industry but why?

Producing high quality products can mean improved return on investment (ROI) and higher market share (Jacobson and Aaker 1987, Phillips et al. 1983, Shetty 1987). Phillips et al. (1983) indicate no consistent direct effect of product quality on ROI in raw and semifinished materials businesses, however, they did find indirect effects through enhanced market position. A study of

product quality as a strategic option performed by Jacobson and Aaker (1987) concluded that product quality is positively reflected in higher ROI (i.e., a premium is placed on quality, and customers are willing to pay that premium for quality).

In their book *The PIMS Principles*, Buzzell and Gale (1987) discuss PIMS (Profit Impact of Marketing Strategy) findings regarding the relationship between quality and performance. In the PIMS studies quality is measured relative to competitors. Market share is key to a company's growth and profitability. One thing more than any other drives market share, quality. Whether profitability is measured as return on sales or return on investment, quality and profitability are related (Buzzell and Gale 1987).

Shetty (1987) claims that high quality increases profitability even in mature industries. In fact, quality may be more significant to mature industries than others because of their limited repertoire of competitive tools. As mentioned earlier, softwood lumber is considered a commodity product and is produced by a mature industry (Vasconcellos 1991).

Defining Quality

Garvin (1984b p. 40) says that, "quality is one of those slippery concepts, easy to visualize and yet exasperatingly difficult to define." In fact, he claims that there are five different approaches to defining quality. The Transcendent, Product-based, User-based, Manufacturing-based, and Value-based approaches. The Transcendent approach views quality as innate excellence while the Product-based approach views quality as the presence or absence of measurable attributes. In the User-based approach, quality "lies in the eye of the beholder" and in the Manufacturing-based approach quality

is "conformance to requirements." The Value-based approach considers costs and prices when defining quality.

Holbrook and Corfman (1985) claim that there are as many definitions of quality as there are authors on the subject. Crosby (1979 p. 40) defines quality as "conformance to requirements." However, O'Neal and LaFief (1992) point out that if quality is conformance to requirements it is merely conformance to customer requirements. Juran (1974 p. 2-2) views quality as "fitness for use" and that "fitness for use is judged as seen by the user . . ." Bishop (1990 p.29) states, "Quality means meeting or exceeding a specific customer's full range of expectations about your product." Stebbing (1986 p. 4) says quality is, "the totality of features and characteristics of a product or service that bear on its ability to satisfy a given need." Whiting and Walsh (1986 p. 146) define quality as, "a means through which the product and service in use will meet the expectations of the customer." Morgan and Piercy (1992) claim that quality is most important in terms of customer perceptions. A total quality management technique called Quality Function Deployment treats customer perceptions and needs as the foundation for creating a quality product (Griffin and Hauser 1993). Recognizing and utilizing the importance of consumer perceptions in defining quality is similar to the User-based approach to defining quality outlined by Garvin (1984b).

Many of these definitions have one commonality, the customer. Clearly, the customer's wants are key to producing a quality product. Without the customer there is nothing. Accordingly, his or her definition of quality is the only definition of consequence.

The Dimensionality of Quality

Garvin (1984a p. 41) suggests that quality is "multifaceted" and "appears in many forms", and proposes that quality is made up of eight different dimensions:

Performance	"Primary operating characteristics" of the product. Performance for a television would be things such as picture clarity and color.
Features	"Bells and whistles" inherent in the product. Features can be thought of as a secondary aspect of Performance. The screen-in-screen option on a television is an example of a feature.
Reliability	How soon and often the product fails. Reliability is the probability that a product will fail. It can be measured as the mean time to first failure and mean time between failures.
Conformance	The extent to which a product meets its design standards. This is a measure of how well the manufacturing process was carried out.
Durability	"The amount of use one gets from a product before it physically deteriorates." Expected life of a product would be a measure of durability.
Serviceability	The "speed, courtesy, and competence of repair." This refers to the whole realm of services associated with complaint handling.
Aesthetics	"How a product looks, feels, sounds, tastes, or smells", a matter of personal judgement.
Perceived quality	The consumer's opinion of the product as it has been influenced through "images, advertising, or brand names." Perceived Quality is a way of inferring quality when no direct measure is available. Things such as reputation and past experience with the company are important here.

With the exception of **Serviceability** and to a certain extent **Perceived Quality**, the above dimensions address physical product quality. Services associated with the physical product should also be considered as part of its quality. Services are distinctly different from physical products.

Intangibility, inseparability, heterogeneity, and perishability make up the four basic characteristics of services and the nature of these characteristics may make it very difficult for companies to reach a specific level of quality (Kaspar and Lemmink 1989). Zeithaml et al. (1985 p. 33) explain that services are intangible because they, ". . . are performances, rather than objects, they cannot be seen, felt, tasted, or touched in the same manner in which goods can be sensed." Inseparability refers to the fact that production and consumption are simultaneous, heterogeneity means that services have the potential of being variable and hard to keep consistent, and perishability means that services cannot be stored.

Parasuraman et al. (1988) concluded that service quality is made up of five dimensions.

Reliability	Ability to perform the promised service dependably and accurately.
Responsiveness	Willingness to help customers and provide prompt service.
Assurance	Knowledge and courtesy of employees and their ability to inspire trust and confidence.
Empathy	Caring, individualized attention the firm provides its customers.
Tangibles	Physical facilities, equipment, and appearance of personnel.

While these dimensions of service quality were developed to address the needs of marketing services themselves, they are also applicable to the services associated with the marketing of a physical product and can be applied to softwood lumber. Kaspar and Lemmink (1989) claim that the concept of service quality proposed by Parasuraman et al. (1988) may be applied to services offered as part of an industrial product.

Total Product Concept

Following the work of Garvin (1984a, 1984b) and Parasuraman et al. (1988), researchers have most often kept product and service quality separate. However, every product has services associated with it and both should be considered when measuring quality. The services associated with a product are very important. Sonnenburg (1989) cites a survey in which the number one reason for customers switching to the competition was poor service, an indication that service quality is essential to the physical product being perceived as high quality. Powers (1988) claims that often non-product related items are of primary importance to potential customers. Sinclair et al. (1993) state that the quality of services significantly contribute to the perceived quality of the product. It may be, because of the commodity nature of many softwood lumber products, that service is more important to the perceived quality of the product than the physical characteristics it possesses.

Given the importance of services to the overall evaluation of the product, it is the premise of this study that when defining quality it is extremely important to consider the physical product and its associated services. In creating a definition of quality, the product should be considered a package of benefits that includes service. When including all the benefits inherent in that package it becomes what this study considers a *total product*. Brown and Fern (1981) address this concept suggesting that many times managers and researchers concentrate on the physical product while the consumer evaluates the total product.

Rather than creating a definition of quality for a physical product or its services separately, this study combined the two and created a definition of total product quality. This is important not only at a conceptual level, but at a practical level as well. Kaspar and Lemmink (1989) claim that product and service strategies should be matched because the industrial consumer evaluates the

physical product's quality as well as the quality of the service associated with that physical product. This means that quality judgements will be made on the total product including both the physical product and its associated services (Kujala 1987). With the total product concept in mind, this study combined the models of Garvin (1984a) and Parasuraman et al. (1988) to obtain a single model of quality for a total product. The combination and item selection phases of the study are discussed in more detail later in the chapter.

Methods

Population of Interest

In 1992, consumption of softwood lumber in the United States was approximately 45.7 billion board feet (Miller Freeman 1993). Over one-third of United States consumption was accounted for by three major consumer groups: wood truss manufacturers, wood treaters, and home centers/lumber-building materials outlets (hereafter referred to as home centers). Because of the significant volume they consume and their potentially varying perceptions of quality due to the nature of product end use, professional lumber buyers in each of the three industries were queried to determine their perceptions of quality in softwood lumber.

Truss Manufacturers

In 1992, wood trusses utilized roughly four billion board feet of softwood lumber (Grundel 1994). This figure represents about nine percent of total United States consumption in 1992. As

physical/mechanical performance is the most critical element of their finished product, the evaluation of quality by truss manufacturers may be significantly different than for wood treaters and home centers, who are likely to be more appearance oriented.

Wood Treating Firms

For the purposes of this study, wood treating firms were defined as companies engaged in the preservative treatment of softwood dimension lumber. In 1992, approximately 6.2 billion board feet of southern pine lumber and timbers were preservatively treated. Southern pine makes up approximately 85 percent of all treated lumber and timbers (Easterling 1994). Accordingly, treated lumber and timbers amounted to approximately 7.3 billion board feet in 1992. Much of the lumber processed by treaters is ultimately outside on display. In this application, appearance is a critical criterion in evaluating the quality of softwood lumber.

Home Centers

The 1991 *Directory of Home Center Operators & Hardware Chains* (CSG Information Services 1991) estimates 1990 home improvement company sales to be approximately \$66.7 billion. Lumber products amounted to 31.2 percent of those sales for a total of \$20.8 billion. In 1992, for the twelve western states tracked by the Western Wood Products Association, 15.4 percent of softwood lumber went directly from the mill to the retailer (home centers) and another 55.9 percent went to wholesalers (Yuhas 1994). A major portion of the volume going to wholesalers would also ultimately arrive at the retail level.

This market is different than the two previously mentioned, as there is typically no remanufacture or value added to the lumber. Home centers are in close contact with the final customer, be it the do-it-yourself (DIY) homeowner or the professional contractor, and may have a different perspective concerning quality.

Quality Operationalized

Parasuraman et al. (1985 & 1988 p. 17) claim that quality is similar to an attitude and that, "Perceived quality is therefore viewed as the degree and direction of discrepancy between consumer's perceptions and expectations." That is, quality is measured by comparing what consumers expect firms should provide and their evaluation of a particular firm's performance [Quality = Perceptions - Expectations]. This gap score measurement method originated in the customer satisfaction literature. The concept is that a customer is satisfied if performance exceeds expectations (Bolton and Drew 1991).

However, this quality measurement method has seen considerable debate in the literature (Parasuraman et al. 1993, Peter et al. 1993, Brown et al. 1993, Cronin and Taylor 1992, Babakus and Boller 1992, Parasuraman et al. 1991, Carman 1990, Babakus 1990, Babakus and Inhofe 1993, and Brown and Swartz 1989). Brown et al. (1993) discuss problems with reliability, discriminant validity, and variance restriction when using difference or gap scores. Positive correlation between the two scores tends to decrease the reliability of the difference score (Brown et al. 1993). Brown et al. (1993 p. 131) state, "Since difference score measures will not typically demonstrate discriminant validity from their components, their construct validity is questionable." Variance restriction is experienced when one component of the difference score is consistently higher than the other

component (Brown et al. 1993). Given the expectation versus performance method of calculating a difference score, this is clearly a potential problem. Parasuraman et al. (1993) rebut these arguments but the question remains whether the method is acceptable to use.

Since the gap score is based on the perceived performance of a firm with respect to the expectations consumers have of an industry, the resulting definition is necessarily firm specific. Several authors have argued that simple performance measures adequately capture quality, ". . . current performance adequately captures consumers' perceptions of the service quality offered by a specific service provider" (Cronin and Taylor 1992 p. 58). So, in fact, what is being measured is not quality as a higher order abstract (Zeithaml 1988), but rather the consumer's perceptions of how well that firm performs on selected quality criteria. This assumes that the items included in the measure acceptably capture quality.

Other authors envision quality as a function of importance as well as expectations and performance [Quality = Importance * {Performance - Expectations}] (Carman 1990, Cravens et al. 1985). This is still firm specific, but introduces the concept of importance into the measurement of quality. Parasuraman et al. (1988) infer importance of quality dimensions through the use of regression. In their 1991 (p.424) article they state, ". . . direct measures of the importance of various service attributes are also useful, particularly for combining individual attribute ratings to obtain a composite, weighted estimate of overall service quality." The use of importance measures has been investigated in the literature. Lambert and Lewis (1990) found that expectations and importance are essentially equivalent and that either could be used when measuring quality.

Again considering the idea of quality as an attitude, one way of defining attitude is importance weighted performance (Cronin and Taylor 1992). However, in utilizing the performance

construct, the measure of attitude becomes firm specific. If one's goal is to measure quality as a higher order abstract (i.e., measure quality without a relationship to a particular firm) this could be done by merely obtaining the importance of each of many attributes that make up the total product.

After one determines what quality is for a particular product then individual firms can measure their performance in providing quality. This eliminates the difference score problems and serves to measure quality as a higher order abstract.

The definition of quality derived from this study, while based on customer perceptions, is similar to Garvin's (1984b p. 26) User-based Approach to defining quality. This approach states that quality "lies in the eyes of the beholder." Accordingly, ". . . those goods that best satisfy their [customers'] preferences are those that they [customers] regard as having the highest quality." With this in mind, quality in softwood lumber was defined via determination of the preferences customers hold for various characteristics of softwood lumber and the services associated with that product. Those preferences were determined using the level of importance the respondents assigned to each of the characteristics.

Item Selection

Churchill (1991) suggests that techniques used in exploratory research such as literature searches, experience surveys, and insight-stimulating examples are appropriate for generating items for construct measurement. In this study, both literature searches and experience surveys were utilized. Previous literature (Garvin 1984a, 1984b; Parasuraman et al. 1988; Govett and Sinclair 1984; Seward and Sinclair 1988; Hansen 1992) and discussions with Virginia Tech faculty and

industry professionals provided an enhanced understanding of the items considered by consumers of softwood lumber when evaluating quality.

Items were selected to represent dimensions of total product quality in softwood lumber. The model of product quality (Garvin 1984b) and service quality (Parasuraman et al. 1988) previously outlined were combined to form a single model of total product quality. All of the dimensions with the exception of Garvin's (1984b) **Serviceability** appeared applicable to softwood lumber. **Serviceability**, defined as the "speed, courtesy and competence of repair" (p. 32), did not apply to softwood lumber and was excluded from further analysis. **Performance and Conformance** were combined and items identified to represent the combination. Given the remaining potential dimensions, quality items were selected that described each.

Nine of the assembled items did not appear to measure any of the 11 total quality dimensions. These items did appear to measure something different than the 11 dimensions of the combined model, specifically, the cooperativeness of the supplier or the services that a supplier provides. These items were considered to represent a twelfth dimension. The combined, 80 item model with items representing each dimension is shown in Figure 1-1.

Sample Frame

Professional softwood lumber buyers from home center, wood treating, and truss manufacturing firms were included in the sample. Approximately 1000 home centers were selected from the 1991 *Directory of Home Center Operators & Hardware Chains* (CSG Information Services 1991). This directory catalogs 6358 companies that operate 20,831 stores in the United States. Of those 6358 companies, 5838 are home centers. Obtaining a list for the truss and treating

industries proved to be much more difficult. Selection of the sample for wood treaters and truss manufacturers each began with, Miller Freeman's 1990 *Directory of the Forest Products Industry* (Miller Freeman 1990). In addition, the treating sample was compiled from the following: *Wood Preserving Plants in the United States* (Micklewright 1990), provided by the American Wood-Preservers Association, buyers guides from the Southern Pressure Treaters Association and Western Wood Preservers Institute, and confidential lists from two chemical companies. Additional truss manufacturers were compiled from membership of the Wood Truss Council of America and the Truss Plate Institute. All wood treating and wood truss manufacturing firms found within these lists were included in the sample.

Data Collection

First Questionnaire

A questionnaire was developed which included the 80 quality items and questions designed to obtain respondent demographic information. The 80 quality items were measured on a seven point importance scale. The left end (1) was labeled "Well Below Average Importance", the midpoint (4) "Average Importance", and the right end (7) "Well Above Average Importance." Respondents rated each item by circling the number they felt most accurately represented the item's importance to overall quality. Demographic data that was collected consisted of: business size as measured by sales revenue and total number of employees, region of the country in which the company was located, volume of softwood lumber purchased, primary channels through which lumber was purchased, and the respondent's duties within the company. Three questions were also included that were designed to assess the respondents purchase tendencies in relation to quality and price.

After many revisions, the questionnaire was reviewed by faculty and graduate students of the Department of Wood Science and Forest Products. The questionnaire was then pretested with local industry members (two wood treating firms, one truss manufacturer, and four home centers). The author visited each firm and discussed the questionnaire with the subject as they completed it. The questionnaire functioned well during the pretest process. Minor changes were made in the form of short definitions on several quality items to allow all respondents a complete understanding of the meaning of the items.

The questionnaire was next pilot tested using a sub-sample of 100 home center firms. Pilot testing was performed to assess the expected response rate for the survey and to assure that respondents would complete the entire questionnaire. The author was concerned with the length of the questionnaire and the repetitive nature of rating 80 quality items. With no prenotification and no follow-up, the pilot test provided 18 useable responses. In addition, respondents did not skip quality items or circle large blocks of numbers. The questionnaire appeared to function well and provided a reasonable return rate. Given these results, the full scale survey was undertaken.

A structured, undisguised mail survey was used to collect data. This system of collecting data is the most efficient and cost effective means of securing nationally distributed data (Dillman 1978), affords a high degree of anonymity for the respondent, and is not limited by rigid time constraints that impede the effectiveness of other methods.

The survey process began with a prenotification post card to heighten the awareness of the respondent and expose undeliverable addresses. Two weeks after prenotification, questionnaires, including a cover letter soliciting participation, were mailed. Ten days subsequent to this, a follow up post card was sent to respondents as a reminder to reply. After another two weeks, questionnaires

were again sent to those who had not responded. A second follow up post card concluded the survey process. Since the wood treating group was so small, an additional questionnaire and follow up were mailed to increase total response. The surveying process began in August of 1991 and was completed in early October. Adjusted response rates for home center, wood treating, and truss manufacturing firms were 34, 51, and 50 percent, respectively (Table 1-1).

Second Questionnaire

A second questionnaire was developed based on analysis of data from the first questionnaire. This questionnaire was used to measure perceived importance of quality dimensions as well as perceived performance of most and least preferred suppliers of respondents. A total of 846 questionnaires were mailed and 332 useable responses received. The survey process consisted of one mailing of the questionnaire and one postcard follow-up. Specifics of the second questionnaire and its development and content will be discussed further in subsequent chapters.

Survey Results and Demographics

Nonresponse bias

Nonresponse bias is a common concern in survey research and occurs when there is a failure to obtain information from a large number of members of the sample and these members somehow differ from respondents thus possibly affecting conclusions (Yu and Cooper 1983). Fowler (1984)

claims that nonresponse potentially presents the most important source of systematic error and could present the greatest problem with respect to the accuracy of sample estimates.

High response rates, such as those obtained in this study, decrease the likelihood of nonresponse bias being a problem (Fowler 1984, Churchill 1991). To investigate the possibility of bias, early respondents from each group were compared to late respondents on each of the quality items and on the demographic variables: Volume of lumber purchased, sales volume, and total number of employees.

By comparing those who respond immediately to those who fail to reply until after follow-up steps are taken (given the assumption that late respondents are similar to nonrespondents), evidence of the existence or nonexistence of nonresponse bias can be obtained.

All 80 quality items were used in a multivariate analysis of variance to determine if early responders differed from late responders. In addition, the demographic variables were compared using analysis of variance. No differences were found for any of the three groups. Given this information, it was assumed that nonresponse bias was not present in the data.

Demographic Findings

Wood treating firms were largest in two out of three size related demographic categories (lumber use and average sales). Home centers were largest when measured by their number of employees (Table 1-2). Species utilization can be seen in Table 1-3 and follow what might be expected. Nearly 75 percent of the lumber treated was southern pine. Hem/fir was the next largest category at just over seven percent. Home centers use southern pine and Canadian SPF in nearly equivalent amounts with Douglas-Fir a distant third. Truss manufacturers used southern pine the

most with Canadian SPF a close second. This information is given by region for each industry in Tables 1-4, 1-5, and 1-6.

All three industries purchase the majority of their lumber directly from the sawmill. Wholesalers/Brokers/Distribution Centers was the next most common channel category (Table 1-7). Truss manufacturers and wood treaters obtained significant proportions of their lumber from company owned sawmills. Home centers purchased larger proportions of their lumber from co-ops and reload centers than either wood treaters or truss manufacturers. Breakdowns for each industry by region can be found in Tables 1-8, 1-9, and 1-10.

The author considered it important that respondents be buyers of softwood lumber. It is often difficult to obtain the correct contact within a company and even then one is never assured that the questionnaire isn't passed on to a subordinate. Because of this concern, respondents were asked to indicate their responsibilities within their respective companies. Table 1-11 displays the percentage of respondents within each responsibility category. Because of the high percentage answering that they were responsible for purchasing it appeared that the questionnaire made it to the proper person within the company most of the time.

The United States was divided into the four census regions and an additional division of the southern region was made because of possible differences in treaters of east side and west side southern pine (Figure 1-2). Table 1-12 shows the distribution of respondents among the five regions.

Additional results specific to the testing of the theorized model of softwood lumber quality displayed in Figure 1-1 are discussed in the following sections of this document.

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Table 1-1: Sample Size and Adjusted Response Rates for Each Group Sampled

Respondent Group	Valid Sample Size	Valid Returns	Adjusted Response Rate
Home Centers	1063	375	34.0%
Treaters	367	187	51.0%
Truss Manufacturers	610	305	50.0%

Table 1-2: Average Sales, Average Lumber Volume Purchased, and Employment by Respondent Group

Category	Respondent Group		
	Truss Mfgs.	Treaters	Home Centers
Average Board Foot Volume (MBF)	8,185	40,162	15,524
Average Sales (\$000)	\$10,503	\$60,252	\$38,798
Average Number of Employees	83	159	198

Table 1-3: Species Utilization by Responding Firms

Lumber Species Utilized	Respondent Group		
	Truss Mfgs.	Treaters	Home Centers
Douglas-Fir	13.0%*	5.6%	15.4%
Southern Pine	36.5%	73.3%	29.3%
Ponderosa/Lodgepole Pine	1.8%	5.1%	4.0%
Hem/Fir	15.3%	7.2%	9.6%
Northern Pine	0.0%	1.5%	0.4%
Spruce/Fir (U.S.)	4.6%	1.1%	6.5%
SPF (Canada)	27.6%	5.6%	32.0%
White Pine	1.1%	0.3%	2.5%
Other	0.2%	0.3%	0.5%

* Percent breakdown based on lumber volume. May not add to 100% due to rounding.

Table 1-4: Species Utilization by Region for Truss Manufacturers

Lumber Species Utilized	Region				
	West	North Central	South Central	Northeast	Southeast
Douglas-Fir	47.0%*	4.0%	12.9%	9.9%	7.8%
Southern Pine	1.4%	22.1%	59.8%	46.5%	52.7%
Ponderosa/Lodge pole Pine	1.4%	1.2%	0.0%	0.8%	2.9%
Hem/Fir	30.7%	24.2%	0.6%	2.5%	4.1%
Northern Pine	0.0%	0.0%	0.0%	0.0%	0.0%
Spruce/Fir (U.S.)	1.7%	2.1%	11.1%	10.8%	7.2%
SPF (Canada)	17.5%	46.1%	15.6%	28.7%	22.9%
White Pine	0.1%	0.4%	0.0%	0.8%	2.1%
Other	0.2%	0.0%	0.0%	0.0%	0.3%

* Percent breakdown based on lumber volume. May not add to 100% due to rounding.

Table 1-5: Species Utilization by Region for Home Centers

Lumber Species Utilized	Region				
	West	North Central	South Central	Northeast	Southeast
Douglas-Fir	62.5%*	8.7%	10.0%	9.6%	2.4%
Southern Pine	3.9%	14.6%	18.2%	22.9%	42.8%
Ponderosa/Lodge pole Pine	3.3%	6.2%	1.9%	1.0%	3.2%
Hem/Fir	22.9%	11.9%	4.4%	9.2%	3.4%
Northern Pine	0.0%	1.6%	2.1%	0.8%	0.4%
Spruce/Fir (U.S.)	1.9%	2.4%	3.8%	11.7%	4.6%
SPF (Canada)	3.5%	53.5%	58.5%	38.7%	41.5%
White Pine	0.4%	0.8%	1.0%	5.6%	1.4%
Other	1.5%	0.2%	0.0%	0.4%	0.2%

* Percent breakdown based on lumber volume. May not add to 100% due to rounding.

Table 1-6: Species Utilization by Region for Treating Firms

Lumber Species Utilized	Region				
	West	North Central	South Central	Northeast	Southeast
Douglas-Fir	29.7%*	15.6%	23.3%	15.3%	2.4%
Southern Pine	10.6%	43.2%	76.4%	65.2%	42.8%
Ponderosa/Lodge pole Pine	4.6%	15.6%	0.0%	3.7%	3.2%
Hem/Fir	39.9%	3.4%	0.2%	1.7%	3.4%
Northern Pine	1.1%	4.8%	0.0%	1.1%	0.4%
Spruce/Fir (U.S.)	2.9%	2.6%	0.0%	0.9%	4.6%
SPF (Canada)	9.7%	13.5%	0.0%	11.2%	41.5%
White Pine	1.0%	0.7%	0.0%	0.5%	1.4%
Other	0.5%	0.6%	0.1%	0.4%	0.2%

* Percent breakdown based on lumber volume. May not add to 100% due to rounding.

Table 1-7: Distribution Channels Utilized by Responding Firms

Channel	Respondent Group		
	Truss Mfgs.	Treaters	Home Centers
Direct from Sawmill	47.5%*	68.7%	46.1%
Company Owned Sawmill	9.3%	11.4%	3.4%
Buyer Co-ops	4.5%	0.7%	6.1%
Wholesaler/Broker/ Distribution Center	36.1%	18.4%	34.6%
Reload Center	2.6%	0.8%	9.8%
Other	0.0%	0.0%	0.0%

* Percent breakdown based on lumber volume. May not add to 100% due to rounding.

Table 1-8: Distribution Channel Utilization by Region for Truss Manufacturers

Channel	Region				
	West	North Central	South Central	Northeast	Southeast
Direct from Sawmill	55.6%*	51.0%	50.7%	46.7%	47.8%
Company Owned Sawmill	0.0%	2.5%	32.2%	21.8%	18.1%
Buyer Co-ops	0.8%	5.6%	0.0%	7.2%	2.3%
Wholesaler/ Broker/ Distribution Center	42.3%	38.7%	16.0%	19.8%	30.0%
Reload Center	1.1%	2.2%	1.1%	4.4%	1.8%
Other	0.1%	0.0%	0.0%	0.1%	0.0%

* Percent breakdown based on lumber volume. May not add to 100% due to rounding.

Table 1-9: Distribution Channel Utilization by Region for Home Centers

Channel	Region				
	West	North Central	South Central	Northeast	Southeast
Direct from Sawmill	48.8%*	62.4%	64.2%	47.9%	49.3%
Company Owned Sawmill	5.7%	0.8%	0.1%	3.6%	2.8%
Buyer Co-ops	1.3%	2.2%	3.0%	12.8%	3.6%
Wholesaler/ Broker/ Distribution Center	41.5%	23.2%	21.8%	24.5%	31.7%
Reload Center	2.7%	11.4%	11.0%	11.1%	12.5%
Other	0.0%	0.0%	0.0%	0.0%	0.0%

* Percent breakdown based on lumber volume. May not add to 100% due to rounding.

Table 1-10: Distribution Channel Utilization by Region for Treating Firms

Channel	Region				
	West	North Central	South Central	Northeast	Southeast
Direct from Sawmill	68.7%*	52.1%	58.5%	68.3%	49.3%
Company Owned Sawmill	2.7%	18.6%	16.3%	2.8%	2.8%
Buyer Co-ops	0.5%	0.0%	1.4%	0.0%	3.6%
Wholesaler/ Broker/ Distribution Center	27.6%	27.6%	23.3%	28.1%	31.7%
Reload Center	0.4%	1.7%	0.5%	0.8%	12.5%
Other	0.0%	0.0%	0.0%	0.0%	0.0%

* Percent breakdown based on lumber volume. May not add to 100% due to rounding.

Table 1-11: Respondent's Reported Duties Within Their Company

Responsibility	Respondent Group		
	Truss Mfgs.	Treaters	Home Centers
Buying	94.3%*	97.8%	96.9%
Quality Control	63.5%	63.7%	64.3%
Production Mgmt.	86.2%	51.4%	17.6%
Retail Mgmt.	35.5%	25.7%	66.3%
Sales	59.8%	75.4%	66.3%
Engineering	48.0%	22.9%	8.5%

*Columns add to more than 100% due to multiple responsibilities for each respondent.

Table 1-12: Regional Location of Responding Firms

Region	Respondent Group		
	Truss Mfgs.	Treaters	Home Centers
West	25.9%*	17.2%	15.7%
North Central	25.2%	20.3%	28.0%
South Central	5.9%	13.4%	7.5%
Northeast	16.1%	12.8%	25.9%
Southeast	37.7%	54.5%	24.8%

* Columns may add to more than 100% due to multiple location businesses.

SERVICE RELIABILITY

1. Consistent, on Schedule Delivery by Supplier
2. Product Availability
3. Correct Record Keeping by Supplier
4. Accuracy of Supplier's Billing System

RESPONSIVENESS

5. Supplier's Ability to Deliver Quickly on Short Notice
6. Eagerness of Supplier's Salespeople to Meet your Needs
7. Supplier's Salespeople Enjoy Their Job
8. Supplier Rapidly Responding to and Solving Problems
9. Quick Callbacks by Supplier's Salespeople
10. Electronic Data Interchange with Supplier
11. Not Being Put on Hold Excessively when Telephoning Supplier
12. The Ease with Which the Supplier Can be Contacted by Telephone

ASSURANCE

13. Knowledge and Skill of Supplier's Sales Personnel
14. Manufacturing Expertise of Supplier
15. Absence of Hard Sell Techniques by Supplier's Salespeople
16. Dealings with Supplier Being Held Confidential
17. Trustworthiness of Supplier's Salesperson
18. Being Respected by Supplier's Salesperson
19. Friendliness of Supplier's Salesperson
20. Ease of Understanding Supplier's Salesperson
21. Supplier Handles Problems Professionally and Fairly
22. Personal Relationship with Supplier
23. Personal Relationship with Supplier's Salesperson
24. Supplier's ability to Understand Conditions of Special Orders
25. Candidness of Supplier's Salesperson

EMPATHY

26. Convenience of Supplier's Hours of Operation
27. Supplier's Willingness to Learn Your Specific Requirements
28. Supplier's Salesperson Giving Individualized Attention
29. Being Recognized by Supplier's Salespeople as a Regular Customer
30. Empathy by the Supplier for Your Needs
31. Supplier Understanding Your Needs
32. Supplier Anticipating Your Needs

TANGIBLES

33. Supplier's Physical Facilities
34. Tools/Equipment Used to Produce Lumber
35. Convenience of Supplier's Location

PERFORMANCE/CONFORMANCE

36. Location and Legibility of Grade Stamp
37. Stiffness/Strength of Lumber
38. Dense/Non-Dense Classification
39. Ease of Nailing
40. Fastener Retention
41. Lumber Straightness
42. Absence of End Splits
43. Absence of Wane
44. Absence of Sloped Grain

45. Absence of Knots
46. Absence of Shake
47. Absence of Heartwood
48. Accuracy and Consistency of Grading
49. Accuracy and Consistency of Machining
50. Accuracy and Consistency of Moisture Content
51. Kiln Dried
52. Precision End Trimming
53. Square End Trimming

AESTHETICS

54. Overall Lumber Appearance
55. Clean Lumber/Pack
56. Neat-Undamaged Pack
57. Absence of Torn Grain
58. Absence of Stain
59. Absence of Planer Skip

DURABILITY

60. Durability of Lumber
61. Long Service Life of Lumber

PRODUCT RELIABILITY

62. Failure Rate of Lumber in Service
63. Reliability of Lumber Strength Values

PERCEIVED QUALITY

64. Reputation of Supplier
65. Previous Experiences with Supplier
66. Reputation of Supplier's Salesperson

FEATURES

67. Machine Stress Rating
68. Anti-Stain Treatment
69. Bar Coding of Lumber
70. End Coating of Lumber
71. Protective Wrapping of Lumber

COOPERATIVENESS/SUPPLIER SERVICES

72. Supplier's Willingness to Fill Large Orders
73. Supplier's Willingness to Fill Small Orders
74. Supplier Arranged Shipping
75. Supplier's Willingness to Supply Mixed Loads
76. Supplier Offering a Variety of Species
77. Credit Terms Offered by Supplier
78. Long Term Price Agreements Offered by Supplier
79. Firm Prices Quoted by Supplier
80. Just In Time Delivery Offered by Supplier

Figure 1-1: Theorized Dimensions of Total Product Quality and Corresponding Items Used for Measurement

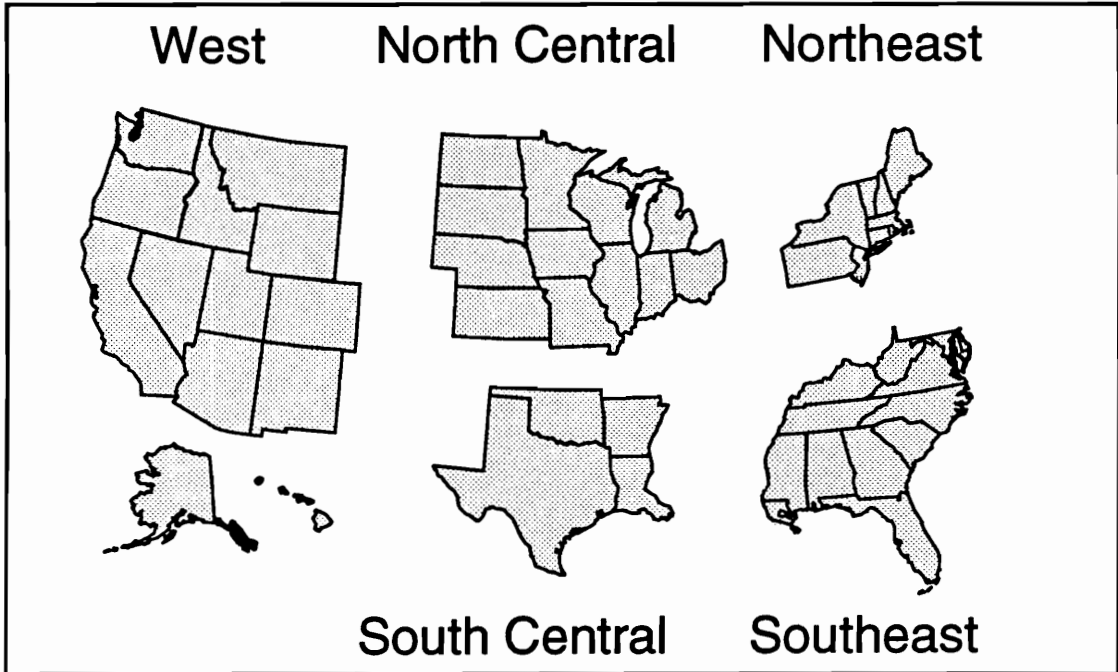


Figure 1-2: Regional Breakdown of United States Used in This Study

AN EMPIRICAL ASSESSMENT OF THE DIMENSIONS OF TOTAL PRODUCT QUALITY

Abstract: A model of total product quality, based on previous work (Garvin 1984 and Parasuraman et al. 1988), was developed and tested using three groups of softwood dimension lumber buyers. Initial development resulted in a twelve dimension, 80 item, model of quality. The model was tested using confirmatory factor analysis which indicated that the data did not fit the model. Exploratory factor analysis was then used to identify the dimensions underlying the data. Five dimensions of quality were found: **Supplier/Salesperson Characteristics, Supplier Services, Supplier Facilities, Lumber Performance, and Lumber Characteristics**. Additional data was collected to assess the appropriateness of the model. The evidence indicated that buyers of softwood lumber appear to perceive softwood lumber quality in five dimensions and prefer suppliers who perform well on those dimensions.

Introduction

The importance of quality should not be underestimated. Cravens et al. (1988) state that regardless of whether one is concerned with goods or services, developing an effective quality strategy is one of the most important challenges top management faces. O'Neal and LaFief (1992 p. 134) state that ". . . quality is increasingly cited as a primary strategic variable for effectively competing in the global marketplace." Some feel that quality often must be improved merely to maintain competitive position (Whiting and Walsh 1986) and Steenkamp (1990) claims that quality competition has even taken the place of price competition.

According to Garvin (1987), quality isn't just a problem to be solved, but a competitive opportunity. In fact, quality as a competitive strategy is becoming more prevalent. Why pursue a quality strategy? Because producing high quality products can mean improved return on investment (ROI) and higher market share (Jacobson and Aaker 1987, Phillips et al. 1983, Shetty 1987). Phillips et al. (1983) indicate no consistent direct effect of product quality on ROI in raw and semifinished materials businesses, however, they did find indirect effects through enhanced market position.

The importance of quality is nearly universally recognized, yet very little is understood about the concept. To strive for and improve upon a quality strategy, quality has to be accurately and periodically measured (Shetty 1987, Whiting and Walsh 1986). However, the conceptualization and measurement of quality have not been adequately studied (Zeithaml 1988). An enhanced understanding of quality as a strategic variable is an essential tool in the quest for competitive advantage.

To develop a better understanding of quality, this study was undertaken to measure quality in the commodity product softwood dimension lumber. A theoretical model based on past research (Parasuraman et al. 1988, Garvin 1984) was developed and empirically tested.

Operationalizing Quality

Researchers in the area of quality conclude that the customer's perception of quality, is the key to producing a high quality product (Garvin 1984, Takeuchi & Quelch 1983, Ross & Shetty 1985, Kaspar & Lemmink 1989, Parasuraman et al. 1988). Garvin (1984) and Parasuraman et al. (1988) have extensively researched quality. Garvin's research was primarily concerned with product quality while Parasuraman et al's was in the area of service quality. Following Garvin's and Parasuraman et al's. work, the literature has most often separated the physical product from its associated services. This separation, however, provides an incomplete perspective of quality since every physical product has services associated with it (credit, delivery, etc.).

Other researchers have pointed out this discrepancy by suggesting that a product be evaluated as a *total* or *augmented* product which simply means the package of benefits a product provides, including services. Brown and Fern (1981) suggest that managers and researchers tend to concentrate on the physical product while the consumer evaluates the total product. Powers (1988) claims that non-product related items are often of primary importance to potential customers. Kyj (1987) claims that customer service cannot be separated from the physical product because the utility of the entire product is influenced by service quality. Cravens et al.

(1988) state that a quality program must consider the attributes of the physical product as well as the supporting services.

The evidence suggests that when defining quality one cannot merely consider the physical product itself, but must also consider the services associated with that product (i.e. the total product). Sinclair et al. (1993 p. 75) state ". . . the services offered and the quality of those services significantly impact the perceived quality of the entire company and its product(s)." and "Companies may well be perceived through people and through the services they provide as much or more than through the actual physical product." In fact, Sonnenburg (1989) cites a survey in which the number one reason for customers switching to the competition was poor service, an indication that service quality is essential to the physical product being perceived as high quality. Kaspar and Lemmink (1989) claim that product and service strategies should be matched because the industrial consumer evaluates the physical product's quality as well as the quality of the service associated with that physical product. Accordingly, quality judgements are made on the total product including both the physical product and its associated services (Kujala 1987). In commodity products such as the one investigated in this study this may be of particular relevance.

This study's goal was to construct a model of total product quality (both product and service quality) for softwood lumber. Twelve theorized dimensions were identified primarily from the work of Garvin (1984) and Parasuraman et al. (1988). Underlying previous work in the area of quality is the idea that quality can be generalized across products. That is, the concept of quality is the same for all products (Zeithaml 1988). Therefore, it is appropriate to apply the models of quality purported by these authors to softwood dimension lumber.

Service Quality Model

Parasuraman et al. (1988) outline five dimensions of service quality. **Service Reliability** is the *ability to perform the promised service dependably and accurately*, **Responsiveness** is the *willingness to help customers and provide prompt service*, **Assurance** is the *knowledge and courtesy of employees and their ability to inspire trust and confidence*, **Empathy** is the *caring, individualized attention the firm provides its customers*, and **Tangibles** are the *physical facilities, equipment, and appearance of personnel*. These dimensions of quality proposed by Parasuraman et al. (1988) were for services such as banking; however, they apply equally to the services associated with a physical product. Kaspar and Lemmink (1989) claim that the concept of service quality proposed by Parasuraman et al. (1988) may be applied to services offered as part of an industrial product.

Product Quality Model

Garvin (1984) proposed eight dimensions of product quality. **Performance** is the *"primary operating characteristics" of the product such as picture clarity in a television*, **Features** are the *"bells and whistles" inherent in the product such as a screen-in-screen option on a television*, **Product Reliability** is *how soon and often the product fails*, **Conformance** is *whether the product meets its design standards*, **Durability** is *"the amount of use one gets from a product before it physically deteriorates."*, **Serviceability** is the *"speed, courtesy, and competence of repair."*, **Aesthetics** is *"how a product looks, feels, sounds, tastes, or smells"*, a *matter of personal judgement*, and **Perceived Quality** is the *consumer's opinion of the product*

as it has been influenced through "images, advertising, or brand names." or how the consumer evaluates the product when other information is unavailable.

Combined Model

Garvin's (1984) model of product quality and Parasuraman et al's (1988) model of service quality address only one component each of the total quality picture. To prepare a complete model of total product quality it was necessary to utilize both models. This combination provided an initial model containing 13 dimensions of total product quality. There is no empirical evidence to suggest that combining these models will result in a complete model of total product quality. Additional dimensions of total product quality may exist (i.e., this model may not be exhaustive). Nor is there evidence to suggest that these dimensions are mutually exclusive.

Item Measurement

While there is a general consensus in the literature that quality is multi-dimensional and should be measured by customer ratings of items designed to represent these dimensions there is little consensus concerning the method of measuring the items. Many studies have used a difference or gap score to measure quality. Parasuraman et al. (1988) measure quality as the difference between what a consumer expects firms in general to provide and how well a particular firm performs (Quality = Performance - Expectations). In other words, if performance exceeds expectations then the consumer is satisfied with the quality of the product or service.

There are, however, significant problems with this approach to measuring quality. Several authors claim that difference scores are simply not appropriate. Reliability, discriminant

validity, and variance restriction problems are inherent to the difference score method (Brown et al. 1993, Peter et al. 1993). Reliability of the difference score is affected by the correlation of the two measures and their respective reliabilities (Parasuraman et al. 1993) so if one is unreliable then the difference score is unreliable and not valid. Discriminant validity is the degree to which measures of theoretically unrelated constructs are correlated (Brown et al. 1993). Measures with low reliabilities are naturally less correlated meaning that discriminant validity may appear to be present merely as a function of the low reliabilities of the measures (Brown et al. 1993). Variance restriction can occur when one measure is consistently rated higher than the other (Peter et al. 1993). This might often be the case when comparing expectations to performance where expectations might be consistently higher than performance.

Although Parasuraman et al. (1993) argue that these problems are of little significance in their work, other authors argue that difference scores should not be used because they provide inconsistent factor structures and often are affected by psychological constraints (Carman 1990, Babakus and Boller 1992).

Beyond these arguments looms a larger problem associated with this method of measurement. Zeithaml (1988) states that quality is a higher order abstract. This simply means that dimensions of quality should be similar regardless of the product. If this is truly the case, performance and expectations (the two components of the difference score) are only significant in assessing how well a particular firm is providing quality. This method of measurement assumes quality is predefined and is merely measuring the performance of a specific firm. In fact, Cronin and Taylor (1992 p. 58) state, ". . . current performance adequately captures consumers' perceptions of the service quality offered by a *specific* service provider (emphasis added)."

The importance of items and the dimensions they represent is the true key to understanding and defining quality. Cravens et al. (1988) claim that an operational concept of quality should start with the buyer's perceptions and that the real issue is finding what is important to that buyer. In fact some authors (Carman 1990, Cravens et al. 1985) suggest that in addition to expectations and performance, quality is a function of importance. Other studies have found that expectations and importance scales are interpreted the same by respondents and that either may be used when measuring quality (Lambert and Lewis 1990). Even Parasuraman et al. (1991 p. 424) state that, ". . . direct measures of the importance of various service attributes are also useful, particularly for combining individual attribute ratings to obtain a composite, weighted estimate of overall service quality."

Importance ratings can be obtained from the respondent without reference to a specific firm and they do not pose the problems of difference scores. In addition, importance scores can be used to establish an ideal level such as that used by Cravens et al. (1985). Proceeding on the arguments presented, this study used importance ratings to measure quality items. Each item's importance to overall quality was based on an 7 point scale with "1" labeled "Well Below Average Importance", "4" labeled "Average Importance", and "7" labeled "Well Above Average Importance."

Methods

Softwood dimension lumber and its associated services was chosen as the total product to investigate in this study because of the large volumes consumed in the United States

(approximately 45.7 billion board feet in 1992) (Miller Freeman 1993) and the limited understanding of quality in that product. Three large softwood dimension lumber consumer groups were sampled (retail home centers, wood treating firms, and wood truss manufacturers). Each group was queried as to its perceptions of quality in softwood lumber.

Garvin's (1984) and Parasuraman et al.'s (1988) models of quality were evaluated as to their application to softwood lumber as a total product. All of the dimensions except Garvin's **Serviceability** appeared applicable. **Serviceability**, defined as the "speed, courtesy and competence of repair", did not apply to softwood lumber and was not considered further. **Performance** and **Conformance** could not be separated in the context of softwood lumber. These two dimensions were combined and items compiled to represent **Performance/Conformance**. Quality items were selected that described each of the remaining dimensions.

Item Selection

Churchill (1991) suggests that techniques used in exploratory research such as literature searches, experience surveys, and insight-stimulating examples are appropriate for generating items for construct measurement. Literature searches and experience surveys were both used to assemble quality items. Previous literature (Garvin 1984, Parasuraman et al. 1988, Govett and Sinclair 1984, Seward and Sinclair 1988, Hansen 1992) and discussions with University faculty and industry professionals provided an enhanced understanding of the items considered by consumers of softwood lumber when evaluating quality.

The final result after gathering, editing, and eliminating duplicates was a set of 80 items representing various aspects of quality. Nine of the 80 items did not appear to describe any of the 11 total quality dimensions from the combined theoretical model. These items however, did appear to measure the cooperativeness of the supplier and the services that a supplier provides. Accordingly, an additional dimension was added to the combined model for a total of 12 theoretical dimensions of total product quality. Figure 2-1 shows the theorized dimensions with the wordings of items representing each.

Data Collection

A mail survey was used for data collection. Prior to mailing, softwood lumber buyers were identified in each sampled firm. Wood treating firms, wood truss manufacturing firms, and home centers were sampled. Respondents rated the importance to overall quality of each of the 80 items, rated their agreement with several quality and price related purchase decision criteria, and provided various categories of demographic information.

Response Rate

A total sample size of 2040 provided 375, 187, and 305 returned, useable questionnaires from home center, wood treating firm, and wood truss manufacturer buyers, respectively. Response rates were adjusted to account for undeliverables and companies outside the population of interest. The adjusted response rate for each of the three groups of respondents was 34, 51, and 50 percent, respectively, for an overall response rate of 43 percent.

Nonresponse bias

Nonresponse bias results when there is a failure to obtain information from a large number of members of the sample and they somehow differ from respondents, thus possibly influencing conclusions (Yu and Cooper 1983). Response rates in this study were high for an industrial population. To investigate the possibility of nonresponse bias, early respondents were compared to late respondents on each of the quality items and on the demographic variables: volume of lumber purchased, sales volume, and total number of employees. The 80 items were compared using multivariate analysis of variance and the three demographic variables were compared using simple analysis of variance. No significant differences were found. Nonresponse bias did not appear to be present.

Results and Discussion

Gerbing and Anderson (1988) outlined an updated paradigm for scale development. This paradigm incorporates the use of confirmatory factor analysis to assess the unidimensionality of measures. For a measure to be unidimensional it should be both internally consistent and externally consistent. "The criterion of internal consistency specifies how the items composing a unidimensional cluster should correlate with one another. The criterion of external consistency or parallelism specifies how these items should correlate with variables outside the cluster" (Hunter and Gerbing 1982 p. 278). The unidimensionality of the twelve theorized dimensions of quality were assessed using the confirmatory factor analysis software package, ITAN (Gerbing and Hunter 1988). More simply stated, confirmatory factor analysis was used to determine if the

items measuring each of the theoretical dimensions of total product quality were measuring one and only one construct.

Similarity coefficients indicated a lack of external consistency in the twelve dimensions of quality (Anderson and Gerbing 1982). This was evidence that the twelve constructs were not each unidimensional and suggested that total product quality is not made up of 12 dimensions. The apparent failure of the 12 dimension model necessitated the use of exploratory factor analysis to assess the underlying dimensionality of the data.

The Kaiser-Meyer-Olkin measure of sampling adequacy, ". . . provides a measure of the extent to which the variables belong together and are thus appropriate for factor analysis" (Hair et al. 1987 p. 285). According to the calibration provided by Kaiser and Rice (1974) the value for the data in this study (.95) is considered marvelous (i.e., anything above .9 is very good). Bartlett's test of sphericity tests the hypothesis that, ". . . the correlation matrix came from a population of variables that are independent" (Hair et al. 1987 p. 285). One would not want variables theorized to measure the same construct to be independent. For the data in this study the hypothesis was rejected (.00). Both tests indicated that factor analysis was an acceptable method of analysis for the data.

Principle-axis factoring with oblique (Oblimin) rotation provided by the Statistical Package for the Social Sciences was used. Since each of the dimensions were assumed to measure some aspect of quality, there was no reason to expect them to be uncorrelated. Accordingly, the non-orthogonal (Oblimin) rotation was chosen. Fifteen factors, explaining 61.4 percent of the variance, obtained eigenvalues greater than one while the scree plot indicated retention of approximately seven factors which explained 49.5 percent of the variance. However,

a five factor model, explaining 41.5 percent of the variance, provided groups of items that appeared to be content valid and thus provided the most interpretable solution.

In the following discussion the original 12 dimension model is compared to the five dimension model in both its initial form and after respecification. Items that did not load at least .4 on any of the five factors were deleted prior to reliability analysis. This eliminated three items: Convenience of Suppliers Location, Electronic Data Interchange with Supplier, and Long Term Price Agreements Offered by Supplier. Figure 2-2 provides a general outline of how the original twelve dimensions joined to form five factors. Thirty-three of the remaining items loaded on a factor that was a combination of the original dimensions: **Service Reliability, Responsiveness, Assurance, Empathy, and Perceived Quality**. Factor two contained two **Tangibles** items and two **Features** items. **Performance/Conformance, Product Reliability, Durability, Features, and Aesthetics** combined to form two factors. Finally, the fifth factor was primarily made up of items used to measure the dimension added by the author: **Cooperativeness/Supplier Services**. Figure 2-3 displays the items representing each of the five factors as well as the reliability of each factor as measured by Cronbach's Alpha. With the exception of Factor 2, this model displays very good reliabilities ranging from a low of .76 to a high of .95. The five factor model was next respecified to obtain the best possible reliabilities.

Respecification began by moving Manufacturing Expertise of Supplier and Product Availability from Factor 4 to Factor 1. Both items displayed similar loadings on Factors 1 and 4. This reassignment accomplished two things. First, it increased the reliability of Factor 1. Second, it allowed Factor 1 to include all items representing four of the five service dimensions

from Parasuraman et al. (1988). After this reassignment a total of seven items were deleted, each of which improved the reliability of their respective factors. The items deleted were: Absence of Hard Sell Techniques by Supplier's Salesperson, Bar Coding of Lumber, Square End Trimming, Anti-Stain Treatment, Precision End Trimming, Kiln Dried, and Absence of Knots.

After respecification of the model based on factor loadings and Cronbach's Alpha, the dimensions were explainable, easy to name, and consistent combinations of the originally theorized dimensions. Figure 2-4 displays the resulting reliability as well as the assigned names of each of the five dimensions.

These findings display both similarities and differences when compared to past research. When investigating the presence of Garvin's eight dimensions in wood office furniture, Sinclair et al. (1993) found that **Performance** and **Features** combined to form one factor as did the dimensions **Serviceability** and **Perceived Quality**. The items selected in this study to measure **Features** ended up in three of the five dimensions, so there is no similarity. However, **Perceived Quality** did combine into a service oriented dimension as it did in the previous work by Sinclair et al. (1993). Babakus and Boller (1992), investigating quality for a utility, found Parasuraman et al.'s (1988) measure of service quality (SERVQUAL) to be essentially unidimensional. Although Cronin and Taylor (1992), investigating the banking, pest control, dry cleaning, and fast food industries, assessed the dimensionality of the expectation and performance components of the SERVQUAL scale separately, they found each of the components to be unidimensional. Finn and Lamb (1991) found that data collected from four types of retail firms did not fit the five factor model of service quality. They did not go so far as to test what dimensions were present in the data. The five dimensions from Parasuraman et al. (1988) combined to form two dimensions

in this study. Similar to these results, Babakus and Inhofe (1993) say that in the utilities industries two dimensions, Tangibles and Intangibles were found. Similar findings were obtained in the health care services area (Mishrah et al. 1991).

In summary, this study found that quality in softwood lumber is made up of at least five dimensions. In the case of softwood lumber, the models originally outlined by Garvin (1984) and Parasuraman et al. (1988) combined to form two dimensions each. The only crossover of Garvin's (1984) dimensions to Parasuraman et al.'s (1988) was **Perceived Quality**. This originally theorized dimension was included in the newly formed dimension, **Supplier/Salesperson Characteristics**. The additional dimension of quality added to the theoretical model by the author remained nearly intact through the analysis process.

Supplier Performance

Additional evidence was sought to determine if buyers of softwood lumber truly perceive quality in five dimensions. A second questionnaire was developed and mailed to all respondents of the first survey. In this questionnaire respondents rated the importance of each dimension of quality and the performance of their most and least preferred suppliers on the dimensions of quality. In the questionnaire, dimension names as well as example items were given to aid the respondent in assessing the meaning of the dimension. For example, the dimension **Lumber Characteristics** was represented by the four items: overall lumber appearance; accuracy and consistency of grading; lumber straightness; and neat, undamaged lumber pack. These four example items were made up of the two with the highest factor loadings and the two most

important in each dimension (**Supplier Facilities** was represented by only two items). In the case where the highest loadings and importance ratings indicated use of the same items, the next most important item was used.

Although the relative importance assigned to each dimension was in most cases higher in the second survey, the ranking of dimensions was identical (The importance rating for the first questionnaire was calculated by averaging across individual items measuring the dimension while the average for the second questionnaire was calculated by averaging the ratings for each dimension) (Table 2-1). The fact that dimensions were partially represented by the two most highly rated items likely explains the higher relative dimension importance in the second questionnaire. This consistency of evaluation seems to indicate that respondents recognized the meaning of the five dimensions of quality and perceive quality to be made up of at least five dimensions.

If the five dimension model captures the construct, quality, one would expect buyers to prefer suppliers that perform well on each of the dimensions of quality. Figure 2-5 displays importance ratings by the respondents as well as performance of their most preferred and least preferred suppliers. Performance ratings were based on a seven point scale anchored by "Well below average performance" and "Well above average performance." On every dimension, most preferred suppliers outperformed least preferred suppliers. In each case the performance of the two groups of suppliers was different at a .01 level of significance. Softwood lumber buyers not only view quality in at least five dimensions, the suppliers they prefer to do business with perform well on the measured dimensions of quality.

Conclusion

The goal of much of the quality research has been to develop a generic measure of quality that can span industries and products/services. Underlying this attempt has been the assumption that quality is a higher order abstract. To state it more simply, the assumption has been that the dimensions of quality are the same for all products, so if those dimensions can be isolated the measurement of quality can be greatly simplified. There is mounting evidence, this study being merely one of many, that this assumption is incorrect.

This study found that buyers of softwood dimension lumber perceive quality to be made up of five dimensions: **Supplier/Salesperson Characteristics, Supplier Services, Supplier Services, Lumber Performance, and Lumber Characteristics**. These findings differ from past research investigating quality and its inherent dimensions. The dimensionality of quality may be product type or industry specific. Although the model of quality developed in this study appears to adequately measure softwood lumber quality, these dimensions are unlikely to apply to all products in all industries. Quality dimensions may be similar from one commodity wood product to the next yet very different from the quality dimensions inherent in specialty products. Future research should attempt to isolate what influences the dimensionality of quality.

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Table 2-1: Mean Respondent Ratings of Quality Dimension Importance*

Dimension	1st Questionnaire		2nd Questionnaire	
	Mean (rank)	Std Dev/n	Mean (rank)	Std Dev/n
Lumber Characteristics	5.56 (1)	.84/836	6.22 (1)	1.08/331
Supplier/Salesperson Characteristics	5.33 (2)	.78/795	5.78 (2)	1.07/331
Lumber Performance	4.86 (3)	1.00/806	5.65 (3)	1.36/330
Supplier Services	4.85 (4)	.91/831	5.47 (4)	1.22/329
Supplier Facilities	4.20 (5)	1.36/848	4.10 (5)	1.43/329

* 1=Well below average importance, 7=Well above average importance. The average for the 1st questionnaire was calculated by averaging across individual items measuring the dimension while the average for the 2nd was calculated by averaging the ratings of each dimension.

SERVICE RELIABILITY

1. Consistent, on Schedule Delivery by Supplier
2. Product Availability
3. Correct Record Keeping by Supplier
4. Accuracy of Supplier's Billing System

RESPONSIVENESS

5. Supplier's Ability to Deliver Quickly on Short Notice
6. Eagerness of Supplier's Salespeople to Meet your Needs
7. Supplier's Salespeople Enjoy Their Job
8. Supplier Rapidly Responding to and Solving Problems
9. Quick Callbacks by Supplier's Salespeople
10. Electronic Data Interchange with Supplier
11. Not Being Put on Hold Excessively when Telephoning Supplier
12. The Ease with Which the Supplier Can be Contacted by Telephone

ASSURANCE

13. Knowledge and Skill of Supplier's Sales Personnel
14. Manufacturing Expertise of Supplier
15. Absence of Hard Sell Techniques by Supplier's Salespeople
16. Dealings with Supplier Being Held Confidential
17. Trustworthiness of Supplier's Salesperson
18. Being Respected by Supplier's Salesperson
19. Friendliness of Supplier's Salesperson
20. Ease of Understanding Supplier's Salesperson
21. Supplier Handles Problems Professionally and Fairly
22. Personal Relationship with Supplier
23. Personal Relationship with Supplier's Salesperson
24. Supplier's ability to Understand Conditions of Special Orders
25. Candidness of Supplier's Salesperson

EMPATHY

26. Convenience of Supplier's Hours of Operation
27. Supplier's Willingness to Learn Your Specific Requirements
28. Supplier's Salesperson Giving Individualized Attention
29. Being Recognized by Supplier's Salespeople as a Regular Customer
30. Empathy by the Supplier for Your Needs
31. Supplier Understanding Your Needs
32. Supplier Anticipating Your Needs

TANGIBLES

33. Supplier's Physical Facilities
34. Tools/Equipment Used to Produce Lumber
35. Convenience of Supplier's Location

PERFORMANCE/CONFORMANCE

36. Location and Legibility of Grade Stamp
37. Stiffness/Strength of Lumber
38. Dense/Non-Dense Classification
39. Ease of Nailing
40. Fastener Retention
41. Lumber Straightness

42. Absence of End Splits
43. Absence of Wane
44. Absence of Sloped Grain
45. Absence of Knots
46. Absence of Shake
47. Absence of Heartwood
48. Accuracy and Consistency of Grading
49. Accuracy and Consistency of Machining
50. Accuracy and Consistency of Moisture Content
51. Kiln Dried
52. Precision End Trimming
53. Square End Trimming

AESTHETICS

54. Overall Lumber Appearance
55. Clean Lumber/Pack
56. Neat-Undamaged Pack
57. Absence of Torn Grain
58. Absence of Stain
59. Absence of Planer Skip

DURABILITY

60. Durability of Lumber
61. Long Service Life of Lumber

PRODUCT RELIABILITY

62. Failure Rate of Lumber in Service
63. Reliability of Lumber Strength Values

PERCEIVED QUALITY

64. Reputation of Supplier
65. Previous Experiences with Supplier
66. Reputation of Supplier's Salesperson

FEATURES

67. Machine Stress Rating
68. Anti-Stain Treatment
69. Bar Coding of Lumber
70. End Coating of Lumber
71. Protective Wrapping of Lumber

COOPERATIVENESS/SUPPLIER SERVICES

72. Supplier's Willingness to Fill Large Orders
73. Supplier's Willingness to Fill Small Orders
74. Supplier Arranged Shipping
75. Supplier's Willingness to Supply Mixed Loads
76. Supplier Offering a Variety of Species
77. Credit Terms Offered by Supplier
78. Long Term Price Agreements Offered by Supplier
79. Firm Prices Quoted by Supplier
80. Just In Time Delivery Offered by Supplier

Figure 2-1: Theorized Dimensions of Total Product Quality and Corresponding Items Used for Measurement

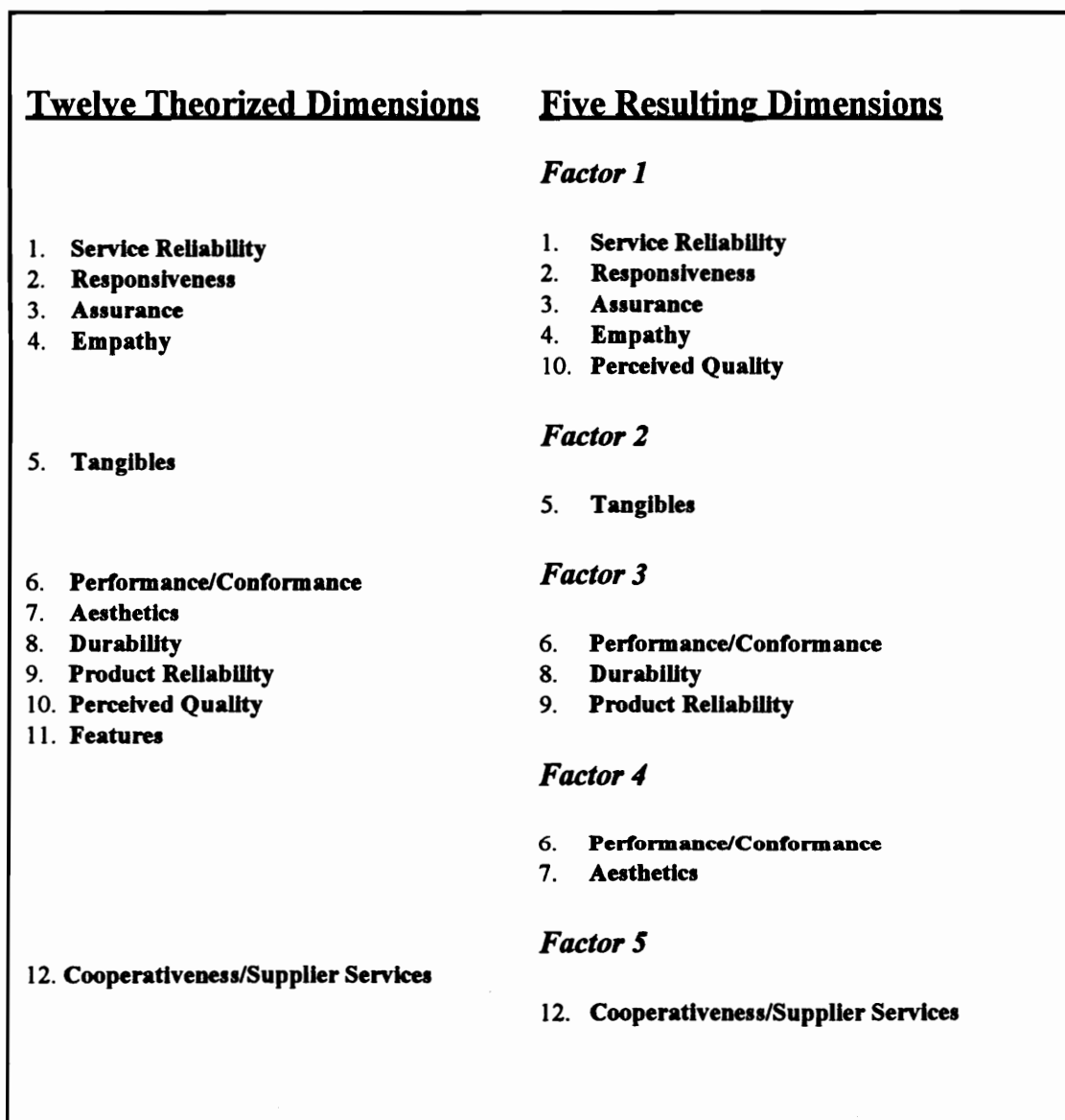


Figure 2-2: Theoretical Dimensions and Resulting Factors*

*This figure provides a general indication of how the twelve theoretical dimensions of quality combined to make five dimensions. Additional details can be found in Figures 2-1 and 2-3.

Factor 1	
Cronbach's Alpha = .949	
1. Consistent, on Schedule Delivery by Supplier	44. Absence of Sloped Grain
3. Correct Record Keeping by Supplier	
4. Accuracy of Supplier's Billing System	47. Absence of Heartwood
5. Supplier's Ability to Deliver Quickly on Short Notice	
6. Eagerness of Supplier's Salespeople to Meet your Needs	
7. Supplier's Salespeople Enjoy Their Job	
8. Supplier Rapidly Responding to and Solving Problems	
9. Quick Callbacks by Supplier's Salespeople	
11. Not Being Put on Hold Excessively when Telephoning Supplier	60. Durability of Lumber
12. The Ease with Which the Supplier Can be Contacted by Telephone	61. Long Service Life of Lumber
13. Knowledge and Skill of Supplier's Sales Personnel	62. Failure Rate of Lumber in Service
	63. Reliability of Lumber Strength Values
15. Absence of Hard Sell Techniques by Supplier's Salespeople	
16. Dealings with Supplier Being Held Confidential	67. Machine Stress Rating
17. Trustworthiness of Supplier's Salesperson	
18. Being Respected by Supplier's Salesperson	69. Bar Coding of Lumber
19. Friendliness of Supplier's Salesperson	
20. Ease of Understanding Supplier's Salesperson	
21. Supplier Handles Problems Professionally and Fairly	Factor 4
22. Personal Relationship with Supplier	Cronbach's Alpha = .910
23. Personal Relationship with Supplier's Salesperson	2. Product Availability
24. Supplier's ability to Understand Conditions of Special Orders	
25. Candidness of Supplier's Salesperson	14. Manufacturing Expertise of Supplier
26. Convenience of Supplier's Hours of Operation	
27. Supplier's Willingness to Learn Your Specific Requirements	41. Lumber Straightness
28. Supplier's Salesperson Giving Individualized Attention	42. Absence of End Splits
29. Being Recognized by Supplier's Salespeople as a Regular Customer	43. Absence of Wane
30. Empathy by the Supplier for Your Needs	
31. Supplier Understanding Your Needs	46. Absence of Shake
32. Supplier Anticipating Your Needs	48. Accuracy and Consistency of Grading
64. Reputation of Supplier	49. Accuracy and Consistency of Machining
65. Previous Experiences with Supplier	50. Accuracy and Consistency of Moisture Content
66. Reputation of Supplier's Salesperson	51. Kiln Dried
72. Supplier's Willingness to Fill Large Orders	52. Precision End Trimming
	53. Square End Trimming
	54. Overall Lumber Appearance
	55. Clean Lumber/Pack
	56. Neat-Undamaged Pack
	57. Absence of Torn Grain
	58. Absence of Stain
	59. Absence of Planer Skip
Factor 2	Factor 5
Cronbach's Alpha = .566	Cronbach's Alpha = .763
33. Supplier's Physical Facilities	70. End Coating of Lumber
34. Tools/Equipment Used to Produce Lumber	71. Protective Wrapping of Lumber
68. Anti-Stain Treatment	
69. Bar Coding of Lumber	73. Supplier's Willingness to Fill Small Orders
	74. Supplier Arranged Shipping
	75. Supplier's Willingness to Supply Mixed Loads
	76. Supplier Offering a Variety of Species
	77. Credit Terms Offered by Supplier
Factor 3	
Cronbach's Alpha = .895	79. Firm Prices Quoted by Supplier
36. Location and Legibility of Grade Stamp	80. Just In Time Delivery Offered by Supplier
37. Stiffness/Strength of Lumber	
38. Dense/Non-Dense Classification	
39. Ease of Nailing	
40. Fastener Retention	

Figure 2-3: Original Five Dimension Model of Total Product Quality and Corresponding Items Used for Measurement

SALESPERSON/SUPPLIER CHARACTERISTICS

Cronbach's Alpha = .952

1. Consistent, on Schedule Delivery by Supplier
2. Product Availability
3. Correct Record Keeping by Supplier
4. Accuracy of Supplier's Billing System
5. Supplier's Ability to Deliver Quickly on Short Notice
6. Eagerness of Supplier's Salespeople to Meet your Needs
7. Supplier's Salespeople Enjoy Their Job
8. Supplier Rapidly Responding to and Solving Problems
9. Quick Callbacks by Supplier's Salespeople

11. Not Being Put on Hold Excessively when Telephoning Supplier
12. The Ease with Which the Supplier Can be Contacted by Telephone
13. Knowledge and Skill of Supplier's Sales Personnel
14. Manufacturing Expertise of Supplier

16. Dealings with Supplier Being Held Confidential
17. Trustworthiness of Supplier's Salesperson
18. Being Respected by Supplier's Salesperson
19. Friendliness of Supplier's Salesperson
20. Ease of Understanding Supplier's Salesperson
21. Supplier Handles Problems Professionally and Fairly
22. Personal Relationship with Supplier
23. Personal Relationship with Supplier's Salesperson
24. Supplier's ability to Understand Conditions of Special Orders
25. Candidness of Supplier's Salesperson
26. Convenience of Supplier's Hours of Operation
27. Supplier's Willingness to Learn Your Specific Requirements
28. Supplier's Salesperson Giving Individualized Attention
29. Being Recognized by Supplier's Salespeople as a Regular Customer
30. Empathy by the Supplier for Your Needs
31. Supplier Understanding Your Needs
32. Supplier Anticipating Your Needs

64. Reputation of Supplier
65. Previous Experiences with Supplier
66. Reputation of Supplier's Salesperson

72. Supplier's Willingness to Fill Large Orders

SUPPLIER FACILITIES

Cronbach's Alpha = .632

33. Supplier's Physical Facilities
34. Tools/Equipment Used to Produce Lumber

LUMBER PERFORMANCE

Cronbach's Alpha = .895

36. Location and Legibility of Grade Stamp
37. Stiffness/Strength of Lumber
38. Dense/Non-Dense Classification
39. Ease of Nailing
40. Fastener Retention

44. Absence of Sloped Grain

47. Absence of Heartwood

60. Durability of Lumber
61. Long Service Life of Lumber
62. Failure Rate of Lumber in Service
63. Reliability of Lumber Strength Values

67. Machine Stress Rating

LUMBER CHARACTERISTICS

Cronbach's Alpha = .908

41. Lumber Straightness
42. Absence of End Splits
43. Absence of Wane

46. Absence of Shake

48. Accuracy and Consistency of Grading
49. Accuracy and Consistency of Machining
50. Accuracy and Consistency of Moisture Content

54. Overall Lumber Appearance
55. Clean Lumber/Pack
56. Neat-Undamaged Pack
57. Absence of Torn Grain
58. Absence of Stain
59. Absence of Planer Skip

SUPPLIER SERVICES

Cronbach's Alpha = .763

70. End Coating of Lumber
71. Protective Wrapping of Lumber

73. Supplier's Willingness to Fill Small Orders
74. Supplier Arranged Shipping
75. Supplier's Willingness to Supply Mixed Loads
76. Supplier Offering a Variety of Species
77. Credit Terms Offered by Supplier

79. Firm Prices Quoted by Supplier
80. Just In Time Delivery Offered by Supplier

Figure 2-4: Respecified Five Dimension Model of Total Product Quality and Corresponding Items Used for Measurement

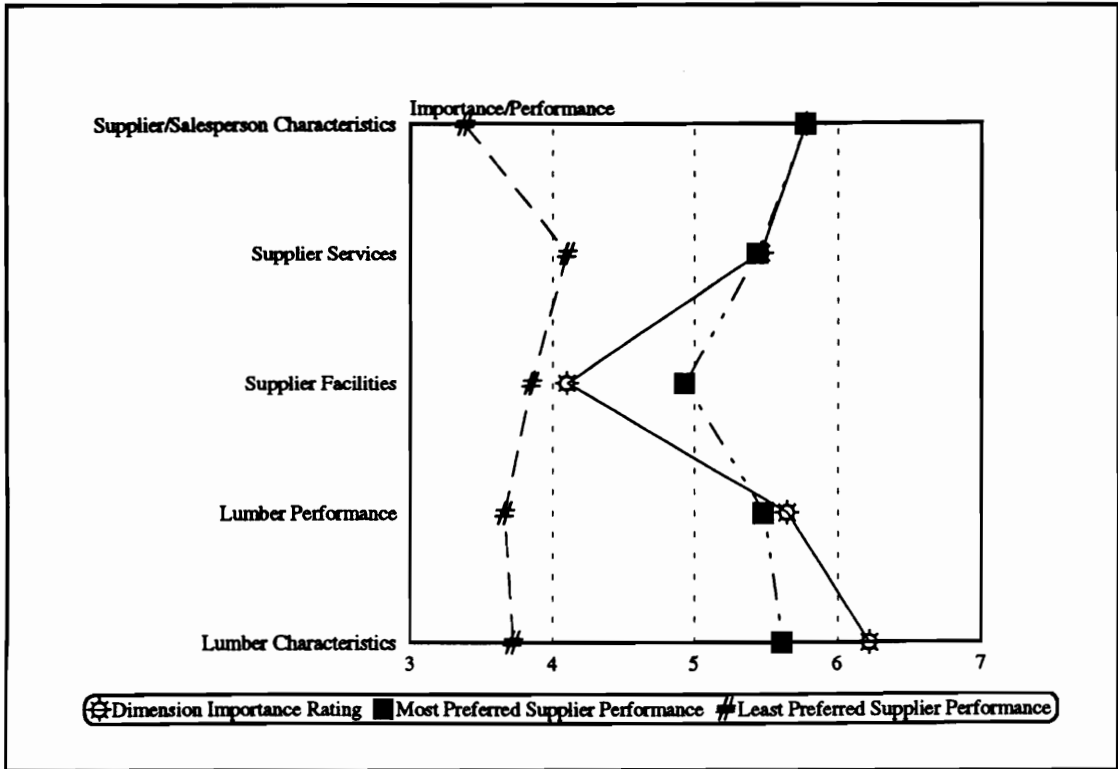


Figure 2-5: Respondent Ratings of Quality Dimension Importance and Most and Least Preferred Supplier Performance

DEVELOPING A QUALITY-BASED MARKETING STRATEGY FOR A COMMODITY PRODUCT

Abstract

Providing a high quality product can be a source of competitive advantage. This study empirically developed a model of quality for softwood dimension lumber consisting of five dimensions (**Supplier/Salesperson Characteristics, Supplier Services, Supplier Facilities, Lumber Performance, Lumber Characteristics**). It was found that buyers of softwood dimension lumber prefer suppliers who perform well in providing the outlined dimensions of quality and they are willing to pay more for better quality products and better service. Competitive advantage through a quality-based marketing strategy is clearly possible in commodity markets. Utilizing the developed model to implement a quality-based marketing strategy is discussed.

Introduction

Everywhere people turn these days they are confronted with quality. The number of academic and trade journal articles on the subject of quality is overwhelming as is the amount of advertising making quality claims. Even the U.S. government has joined the quality bandwagon by creating the Malcolm Baldrige National Quality award. The interest in quality results from the fact that it can be a source of competitive advantage (Cravens et al. 1988). Accordingly, providing a quality product may prove to be a successful strategy for many firms.

Past research has shown that high quality provides market share growth and increased return on investment (Jacobson and Aaker 1987, Phillips et al. 1983, Shetty 1987). In their book *The PIMS Principles*, Buzzell and Gale (1987) discuss PIMS (Profit Impact of Marketing Strategy) findings regarding the relationship between quality and performance. Market share, a key to growth and profitability, is driven by quality and whether profitability is measured as return on sales or return on investment, quality and profitability are related (Buzzell and Gale 1987). Additional evidence of the significance of quality is revealed by a U.S. General Accounting Office study which investigated the effects of Total Quality Management on firm performance. The study found that firms practicing Total Quality Management experienced an average annual increase in market share of 13.7 percent. A variety of other performance indicators were also positive.

Shetty (1987), claims that quality enhances performance even in mature industries. In fact, quality may be more significant to mature industries than others because of their limited repertoire of competitive tools. Despite the growing notoriety and study of quality, it is often misunderstood. To implement a quality-based marketing strategy it is essential to understand the meaning of quality.

Holbrook and Corfman (1985) claim there are as many definitions of quality as writers on the subject! However, similarities among the definitions can be found. Crosby (1979 p. 40) defines quality as "conformance to requirements" while O'Neal and LaFief (1992) believe that if quality is conformance to requirements it is merely conformance to customer requirements. According to Juran (1974 p. 2-2) quality is "fitness for use" and quality lies in the eyes of the beholder. Morgan and Piercy (1992) claim that quality is most important in terms of customer perceptions. This list could continue nearly indefinitely, however, one recurring theme in most definitions of quality, is the customer and his or her requirements.

Given the competitive opportunities inherent in quality, this study developed a model of customer perceived quality for the commodity product softwood dimension lumber. The model was based on the concept of a total product. *Total product* refers to the combination of the physical product and its associated services. While the concept of a total product is intuitive, Brown and Fern (1981) observed that managers often consider only the physical product. Industrial consumers, however, evaluate the quality of services associated with a physical product as well as the physical product's quality (Kaspar and Lemmink 1989). According to Sinclair et al. (1993), customers' perceptions of a company may be based on its people and the services provided as much or more than on the company's product. In fact, non-product related items are often of primary importance to potential customers (Powers 1988). Given the nature of commodity products this may be of particular relevance.

Previous research specific to product quality has not considered commodity products which are common in mature industries. Garvin's (1983, 1984a, 1984b, 1987) work in quality was based on the room air-conditioner industry and Sinclair et al.'s (1993) work was based on the wood office

furniture industry. Consequently, this study investigates quality in softwood lumber which is a commodity product produced by a mature industry (Vasconcellos 1991).

Methods

Dimensions of Quality

In past research, quality has often been considered to consist of a number of dimensions. Authors in the field of quality have proposed dimensions for the quality of products and services. Garvin (1984b p. 41) suggested that **product quality** is "multifaceted" and "appears in many forms", and proposed that quality is composed of eight dimensions:

<i>Performance</i>	"Primary operating characteristics" of the product. Performance for a television would be things such as picture clarity and color.
<i>Features</i>	"Bells and whistles" inherent in the product. Features can be thought of as a secondary aspect of Performance. The screen-in-screen option on a television is an example of a feature.
<i>Product Reliability</i>	How soon and often the product fails. Reliability is the probability that a product will fail. It can be measured as the mean time to first failure and mean time between failures.
<i>Conformance</i>	The extent to which a product meets its design standards. This is a measure of how well the manufacturing process was carried out.
<i>Durability</i>	"The amount of use one gets from a product before it physically deteriorates." Expected life of a product would be a measure of durability.
<i>Serviceability</i>	The "speed, courtesy, and competence of repair." This refers to the whole realm of services associated with complaint handling.
<i>Aesthetics</i>	"How a product looks, feels, sounds, tastes, or smells", a matter of personal judgement.

Perceived Quality The consumer's opinion of the product as it has been influenced through "images, advertising, or brand names." Perceived Quality is a way of inferring quality when no direct measure is available. Reputation and past experience with the company are examples of Perceived Quality.

A series of studies by Parasuraman et al. (1988) concluded that service quality is made up of five dimensions:

Service Reliability Ability to perform the promised service dependably and accurately.

Responsiveness Willingness to help customers and provide prompt service.

Assurance Knowledge and courtesy of employees and their ability to inspire trust and confidence.

Empathy Caring, individualized attention the firm provides its customers.

Tangibles Physical facilities, equipment, and appearance of personnel.

Garvin (1984a) included very little in his model concerning the service associated with the physical product, while Parasuraman et al. (1988) specifically examined the quality of services. Unfortunately, prior research has failed to combine these two concepts to construct a single model. This study utilized just such a combination as a model of total product quality. Although the dimensions of quality proposed by Parasuraman et al. (1988) were for services such as banking, they apply equally well to the services associated with marketing a physical product. In fact, Kaspar and Lemmink (1989) claim that the concept of service quality proposed by Parasuraman et al. (1988) may be applied to services offered as part of an industrial product.

Although the two models of quality were combined to form one model of total product quality, several changes were necessary for application of the model to softwood lumber. As

previously defined above, **Serviceability** did not apply to softwood lumber and was dropped. In addition, **Performance** and **Conformance** were combined to form one dimension. This resulted in a combined model with 11 dimensions.

Quality Measure Development

Descriptive items were used to measure each dimension of quality. For example, an item used to measure **Responsiveness** was, **Supplier's Ability to Deliver Quickly on Short Notice**. A comprehensive list of items was generated specifically to measure the 11 dimensions of the combined model. However, items deemed to be important that did not appear to measure any of the 11 dimensions were also included. Research of previous authors (Govett and Sinclair 1984; Seward and Sinclair 1988; Hansen 1992; Parasuraman et al. 1985, 1988), as well as discussions with University faculty and industry personnel, resulted in selection of 80 items describing assorted aspects of softwood lumber quality. Nine of the items did not describe any of the eleven dimensions but appeared to measure a supplier's cooperativeness or services available from a supplier. Accordingly, this dimension was included in the final combined model of softwood lumber quality (Figure 3-1).

A questionnaire was developed to assess the importance of each of the items as perceived by softwood lumber buyers. Respondents rated the importance of each item on a seven point scale where "1" represented "well below average importance" and "7" represented "well above average importance." The questionnaire was mailed to approximately 2040 buyers in three industries that use softwood lumber: home centers, wood truss manufacturers, and wood treating firms. Approximately 43 percent returned completed, useable questionnaires.

Results

The data were analyzed in several steps, starting with assessment of nonresponse bias. Nonresponse bias was investigated by comparing early respondents to late respondents. The 80 quality items and three demographic variables were considered. Multivariate analysis of variance indicated no differences between early and late respondents based on these variables. Nonresponse bias did not appear to be a problem.

Isolating Product Quality Dimensions

The next stage of analysis investigated the unidimensionality of the measures of the dimensions of quality. Gerbing and Anderson (1988) outline an updated paradigm for scale development. This paradigm incorporates the use of confirmatory factor analysis to assess the unidimensionality of measures. Stated more simply, the method allowed an assessment of whether or not the items representing a dimension were measuring one construct only. The unidimensionality of the twelve theorized dimensions of quality was assessed using the confirmatory factor analysis software package, ITAN (Gerbing and Hunter 1988). Analysis indicated a lack of external consistency in the twelve dimensions of quality (Anderson and Gerbing 1982). This lack of fit indicated that the theorized 12 dimension model did not accurately describe quality in softwood lumber. Exploratory factor analysis was then used to investigate the dimensions underlying the data.

Principle-axis factoring with oblique (Oblimin) rotation was used. The scree plot indicated retention of seven factors, while fifteen factors obtained eigenvalues greater than one. However, a five factor model explaining 41.5 percent of the variance provided the most interpretable solution.

Three items were deleted from the five factor, or dimension, model because they did not achieve minimum acceptable factor loadings of .4. Four of the five dimensions of service quality (**Service Reliability, Responsiveness, Assurance, and Empathy**) outlined by Parasuraman et al. (1988) were combined and named **Supplier/Salesperson Characteristics**. The remaining dimension from Parasuraman et al. (1988), **Tangibles**, remained nearly the same but was renamed **Supplier Facilities**. The dimension describing cooperativeness of the supplier or supplier services (added by the authors to the combined model) remained mostly intact and was named **Supplier Services**. The dimensions of product quality outlined by Garvin (1984a) became two dimensions which included the concepts of performance and aesthetics. They were named **Lumber Performance** and **Lumber Characteristics** (Figure 3-2).

The redefined model held promise of further improvement through respecification. Respecification began by moving two items with similar factor loadings, **Manufacturing Expertise of Supplier and Product Availability**, from **Lumber Characteristics** to **Supplier/Salesperson Characteristics**. Deletion of seven items improved the reliability of several dimensions. With the exception of **Supplier Facilities**, the dimensions obtained very good reliabilities (.76-.95) (Figure 3-2).

Does Quality Matter for a Commodity Product?

Given that buyers of softwood lumber view quality in the five dimensions outlined above, it would be reasonable to expect them to purchase from suppliers that perform well on those dimensions. To assess if this was truly the case, a second questionnaire was designed and mailed to

each of the respondents to the first survey. The importance of each dimension of quality was rated as was the performance of the respondent's most preferred and least preferred supplier on each dimension. The importance scale was the same as that used in the first questionnaire and performance was measured on a seven point scale with "1" representing "well below average performance" and "7" representing "well above average performance." To help respondents understand the meaning of each quality dimension, the two most important items and the two items with the highest factor loadings on that dimension were given as examples of its meaning. When these two criteria indicated use of the same item, the next most important item was used (Supplier Facilities was represented by only two items). A total of 332 responses to the second questionnaire were received.

A similar measure of each dimension's importance was derived from results of the two questionnaires (the average importance rating of the items making up each dimension from the first questionnaire and the direct rating of importance from the second questionnaire). Table 3-1 shows how these two methods compare in importance ratings. Although the dimensions were generally rated higher in the second questionnaire, the rank of the dimensions was identical. The fact that respondents ranked the dimensions similarly between two measurement methods indicates that they view quality in at least five dimensions and recognize those dimensions by the names and examples provided.

The selection of suppliers based on dimensions of quality was assessed through performance ratings of buyers' most preferred and least preferred suppliers. Table 3-2 compares these performance levels. Clearly buyers prefer suppliers that perform well on the measured dimensions of quality. Most preferred suppliers rate much higher in performance than did least preferred suppliers.

In fact, several respondents failed to answer for the performance of least preferred supplier. Instead, they explained that they did not have a least preferred supplier. If a supplier didn't perform to an acceptable level they simply did not buy from them. This suggests that most preferred suppliers have differentiated themselves from least preferred suppliers, based on quality.

Additional evidence that quality creates advantage is the fact that respondents claimed that they would pay more for better quality softwood lumber and better service despite the fact that they considered price to be very important (Table 3-3). Respondents were asked to provide their level of agreement (on a seven point scale) with three statements concerning their buying tendencies. On average, respondents would pay a higher price for better product quality and better service. This suggests that suppliers who provide quality can not only differentiate themselves, but command a higher price thereby achieving competitive advantage.

Developing a Quality-Based Strategy

In order to maintain, improve, or use quality as a marketing strategy, it is necessary for it to be accurately and periodically measured (Shetty 1987). This study has shown that quality is, for the commodity product softwood dimension lumber, multi-dimensional and can be measured. In addition, it is evident from this and past research that quality can provide competitive advantage. Clearly, there is opportunity, even in commodity-based, mature industries, to use quality as a marketing strategy.

Understanding quality from the customer's perspective is a prerequisite for implementing a quality-based marketing strategy. Importance ratings of quality dimensions provides a vehicle for measurement and a more complete understanding of quality as perceived by the customer. This is a

critical part of a quality-based marketing strategy, as customers often view quality differently than suppliers expect them to. A study by Kaspar and Lemmink (1989) compared customers' perceptions of service quality to management's perceptions of customer perceived service quality and found large differences. Ross and Shetty (1985) found a gap between the perceptions of executives and customers, and Takeuchi and Quelch (1983) outlined results from several surveys that indicated differing perceptions of quality between executives and consumers.

Importance - Performance Analysis

Importance - Performance Analysis (Martilla and James 1977) provides a simple yet useful way of guiding a quality-based marketing strategy. The importance component identifies those dimensions which customers perceive most influence total product quality. Firm performance identifies those dimensions on which the firm should concentrate. Ratings of importance and performance can be placed on a grid to graphically display a firm's strengths and weaknesses in providing a total quality product.

The following Importance - Performance Analysis example, based on ratings of most and least preferred suppliers, outlines how the method can be utilized to guide a quality-based marketing strategy. By plotting the values for dimension importance and least preferred supplier performance on an Importance - Performance Grid, one can get a feel for the usefulness of this type analysis (Figure 3-3). Grid placement is a matter of judgement based on the level of performance and importance for the dimensions in question. The grid is very logical in that if importance and performance are both high for a particular dimension, the company's competitive position on that

dimension is good. However, if importance is high and performance is low, the need for improvement is evident.

For least preferred suppliers, four of the five dimensions of quality fall into the Concentrate Here quadrant of the Importance - Performance Grid. To improve competitive position, these firms can either lower customers' perceptions of dimension importance and/or increase their performance on the dimension. For example, they might teach their customers that, although their product isn't as "pretty" (lower **Lumber Characteristics**) as that of the competition, it is just as functional. This might move **Lumber Characteristics** from the Concentrate Here quadrant to Low Priority. The more likely method of influencing perceptions is to increase firm performance. In general, the importance of the dimension should be considered a guideline for prioritizing actions, however, there are many complicating factors.

Assessing performance of competitors can provide additional information for prioritizing actions. Figure 3-4 shows how most preferred suppliers fit on the Importance - Performance Grid relative to least preferred. Placement on the grid indicates that least preferred suppliers are least competitive with most preferred on **Supplier/Salesperson Characteristics**. This dimension is second in importance and there is a large difference in performance. Given the relative importance of the dimensions, priority would go to **Lumber Characteristics** first and **Supplier/Salesperson Characteristics** second. However, judgement again must be practiced by evaluating the ability of the firm to improve performance and the anticipated return on investment for the available alternatives. It is quite possible that the greatest success will come from concentrating on one dimension and becoming the clear leader in that area rather than improving a little in several

dimensions. In other words, least preferred suppliers might be more successful in attempting to surpass most preferred suppliers performance on **Supplier Services** rather than the most important dimension, **Lumber Characteristics**.

Even though most preferred suppliers are predominately in the "Keep Up The Good Work" quadrant of the grid they should not ignore the dimensions of quality. Least preferred suppliers may try to gain advantage through any one of the dimensions. Most preferred suppliers are the clear leaders in performance; however, this might change which suggests a key element of a quality based marketing strategy. Markets, customers, and performance are all dynamic, so periodic measurement is essential to monitor competitor movements and firm progress.

Conclusions

Quality, as a source of competitive advantage, will continue to increase in importance in the foreseeable future. Firms seeking to remain competitive must actively work to improve the quality of their total product. This study found quality in softwood lumber to consist of the following dimensions: **Supplier/Salesperson Characteristics, Supplier Services, Supplier Facilities, Lumber Performance, and Lumber Characteristics**. The five dimension model of quality provides an enhanced understanding of quality and how softwood lumber buyers evaluate it. It is evident that some suppliers have differentiated themselves based on quality and that buyers are willing to pay more for better quality. Importance - Performance Analysis, based on a sound model of quality, can be a useful tool for assessing firm strengths and weaknesses and concentrating improvement efforts toward achieving competitive advantage.

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Table 3-1: Mean Respondent Ratings of Quality Dimension Importance*

Dimension	1st Questionnaire		2nd Questionnaire	
	Mean (rank)	Std Dev/n	Mean (rank)	Std Dev/n
Lumber Characteristics	5.56 (1)	.84/836	6.22 (1)	1.08/331
Supplier/Salesperson Characteristics	5.33 (2)	.78/795	5.78 (2)	1.07/331
Lumber Performance	4.86 (3)	1.00/806	5.65 (3)	1.36/330
Supplier Services	4.85 (4)	.91/831	5.47 (4)	1.22/329
Supplier Facilities	4.20 (5)	1.36/848	4.10 (5)	1.43/329

* 1=Well below average importance, 7=Well above average importance. The average for the 1st questionnaire was calculated by averaging across individual items measuring the dimension while the average for the 2nd was calculated by averaging the ratings of each dimension.

Table 3-2: Mean Respondent Ratings of Most and Least Preferred Supplier Performance on Dimensions of Quality

Dimension	Most Preferred Supplier	Least Preferred Supplier
Supplier/Salesperson Characteristics	5.78*	3.38
Supplier Services	5.45	4.10
Supplier Facilities	4.94	3.85
Lumber Performance	5.49	3.66
Lumber Characteristics	5.62	3.72

*1 = well below average performance, 7 = well above average performance.

Table 3-3: Mean Respondent Ratings of Selected Purchase Decision Criteria

Purchase Decision Criteria	Rating
Price is very important in your softwood lumber purchase decisions.	6.01*
You pay a higher price to suppliers of better quality softwood lumber.	5.52
You pay a higher price to suppliers that provide better service.	4.83

* (1=Strongly Disagree, 7=Strongly Agree)

SERVICE RELIABILITY

- 1. Consistent, on Schedule Delivery by Supplier
- 2. Product Availability
- 3. Correct Record Keeping by Supplier
- 4. Accuracy of Supplier's Billing System

RESPONSIVENESS

- 5. Supplier's Ability to Deliver Quickly on Short Notice
- 6. Eagerness of Supplier's Salespeople to Meet your Needs
- 7. Supplier's Salespeople Enjoy Their Job
- 8. Supplier Rapidly Responding to and Solving Problems
- 9. Quick Callbacks by Supplier's Salespeople
- 10. Electronic Data Interchange with Supplier
- 11. Not Being Put on Hold Excessively when Telephoning Supplier
- 12. The Ease with Which the Supplier Can be Contacted by Telephone

ASSURANCE

- 13. Knowledge and Skill of Supplier's Sales Personnel
- 14. Manufacturing Expertise of Supplier
- 15. Absence of Hard Sell Techniques by Supplier's Salespeople
- 16. Dealings with Supplier Being Held Confidential
- 17. Trustworthiness of Supplier's Salesperson
- 18. Being Respected by Supplier's Salesperson
- 19. Friendliness of Supplier's Salesperson
- 20. Ease of Understanding Supplier's Salesperson
- 21. Supplier Handles Problems Professionally and Fairly
- 22. Personal Relationship with Supplier
- 23. Personal Relationship with Supplier's Salesperson
- 24. Supplier's ability to Understand Conditions of Special Orders
- 25. Candidness of Supplier's Salesperson

EMPATHY

- 26. Convenience of Supplier's Hours of Operation
- 27. Supplier's Willingness to Learn Your Specific Requirements
- 28. Supplier's Salesperson Giving Individualized Attention
- 29. Being Recognized by Supplier's Salespeople as a Regular Customer
- 30. Empathy by the Supplier for Your Needs
- 31. Supplier Understanding Your Needs
- 32. Supplier Anticipating Your Needs

TANGIBLES

- 33. Supplier's Physical Facilities
- 34. Tools/Equipment Used to Produce Lumber
- 35. Convenience of Supplier's Location

PERFORMANCE/CONFORMANCE

- 36. Location and Legibility of Grade Stamp
- 37. Stiffness/Strength of Lumber
- 38. Dense/Non-Dense Classification
- 39. Ease of Nailing
- 40. Fastener Retention
- 41. Lumber Straightness

- 42. Absence of End Splits
- 43. Absence of Wane
- 44. Absence of Sloped Grain
- 45. Absence of Knots
- 46. Absence of Shake
- 47. Absence of Heartwood
- 48. Accuracy and Consistency of Grading
- 49. Accuracy and Consistency of Machining
- 50. Accuracy and Consistency of Moisture Content
- 51. Kiln Dried
- 52. Precision End Trimming
- 53. Square End Trimming

AESTHETICS

- 54. Overall Lumber Appearance
- 55. Clean Lumber/Pack
- 56. Neat-Undamaged Pack
- 57. Absence of Torn Grain
- 58. Absence of Stain
- 59. Absence of Planer Skip

DURABILITY

- 60. Durability of Lumber
- 61. Long Service Life of Lumber

PRODUCT RELIABILITY

- 62. Failure Rate of Lumber in Service
- 63. Reliability of Lumber Strength Values

PERCEIVED QUALITY

- 64. Reputation of Supplier
- 65. Previous Experiences with Supplier
- 66. Reputation of Supplier's Salesperson

FEATURES

- 67. Machine Stress Rating
- 68. Anti-Stain Treatment
- 69. Bar Coding of Lumber
- 70. End Coating of Lumber
- 71. Protective Wrapping of Lumber

COOPERATIVENESS/SUPPLIER SERVICES

- 72. Supplier's Willingness to Fill Large Orders
- 73. Supplier's Willingness to Fill Small Orders
- 74. Supplier Arranged Shipping
- 75. Supplier's Willingness to Supply Mixed Loads
- 76. Supplier Offering a Variety of Species
- 77. Credit Terms Offered by Supplier
- 78. Long Term Price Agreements Offered by Supplier
- 79. Firm Prices Quoted by Supplier
- 80. Just In Time Delivery Offered by Supplier

Figure 3-1: Theorized Dimensions of Total Product Quality and Corresponding Items Used for Measurement

SALESPERSON/SUPPLIER CHARACTERISTICS

Cronbach's Alpha = .952

1. Consistent, on Schedule Delivery by Supplier
2. Product Availability
3. Correct Record Keeping by Supplier
4. Accuracy of Supplier's Billing System
5. Supplier's Ability to Deliver Quickly on Short Notice
6. Eagerness of Supplier's Salespeople to Meet your Needs
7. Supplier's Salespeople Enjoy Their Job
8. Supplier Rapidly Responding to and Solving Problems
9. Quick Callbacks by Supplier's Salespeople

11. Not Being Put on Hold Excessively when Telephoning Supplier
12. The Ease with Which the Supplier Can be Contacted by Telephone
13. Knowledge and Skill of Supplier's Sales Personnel
14. Manufacturing Expertise of Supplier

16. Dealings with Supplier Being Held Confidential
17. Trustworthiness of Supplier's Salesperson
18. Being Respected by Supplier's Salesperson
19. Friendliness of Supplier's Salesperson
20. Ease of Understanding Supplier's Salesperson
21. Supplier Handles Problems Professionally and Fairly
22. Personal Relationship with Supplier
23. Personal Relationship with Supplier's Salesperson
24. Supplier's ability to Understand Conditions of Special Orders
25. Candidness of Supplier's Salesperson
26. Convenience of Supplier's Hours of Operation
27. Supplier's Willingness to Learn Your Specific Requirements
28. Supplier's Salesperson Giving Individualized Attention
29. Being Recognized by Supplier's Salespeople as a Regular Customer
30. Empathy by the Supplier for Your Needs
31. Supplier Understanding Your Needs
32. Supplier Anticipating Your Needs

64. Reputation of Supplier
65. Previous Experiences with Supplier
66. Reputation of Supplier's Salesperson

72. Supplier's Willingness to Fill Large Orders

SUPPLIER FACILITIES

Cronbach's Alpha = .632

33. Supplier's Physical Facilities
34. Tools/Equipment Used to Produce Lumber

LUMBER PERFORMANCE

Cronbach's Alpha = .895

36. Location and Legibility of Grade Stamp
37. Stiffness/Strength of Lumber
38. Dense/Non-Dense Classification
39. Ease of Nailing
40. Fastener Retention

44. Absence of Sloped Grain

47. Absence of Heartwood

60. Durability of Lumber
61. Long Service Life of Lumber
62. Failure Rate of Lumber in Service
63. Reliability of Lumber Strength Values

67. Machine Stress Rating

LUMBER CHARACTERISTICS

Cronbach's Alpha = .908

41. Lumber Straightness
42. Absence of End Splits
43. Absence of Wane

46. Absence of Shake

48. Accuracy and Consistency of Grading
49. Accuracy and Consistency of Machining
50. Accuracy and Consistency of Moisture Content

54. Overall Lumber Appearance

55. Clean Lumber/Pack
56. Neat-Undamaged Pack
57. Absence of Torn Grain
58. Absence of Stain
59. Absence of Planer Skip

SUPPLIER SERVICES

Cronbach's Alpha = .763

70. End Coating of Lumber
71. Protective Wrapping of Lumber

73. Supplier's Willingness to Fill Small Orders
74. Supplier Arranged Shipping
75. Supplier's Willingness to Supply Mixed Loads
76. Supplier Offering a Variety of Species
77. Credit Terms Offered by Supplier

79. Firm Prices Quoted by Supplier
80. Just In Time Delivery Offered by Supplier

Figure 3-2: Respecified Five Dimension Model of Total Product Quality and Corresponding Items Used for Measurement

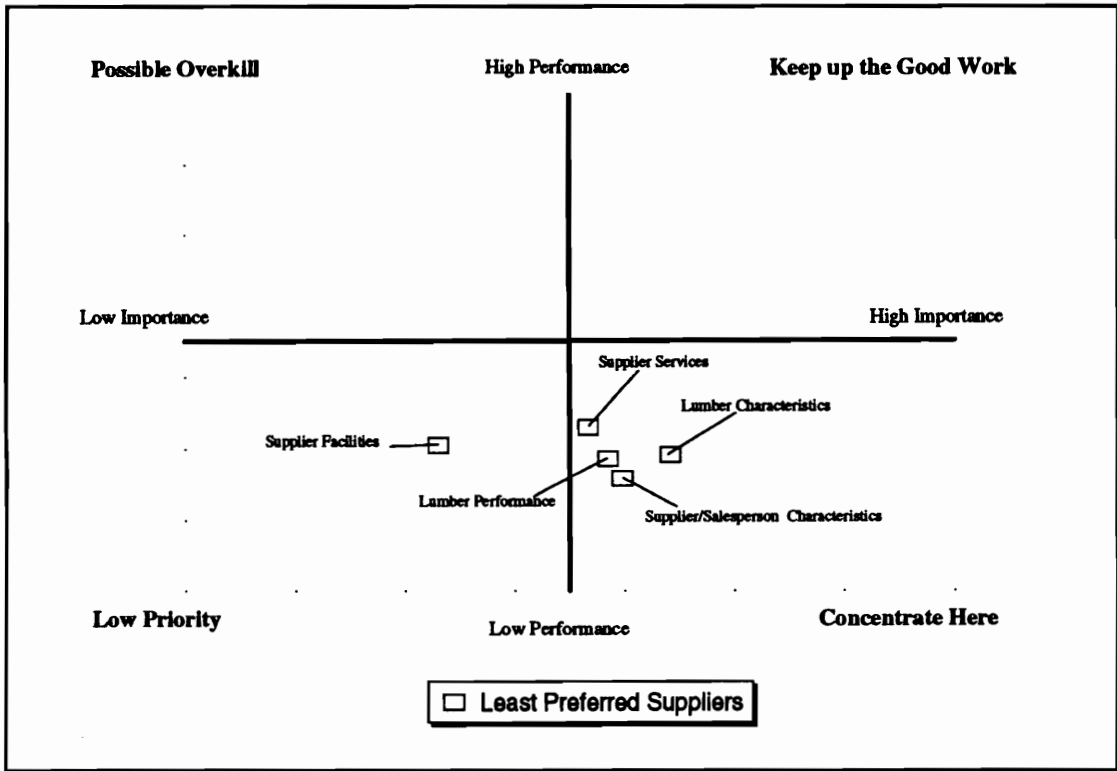


Figure 3-3: Importance and Performance Ratings for Least Preferred Suppliers. (Importance-Performance Grid adapted from Martilla and James 1977)

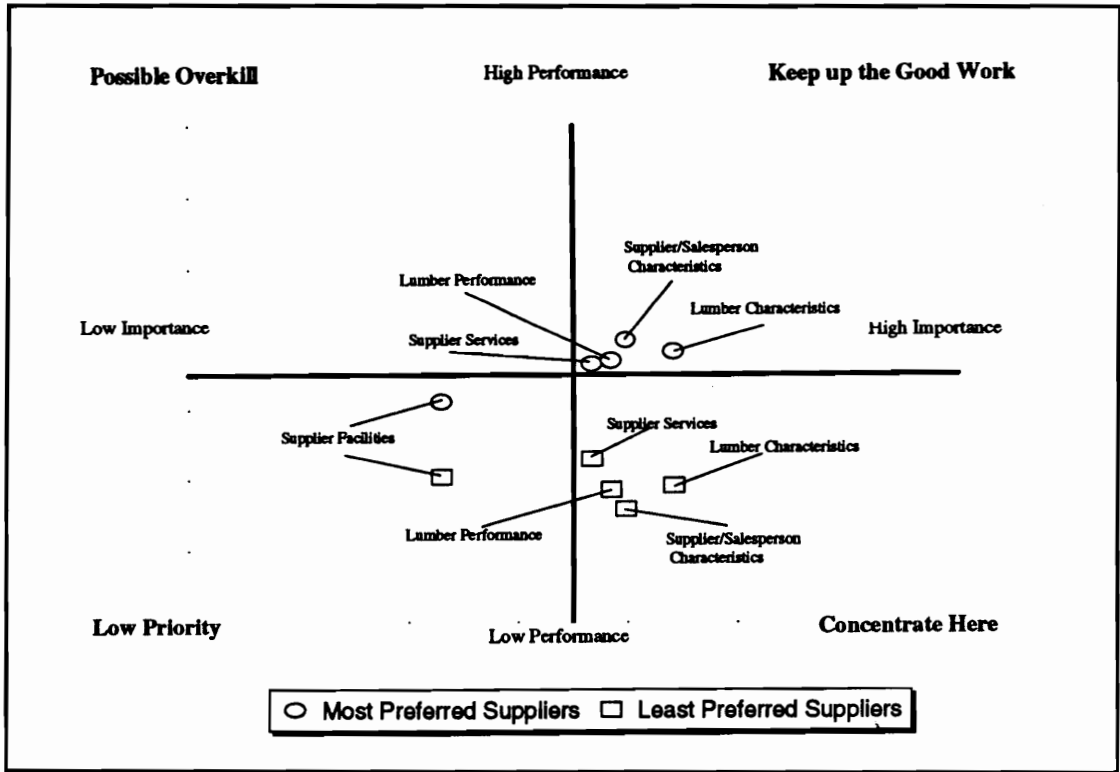


Figure 3-4: Importance and Performance Ratings for Least Versus Most Preferred Suppliers.
 (Importance-Performance Grid adapted from Martilla and James 1977)

CONSUMER PERCEPTIONS OF SOFTWOOD LUMBER QUALITY

Abstract: Suppliers of softwood lumber can gain competitive advantage through providing a high quality product. This study developed a model of quality for softwood dimension lumber that can be utilized to pursue a quality-based marketing strategy. Results of this research indicate that quality in softwood lumber is perceived to be made up of five dimensions: **Supplier/Salesperson Characteristics, Supplier Facilities, Supplier Services, Lumber Performance, and Lumber Characteristics**. Buyers of softwood dimension lumber prefer suppliers who perform well in providing quality and are willing to pay more for better quality products and better service. Competitive advantage through a quality-based marketing strategy is clearly possible for suppliers of softwood lumber. A condensed version of the quality model is presented that can be used by industry to pursue quality improvement.

Introduction

Softwood lumber, like many wood products, is sold under a standard set of voluntary grades (Seward and Sinclair 1988). The first published grading rules for lumber were completed in Stockholm, Sweden in 1754. In 1922, assisted by Secretary of Commerce Herbert Hoover, the U.S. industry instituted basic standards for softwood lumber and in 1924 the American Lumber Standards were completed (Horn 1951). These standards evolved into regional commercial grading rules governed by such agencies as the Southern Pine Inspection Bureau.

Some have argued that a system of product standards, such as that used for softwood lumber, tend to drive quality down (Keating 1986). The logic in this argument is that if the standards allow five percent of the pieces in a pack to be off grade, that is exactly what a supplier will aim to ship. In other words, suppliers will produce a product which just passes the standard. This system may have created a damaging mentality in many companies. Bishop (1990 p. 30) explained the situation when he said, "Some companies believe that acceptable quality is never losing a reinspection." Clearly, the mere need for reinspection is an indication that the customer is displeased with the product and may result in less than favorable customer perceptions of the company and its product.

A phenomenon compounding this potential quality problem is the evolving forest resource. The industry may soon be characterized entirely by second-growth timber users. The second-growth resource, in most cases of lower quality than the virgin resource, holds the potential to negatively impact the quality of the end product (Widman 1991).

The softwood lumber industry faces a grading system that arguably decreases quality and a phenomenon that is driving down the quality of the raw material; yet Bishop (1990 p. 29) claims,

"Quality can no longer be considered a 'bonus' or 'selling point.' Wood products is now a global product. Extraordinarily high quality must be as much a 'given' as adhering to the acknowledged order amount or species."

Thus, at a time when quality is increasing in importance, at least two factors are acting to reduce the quality of softwood lumber.

Providing a high quality product can be a source of competitive advantage (Cravens et al. 1988) and can mean improved firm performance (Jacobson and Aaker 1987, Phillips et al. 1983, Shetty 1987, Buzzell and Gale 1987). In fact, Shetty (1987) claims that quality can enhance performance even in mature industries. Like many other commodities, softwood lumber is produced by a mature industry (Vasconcellos 1991, Sinclair and Stalling 1990). Because of the limited repertoire of competitive tools available to mature industries, quality may hold considerable promise.

Evidence indicates that providing a quality product positively affects performance. However, providing quality is not an easy task. One difficulty lies in the ability to understand quality as perceived by the customer (i.e., the customer's quality requirements). According to Zeithaml (1988), the conceptualization and measurement of quality have not been adequately studied, yet periodic and accurate measurement is clearly essential to providing a quality product (Shetty 1987, Whiting and Walsh 1986).

Background

In this study a model of quality was developed based on a total product. Garvin (1984) and Parasuraman et al. (1988) have extensively studied quality. Garvin's research was primarily concerned with product quality while Parasuraman et al's was in the area of service quality. Following their work, the literature has most often separated the physical product from its associated services. This, however, represents an incomplete perspective of quality since every physical product has associated services (credit, delivery, etc.).

A product and its quality should be evaluated as a total package of benefits, including services (i.e., a total product). Brown and Fern (1981) suggest that managers and researchers tend to concentrate on the physical product while the consumer evaluates the total product. According to Powers (1988), non-product related items (i.e., services) are often of primary importance to potential customers. Kyj (1987) claims that customer service cannot be separated from the physical product because the utility of the entire product is influenced by service quality.

The evidence suggests that when defining quality one cannot merely consider the physical product itself, but must also consider the services associated with that product. Sinclair et al. (1993 p. 75) state ". . . the services offered and the quality of those services significantly impact the perceived quality of the entire company and its product(s)." and "Companies may well be perceived through people and through the services they provide as much or more than through the actual physical product." Kaspar and Lemmink (1989) claim that product and service strategies should be matched because the industrial consumer evaluates the physical product's quality as well as the quality of the service associated with that physical product. Accordingly, quality judgements will be

made on the total product including both the physical product and its associated services (Kyj 1987). For a commodity product like softwood dimension lumber this may be of particular relevance.

Although past research has investigated product and service quality separately, no published research was found which investigated the quality of a total product. In addition, even though Sinclair et al. (1993) investigated quality in wood office furniture no research was found which investigated quality in commodity products or more specifically, softwood dimension lumber. This study developed a model of softwood dimension lumber quality as a total product. Suppliers of softwood lumber can utilize this model to pursue a quality-based marketing strategy which, if properly implemented, can prove a source of competitive advantage.

Methods

Model Development

The model of total product quality for softwood lumber developed in this study was based on two previous models, a model of product quality by Garvin (1984) and a model of service quality by Parasuraman et al. (1988). Garvin (1984) suggested that product quality is made up of eight dimension: **Performance, Features, Product Reliability, Conformance, Durability, Serviceability, Aesthetics, and Perceived Quality**. Parasuraman et al. (1988) empirically derived five dimensions of service quality: **Service Reliability, Responsiveness, Assurances, Empathy, and Tangibles**.

In order to address total product quality in softwood lumber, these two models were combined to develop a single model of total product quality. Although the dimensions derived by

Parasuraman et al. (1988) were for services such as banking, they can also be applied to services offered as part of an industrial product (Kasper and Lemmink 1989). Underlying previous work is the idea that quality can be generalized across products. That is, the dimensions making up quality are the same for all products (Zeithaml 1988). Therefore, it is appropriate to apply the models of quality purported by the above authors to softwood dimension lumber. However, several modifications were seen as necessary to make the combined model applicable to softwood lumber. Garvin's (1984) dimension, **Serviceability** (defined as the speed, competency, and courtesy of repair) was deleted since it could not be logically applied to softwood lumber. Two other dimensions, **Performance** and **Conformance**, were combined to form one dimension.

Items were selected to represent each of the eleven resulting dimensions of total product quality. For example, **Supplier's Ability to Deliver Quickly on Short Notice** was an item chosen to represent **Responsiveness**. Previous research (Garvin 1984, Parasuraman et al. 1988, Govett and Sinclair 1984, Seward and Sinclair 1988, Hansen 1992) as well as discussions with University faculty and industry professionals were utilized to generate items.

During item selection, nine items pertaining to quality did not appear to represent any of the 11 quality dimensions from the combined model. They did, however, appear to measure supplier cooperativeness and services provided by the supplier. As a result, an additional dimension was added to the combined model resulting in a 12 dimension, 80 item model of total product quality (Figure 4-1).

The Sample

In 1992, consumption of softwood lumber in the United States was approximately 45.7

billion board feet (Miller Freeman 1993). Over one third of U.S. softwood lumber consumption was accounted for by three major consumer groups: Wood truss manufacturers, wood treaters, and home centers/lumber-building materials dealers (hereafter referred to as home centers). These markets are significant both for the volume of lumber they consume and their potentially varying perceptions of quality due to the nature of product end use. Professional softwood lumber buyers in each of the three groups were targeted in this study.

The sample of truss manufacturers and wood treaters was assembled from a variety of sources including Miller Freeman's *Directory of the Forest Products Industry* (Miller Freeman 1990) and association membership lists. The 1991 *Directory of Home Center Operators and Hardware Chains* (CSG Information Services 1991) served as the sample frame for home centers.

Truss Manufacturers

In 1992, roughly four billion board feet of softwood lumber were utilized for the production of wood roof and floor trusses (Grundel 1994). This figure represents approximately nine percent of total U.S. softwood lumber consumption in 1992. Since physical/mechanical performance is the most critical element of a finished truss, the evaluation of quality by truss manufacturers may be significantly different from wood treaters and home centers who are likely to be more appearance oriented.

Wood Treaters

For the purposes of this study, wood treaters were defined as companies engaged in the preservative treatment of softwood dimension lumber. In 1992, approximately 6.2 billion board feet

of southern pine lumber and timbers were preservatively treated. Southern pine makes up around 85 percent of all treated lumber and timbers (Easterling 1994). Accordingly, treated lumber and timbers amounted to approximately 7.3 billion board feet in 1992. Much of the lumber processed by wood treaters is ultimately outside on display. In this application, appearance is likely to be a critical criterion in evaluating the quality of softwood lumber.

Home Centers

The 1991 *Directory of Home Center Operators & Hardware Chains* (CSG Information Services 1991) estimated 1990 home improvement company sales to be approximately \$66.7 billion. Lumber products amounted to 31.2 percent of those sales for a total of \$20.8 billion. In 1992, for the twelve western states tracked by the Western Wood Products Association, 15.4 percent of softwood lumber went directly from the mill to the retailer (home centers) and another 55.9 percent went to wholesalers (Yuhas 1994). A major portion of the wholesale volume ultimately arrives at the retail level.

This market is different than the two previously mentioned, as there is typically no remanufacture or value added to the lumber. Home centers are in close contact with the final customer, be it the do-it-yourself (DIY) homeowner or the professional contractor, and may have a different perspective concerning quality.

Data Collection

A mail questionnaire was used to measure consumer perceptions of softwood lumber quality. Respondents rated the importance of each of the 80 items to overall quality, on a seven point scale

ranging from (1) "well below average importance" to (7) "well above average importance." In addition, respondents provided demographic data such as sales volume, lumber volume purchased, and species mix purchased. A total sample of 2040 provided 375, 187, and 305 returned, useable questionnaires from home center, wood treating, and truss manufacturer firms, respectively. Adjusted response rates were 34, 51 and 50 percent, respectively (Table 4-1).

Results and Analysis

Nonresponse Bias

A common concern in survey research is nonresponse bias. Nonresponse bias results when there is a failure to obtain information from a large number of members of the sample and those members somehow differ from respondents, thus possibly influencing conclusions (Yu and Cooper 1983). Relatively high response rates, such as those obtained in this study, decrease the likelihood of nonresponse bias being a problem (Fowler 1984, Churchill 1991). To investigate nonresponse bias in the data, early respondents were compared to late respondents on each of the quality items and on the demographic variables: Volume of lumber purchased, sales volume, and total number of employees. Multivariate analysis of variance was used to test the 80 quality items while analysis of variance was used to test the demographic variables. No significant differences were found. Nonresponse bias did not appear to be a problem in this study.

Assessing Model Fit

Zeithaml (1988) speaks of quality as a higher order abstract. This simply means that the

dimensions of quality should be similar regardless of the product or the customer group investigated. Accordingly, analysis began by testing the fit of the data to the 12 dimension theoretical model. Confirmatory factor analysis, (Gerbing and Hunter 1988), was used to assess data fit. Similarity coefficients indicated a lack of external consistency and thus a lack of fit (Anderson and Gerbing 1982). Therefore, a new model of total product quality was developed.

New Model Development

Because of the lack of fit to the theoretical model, exploratory factor analysis was used to assess the underlying dimensionality of the data. Principle-axis factoring with oblique (Oblimin) rotation was used. A five factor model explaining 41.5 percent of the variance provided the most interpretable solution. Three items were eliminated due to low factor loadings (<.4). The model was respecified to improve fit. Respecification resulted in two items with similar factor loadings being moved and the deletion of seven items.

The five factors were logical combinations of the originally theorized dimensions. The first factor contained the original dimensions: **Service Reliability, Responsiveness, Assurance, Empathy, and Perceived Quality** and was named **Supplier/Salesperson Characteristics**. The second factor retained two of the three items representing **Tangibles** and was renamed **Supplier Facilities. Performance/Conformance, Product Reliability, Durability, Features, and Aesthetics** formed two dimensions which generally followed the lines of appearance and performance and were named **Lumber Performance** and **Lumber Characteristics**. Finally, the fifth factor was primarily composed of items representing the dimension added by the author and was

named **Supplier Services**. Figure 4-2 displays the five dimensions, their reliabilities, and the items representing them.

The following discussion indicates the meaning of each of the five dimensions of quality. **Supplier/Salesperson Characteristics** was measured by items such as Friendliness of Supplier's Salesperson and Supplier Understanding Your Needs and is the personal level of interaction between the salesperson and his or her company and the customer. **Supplier Facilities** was measured by the two items Supplier's Physical Facilities and Tools/Equipment Used to Produce Lumber and is self explanatory. **Supplier Services** was measured by items such as Protective Wrapping of Lumber and Supplier Offering a Variety of Species. This dimension is made up of the extra steps a supplier could take to satisfy a customer. The dimension **Lumber Performance** is self explanatory. Examples of items measuring this dimension are Stiffness/Strength of Lumber and Long Service Life of Lumber. **Lumber Characteristics** is a very appearance and aesthetic oriented dimension measured by items such as Neat, Undamaged Lumber Pack and Overall Lumber Appearance.

Analysis was also performed on each of the three markets separately. The individual models displayed factor structures somewhat different from the overall model. However, they were similar enough that the author considered it appropriate to continue with the overall model. It is also important to note the potential of other variables, such as species utilized, to influence the factor structure of the model of quality.

Comparisons to Past Research

A number of studies utilizing quality models have failed to yield results similar to those in

this study even though quality is purported to be a higher order abstract applicable across differing product types. In comparison to Sinclair et al.'s (1993) study of quality in wood office furniture this study revealed few similarities. Sinclair et al. (1993) found that **Serviceability and Perceived Quality** combined to form one dimension. Similarly in this study, **Perceived Quality** combined with **Service Reliability, Assurance, Responsiveness, and Empathy** to form service oriented dimension.

This study found the dimensions from Parasuraman et al. (1988) combined to form two dimensions: **Supplier/Salesperson Characteristics and Supplier Facilities**. These two dimensions are essentially intangibles and tangibles which is similar to results obtained in the utilities industry (Babakus and Inhofe 1993) and in health care services (Mishrah et al. 1991). Other researchers found the scale used by Parasuraman et al. (1988) to be unidimensional (Babakus and Boller 1992, Cronin and Taylor 1992).

Model Validation

Given the disparity of results, one may question this model's applicability to measuring softwood lumber quality. This concern was investigated by reassessing the importance of the model's dimensions and assessing the influence of these dimensions on supplier preference. A second questionnaire was developed and mailed to every respondent of the original survey. Respondents rated the importance of each quality dimension as well as the performance of their most and least preferred suppliers. Respondents ranked the importance of each quality dimension identically across the two surveys (where dimension importance from the first questionnaire was calculated as the average importance of the items representing that dimension).

Two measurements of the dimensions of quality providing identical results is an indication that respondents understood the five dimensions of quality and that the model is appropriate for softwood lumber. In addition, respondents clearly evaluate suppliers based on the measured dimensions of quality.

Table 4-2 displays the performance ratings of most and least preferred suppliers. Although t-tests indicated that the performance levels on each dimension are different at a .01 level of significance, the sheer magnitude of the difference is very convincing evidence that buyers prefer suppliers that perform well on the dimensions of quality identified by this study. In fact, some respondents refused to provide ratings for a least preferred supplier claiming that they simply did not buy from such suppliers.

Respondents not only evaluate suppliers based on dimensions of quality, but they claim that they pay more for better quality softwood lumber and better service. This was despite the fact that they considered price to be very important in their purchase decision (Table 4-3). Some authors have suggested that providing a quality product can be a source of competitive advantage (Cravens et al. 1988, Shetty 1987). The above discussion provides convincing evidence that this is true for softwood lumber.

Developing Competitive Advantage

Clearly, gaining competitive advantage in the softwood lumber business can be a matter of providing a high quality total product (i.e., becoming a most preferred supplier). Overall, respondents ranked the dimensions in the following order of importance: **Lumber Characteristics (6.22), Supplier/Salesperson Characteristics (5.78), Lumber Performance (5.65), Supplier**

Services (5.47), and Supplier Facilities (4.10). Figure 4-3 shows how the three groups of users investigated in this study differ in their perceived importance of the five dimensions of quality. The three groups were very similar in the importance they placed on **Supplier/Salesperson Characteristics and Lumber Characteristics**. However, there are differences based on the other three dimensions. Truss manufacturers differed from home centers and wood treaters based on the importance of **Lumber Performance**. **Supplier Services** were much more important to home centers than to wood treaters or truss manufacturers. **Supplier Facilities** appears to be of relatively little importance to any of the three groups but were most valued by wood treaters.

No matter which of the three groups a firm targets, the most important aspect of quality is the appearance of the lumber (**Lumber Characteristics**). Buyers desire clean, undamaged packs of lumber and lumber without wane. However, if a firm were to specifically target one or more of the groups investigated in this study, it would want to stress different aspects of quality depending on the chosen target market. If a firm were to target truss manufacturers, its selling efforts should be concentrated on showing the prospective customer its superiority on the dimension, **Lumber Performance**. The availability of machine stress rated lumber may be significant in meeting this groups needs. If a firm were targeting home centers, its superiority in providing **Supplier Services** should be stressed. Supplying mixed loads or accepting small orders along with the ability to supply a variety of species would be important when targeting this group. Although treaters are not significantly different from the other two groups on **Lumber Characteristics**, they rated it much higher than the second most important when compared to the other groups. **Lumber Characteristics**, the appearance of the lumber, is critically important when dealing with treaters.

The process of gaining competitive advantage through emphasis on quality can be fine tuned by regularly assessing firm performance on each of the dimensions of quality. Figure 4-4 displays items representing a condensed, easily applied model of softwood lumber quality. This model of quality incorporates the most important items within a dimension as well as those items most highly correlated with the dimension. The most significant point to notice about this condensed model is that **Supplier Facilities** has been eliminated. Given its low importance, the author felt it unnecessary to include this dimension in a practical quality measurement model.

This condensed model provides a very useable measure of softwood lumber quality. Softwood lumber suppliers can easily and efficiently use it to monitor dimensions importance as well as firm performance in providing quality to the customer. In addition, the supplier could assess the performance of competitors on the same dimensions. This, of course, requires gathering data from the customer concerning the performance of the firm and competing firms in providing quality. This would not only facilitate quality-based strategy development, but the increased supplier/customer interaction would foster a stronger relationship between the supplier and the customer.

Respondent Profile

Table 4-4 provides three categories of size related respondent demographic information: Average lumber volume purchased, sales, and number of employees. Treaters displayed the highest values in two of the three categories, while home centers were largest when measured by number of employees. The reported volume of lumber purchased in 1991 by all responding firms totalled 12.9 billion board feet. Species utilization is illustrated by Table 4-5, displaying results not wholly unexpected. As discussed earlier, southern pine is the predominant species preservatively treated.

The species accounted for over 70 percent of the lumber treated by responding firms. Home centers used southern pine and Canadian SPF (spruce/pine/fir) in nearly equal volumes while Douglas-fir consumption followed as a distant third. Truss manufacturing firms primarily used southern pine, with Canadian SPF a close second. All three industries purchased the majority of their lumber direct from the sawmill (Table 4-6). Treaters purchased the largest percentage (69%) of their lumber direct from the mill and received over 11 percent from company owned sawmills. As would be expected, home centers purchased a larger percentage of lumber through co-ops than either treaters or truss manufacturers. Wholesalers/Brokers/Distribution Centers formed the second largest channel of distribution used by all three groups of firms.

Respondent Comments Concerning Quality

Several open ended questions were included in the second questionnaire to solicit respondent's opinions concerning product and service quality in softwood lumber. In general, respondents were not satisfied with the quality (physical product quality) of the lumber they were receiving. By a ratio of more than seven to one, respondents commented that quality was going down rather than remaining static or getting better. The presence of wane is an especially sensitive issue with many respondents. Offering wane free lumber may serve as a potentially successful tactic, especially when targeting wood treaters.

Respondents indicated that grades have fallen over time and that suppliers continually attempt to provide the absolute minimum quality level to meet grade requirements, a concern expressed by the author at the beginning of this article. One respondent concerned about the industry in general stated, "Being allowed to ship a product with five percent reject material is a sin. The big

three auto makers use to do that and their clock got cleaned. The same is going to happen to this industry." According to respondents, current grading rules do in fact cause suppliers of softwood lumber to produce and package a product that is just good enough to make the grade. One respondent commented that some suppliers tend to barely make grade, and that those suppliers are avoided even though it may mean paying a slight premium for another supplier's product - additional evidence that competitive advantage can be attained through providing quality.

Although respondents were not content with the quality of the lumber they were receiving, they did appear to be somewhat more satisfied with the services provided by suppliers. At a rate of approximately three to one, respondents were content with the service they were receiving. As would be expected with the issues facing the industry, lumber supply is a definite concern of respondents, as is price. One respondent suggested that forming alliances with key customers would benefit sawmills and be appreciated by customers.

Whether it be grading, delivery, or some other aspect of quality, it is clear respondents desire consistency. They want to know what to expect from one delivery to the next. One respondent put it succinctly, "Consistency, good or bad, would be nice." One consistency problem is the fluctuation of quality resulting from demand and price changes. Respondents claim that when demand and price escalate, quality tends to drop. However, when demand and price are lower suppliers concentrate more on quality in order to compete better. Respondents saw a similar correlation between price and service. This type of inconsistency is exactly what buyers want to avoid. Suppliers who maintain quality levels during market fluctuations will be more likely to achieve most preferred supplier status.

Conclusion

Providing quality to customers can be a source of competitive advantage. Past research has supported this contention and this study provides considerable supporting evidence for the specific case of softwood dimension lumber. The ability to measure quality is absolutely critical to realizing advantage through quality-based marketing strategies. The condensed model of quality presented here can be used by suppliers of softwood dimension lumber to develop a quality-based marketing strategy and thereby gain competitive advantage.

In general, buyers of softwood lumber are disenchanted with the softwood lumber they receive and the grading system that is supposed to ensure quality. However, they seem somewhat more satisfied with the service they are receiving. Given their disenchantment with the system and their perceived lack of product quality, there is ample opportunity for innovative lumber suppliers to gain competitive advantage through quality.

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Table 4-1: Sample Size and Adjusted Response Rates for Each Group Sampled

Respondent Group	Valid Sample Size	Valid Returns	Adjusted Response Rate
Home Centers	1063	375	34.0%
Treaters	367	187	51.0%
Truss Manufacturers	610	305	50.0%

Table 4-2: Mean Respondent Ratings of the Performance of Their Most and Least Preferred Suppliers on Selected Dimensions of Quality

Dimension	Most Preferred Supplier	Least Preferred Supplier
Supplier/Salesperson Characteristics	5.78*	3.38
Supplier Services	5.45	4.10
Supplier Facilities	4.94	3.85
Lumber Performance	5.49	3.66
Lumber Characteristics	5.62	3.72

*1 = well below average performance, 7 = well above average performance.

Table 4-3: Mean Respondent Ratings of Selected Purchase Decision Criteria

Purchase Decision Criteria	Rating
Price is very important in your softwood lumber purchase decisions.	6.01*
You pay a higher price to suppliers of better quality softwood lumber.	5.52
You pay a higher price to suppliers that provide better service.	4.83

*1=Strongly Disagree, 7=Strongly Agree.

Table 4-4: Responding Firm: Average Sales, Average Lumber Volume Purchased, and Employment

Category	User Group		
	Truss Mfgs.	Treaters	Home Centers
Average Board Foot Volume (MBF)	8,185	40,162	15,524
Average Sales (\$000)	\$10,503	\$60,252	\$38,798
Average Number of Employees	83	159	198

Table 4-5: Species Utilized by Responding Firms

Lumber Species Utilized	Respondent Group		
	Truss Mfgs.	Treaters	Home Centers
Douglas-Fir	13.0%*	5.6%	15.4%
Southern Pine	36.5%	73.3%	29.3%
Ponderosa/Lodgepole Pine	1.8%	5.1%	4.0%
Hem/Fir	15.3%	7.2%	9.6%
Northern Pine	0.0%	1.5%	0.4%
Spruce/Fir (U.S.)	4.6%	1.1%	6.5%
SPF (Canada)	27.6%	5.6%	32%
White Pine	1.1%	0.3%	2.5%
Other	0.2%	0.3%	0.5%

* Percent breakdown based on lumber volume. May not add to 100% due to rounding.

Table 4-6: Distribution Channels Utilized by Responding Firms

Channel	Respondent Group		
	Truss Mfgs.	Treaters	Home Centers
Direct from Sawmill	47.5%	68.7%	46.1%
Company Owned Sawmill	9.3%	11.4%	3.4%
Buyer Co-ops	4.5%	0.7%	6.1%
Wholesaler/Broker/ Distribution Center	36.1%	18.4%	34.6%
Reload Center	2.6%	0.8%	9.8%
Other	0.0%	0.0%	0.0%

* Percent breakdown based on lumber volume. May not add to 100% due to rounding.

<p>SERVICE RELIABILITY</p> <ol style="list-style-type: none">1. Consistent, on Schedule Delivery by Supplier2. Product Availability3. Correct Record Keeping by Supplier4. Accuracy of Supplier's Billing System	
<p>RESPONSIVENESS</p> <ol style="list-style-type: none">5. Supplier's Ability to Deliver Quickly on Short Notice6. Eagerness of Supplier's Salespeople to Meet your Needs7. Supplier's Salespeople Enjoy Their Job8. Supplier Rapidly Responding to and Solving Problems9. Quick Callbacks by Supplier's Salespeople10. Electronic Data Interchange with Supplier11. Not Being Put on Hold Excessively when Telephoning Supplier12. The Ease with Which the Supplier Can be Contacted by Telephone	
<p>ASSURANCE</p> <ol style="list-style-type: none">13. Knowledge and Skill of Supplier's Sales Personnel14. Manufacturing Expertise of Supplier15. Absence of Hard Sell Techniques by Supplier's Salespeople16. Dealings with Supplier Being Held Confidential17. Trustworthiness of Supplier's Salesperson18. Being Respected by Supplier's Salesperson19. Friendliness of Supplier's Salesperson20. Ease of Understanding Supplier's Salesperson21. Supplier Handles Problems Professionally and Fairly22. Personal Relationship with Supplier23. Personal Relationship with Supplier's Salesperson24. Supplier's ability to Understand Conditions of Special Orders25. Candidness of Supplier's Salesperson	
<p>EMPATHY</p> <ol style="list-style-type: none">26. Convenience of Supplier's Hours of Operation27. Supplier's Willingness to Learn Your Specific Requirements28. Supplier's Salesperson Giving Individualized Attention29. Being Recognized by Supplier's Salespeople as a Regular Customer30. Empathy by the Supplier for Your Needs31. Supplier Understanding Your Needs32. Supplier Anticipating Your Needs	
<p>TANGIBLES</p> <ol style="list-style-type: none">33. Supplier's Physical Facilities34. Tools/Equipment Used to Produce Lumber35. Convenience of Supplier's Location	
<p>PERFORMANCE/CONFORMANCE</p> <ol style="list-style-type: none">36. Location and Legibility of Grade Stamp37. Stiffness/Strength of Lumber38. Dense/Non-Dense Classification39. Ease of Nailing40. Fastener Retention41. Lumber Straightness	<ol style="list-style-type: none">42. Absence of End Splits43. Absence of Wane44. Absence of Sloped Grain45. Absence of Knots46. Absence of Shake47. Absence of Heartwood48. Accuracy and Consistency of Grading49. Accuracy and Consistency of Machining50. Accuracy and Consistency of Moisture Content51. Kiln Dried52. Precision End Trimming53. Square End Trimming
	<p>AESTHETICS</p> <ol style="list-style-type: none">54. Overall Lumber Appearance55. Clean Lumber/Pack56. Neat-Undamaged Pack57. Absence of Torn Grain58. Absence of Stain59. Absence of Planer Skip
	<p>DURABILITY</p> <ol style="list-style-type: none">60. Durability of Lumber61. Long Service Life of Lumber
	<p>PRODUCT RELIABILITY</p> <ol style="list-style-type: none">62. Failure Rate of Lumber in Service63. Reliability of Lumber Strength Values
	<p>PERCEIVED QUALITY</p> <ol style="list-style-type: none">64. Reputation of Supplier65. Previous Experiences with Supplier66. Reputation of Supplier's Salesperson
	<p>FEATURES</p> <ol style="list-style-type: none">67. Machine Stress Rating68. Anti-Stain Treatment69. Bar Coding of Lumber70. End Coating of Lumber71. Protective Wrapping of Lumber
	<p>COOPERATIVENESS/SUPPLIER SERVICES</p> <ol style="list-style-type: none">72. Supplier's Willingness to Fill Large Orders73. Supplier's Willingness to Fill Small Orders74. Supplier Arranged Shipping75. Supplier's Willingness to Supply Mixed Loads76. Supplier Offering a Variety of Species77. Credit Terms Offered by Supplier78. Long Term Price Agreements Offered by Supplier79. Firm Prices Quoted by Supplier80. Just In Time Delivery Offered by Supplier

Figure 4-1: Theorized Dimensions of Total Product Quality and Corresponding Items Used for Measurement

SALESPERSON/SUPPLIER CHARACTERISTICS

Cronbach's Alpha = .952

1. Consistent, on Schedule Delivery by Supplier
2. Product Availability
3. Correct Record Keeping by Supplier
4. Accuracy of Supplier's Billing System
5. Supplier's Ability to Deliver Quickly on Short Notice
6. Eagerness of Supplier's Salespeople to Meet your Needs
7. Supplier's Salespeople Enjoy Their Job
8. Supplier Rapidly Responding to and Solving Problems
9. Quick Callbacks by Supplier's Salespeople

11. Not Being Put on Hold Excessively when Telephoning Supplier
12. The Ease with Which the Supplier Can be Contacted by Telephone
13. Knowledge and Skill of Supplier's Sales Personnel
14. Manufacturing Expertise of Supplier

16. Dealings with Supplier Being Held Confidential
17. Trustworthiness of Supplier's Salesperson
18. Being Respected by Supplier's Salesperson
19. Friendliness of Supplier's Salesperson
20. Ease of Understanding Supplier's Salesperson
21. Supplier Handles Problems Professionally and Fairly
22. Personal Relationship with Supplier
23. Personal Relationship with Supplier's Salesperson
24. Supplier's ability to Understand Conditions of Special Orders
25. Candidness of Supplier's Salesperson
26. Convenience of Supplier's Hours of Operation
27. Supplier's Willingness to Learn Your Specific Requirements
28. Supplier's Salesperson Giving Individualized Attention
29. Being Recognized by Supplier's Salespeople as a Regular Customer
30. Empathy by the Supplier for Your Needs
31. Supplier Understanding Your Needs
32. Supplier Anticipating Your Needs

64. Reputation of Supplier
65. Previous Experiences with Supplier
66. Reputation of Supplier's Salesperson

72. Supplier's Willingness to Fill Large Orders

SUPPLIER FACILITIES

Cronbach's Alpha = .632

33. Supplier's Physical Facilities
34. Tools/Equipment Used to Produce Lumber

LUMBER PERFORMANCE

Cronbach's Alpha = .895

36. Location and Legibility of Grade Stamp
37. Stiffness/Strength of Lumber

38. Dense/Non-Dense Classification
39. Ease of Nailing
40. Fastener Retention

44. Absence of Sloped Grain

47. Absence of Heartwood

60. Durability of Lumber
61. Long Service Life of Lumber
62. Failure Rate of Lumber in Service
63. Reliability of Lumber Strength Values

67. Machine Stress Rating

LUMBER CHARACTERISTICS

Cronbach's Alpha = .908

41. Lumber Straightness
42. Absence of End Splits
43. Absence of Wane

46. Absence of Shake

48. Accuracy and Consistency of Grading
49. Accuracy and Consistency of Machining
50. Accuracy and Consistency of Moisture Content

54. Overall Lumber Appearance

55. Clean Lumber/Pack
56. Neat-Undamaged Pack
57. Absence of Torn Grain
58. Absence of Stain
59. Absence of Planer Skip

SUPPLIER SERVICES

Cronbach's Alpha = .763

70. End Coating of Lumber
71. Protective Wrapping of Lumber

73. Supplier's Willingness to Fill Small Orders
74. Supplier Arranged Shipping
75. Supplier's Willingness to Supply Mixed Loads
76. Supplier Offering a Variety of Species
77. Credit Terms Offered by Supplier

79. Firm Prices Quoted by Supplier
80. Just In Time Delivery Offered by Supplier

Figure 4-2: Respecified Five Dimension Model of Total Product Quality and Corresponding Items Used for Measurement

Supplier/Salesperson Characteristics

	Home Centers	Truss Mfgs.
Home Centers (5.78)*		
Truss Mfgs. (5.77)	No Difference	
Wood Treaters (5.80)	No Difference	No Difference

Lumber Characteristics

	Home Centers	Truss Mfgs.
Home Centers (6.18)		
Truss Mfgs. (6.19)	No Difference	
Wood Treaters (6.36)	No Difference	No Difference

Lumber Performance

	Home Centers	Truss Mfgs.
Home Centers (5.51)		
Truss Mfgs. (6.09)	Difference	
Wood Treaters (5.19)	No Difference	Difference

Supplier Services

	Home Centers	Truss Mfgs.
Home Centers (5.79)		
Truss Mfgs. (5.26)	Difference	
Wood Treaters (5.14)	Difference	No Difference

Supplier Facilities

	Home Centers	Truss Mfgs.
Home Centers (4.01)		
Truss Mfgs. (3.96)	No Difference	
Wood Treaters (4.49)	No Difference	Difference

Figure 4-3: Quality Dimension Importance Level Differences Among Home Center, Wood Treater, and Wood Truss Manufacturer Respondents (simple ANOVA at .05 level of significance)
 *Dimension Importance Rating from Second Questionnaire

IMPORTANCE

Directions: Please rate each item based on how important you feel it is to the quality of lumber or service you receive from your suppliers.

PERFORMANCE

Directions: Please rate each item based on our company's (our competitor's) performance in providing that item.

Supplier/Salesperson Characteristics

1. Friendliness of Supplier's Salesperson
2. Supplier's Salesperson Giving Individualized Attention
3. Ease of Understanding Supplier's Salesperson
4. Supplier Understanding Your Needs
5. Being Treated With Respect by Supplier's Salespeople

Lumber Performance

6. Stiffness/Strength of Lumber
7. Durability of Lumber
8. Fastener Retention
9. Failure Rate of Lumber in Service
10. Long Service Life of Lumber

Lumber Characteristics

11. Neat, Undamaged Lumber Pack
12. Overall Lumber Appearance
13. Clean Lumber/Pack
14. Accuracy and Consistency of Machining
15. Lumber Straightness
16. Accuracy and Consistency of Grading

Supplier Services

17. Supplier Offering a Variety of Species
18. Protective Wrapping of Lumber Packs
19. Supplier's Willingness to Supply Mixed Loads
20. Supplier's Willingness to Fill Small Orders
21. Credit Terms Offered by Supplier
22. Supplier Arranged Shipping
23. Firm Prices Quoted by Supplier

Figure 4-4: Condensed Measurement Model for Softwood Lumber Quality

**STUDY SUMMARY, STUDY BENEFITS AND FUTURE
RESEARCH**

Study Summary

This study was undertaken to accomplish the following objectives:

1. Define quality in softwood lumber, as a total product, from the perspective of the marketplace (customer).
2. Determine if the definition of lumber quality differs among various user groups.
3. Determine if buyers seek out suppliers that display the quality characteristics they perceive to be most important.

The bulk of the study consisted of accomplishing the first objective. A theoretical model of softwood lumber quality was developed based on the previous work of Parasuraman et al. (1988) and Garvin (1984). By combining the dimensions of service and product quality developed by these authors, a model of total product quality was developed. This model consisted of twelve dimensions measured by 80 descriptive items. For example, an item measuring **Service Reliability** was **Consistent, on Schedule Delivery**.

A mail survey was used to gather data from three markets for softwood lumber: wood truss manufacturers, wood treaters, and retail home centers. Respondents indicated their perceived importance of each of the 80 items to the quality of softwood lumber. In total 867 responses were received for an overall response rate of approximately 43 percent. The data was first analyzed using confirmatory factor analysis. This type of analysis indicates whether the items intended to measure a single dimension measure that dimension and only that dimension. The analysis indicated that this was not the case. In other words, the data gathered did not fit the twelve dimension model theorized to represent softwood lumber quality.

Since the data did not fit the model that was theorized at the beginning of the study, exploratory factor analysis was used to assess the dimensions underlying the data. A five factor model provided the following logical and interpretable factors. **Supplier/Salesperson Characteristics, Supplier Facilities, Supplier Services, Lumber Performance, and Lumber Characteristics.**

Supplier/Salesperson Characteristics was measured by items such as Friendliness of Supplier's Salesperson and Supplier Understanding Your Needs and is the personal level of interaction between the salesperson and his or her company and the customer. **Supplier Facilities** was measured by the two items Supplier's Physical Facilities and Tools/Equipment Used to Produce Lumber and is self explanatory. **Supplier Services** was measured by items such as Protective Wrapping of Lumber and Supplier Offering a Variety of Species. This dimension is made up of the extra steps a supplier could take to satisfy a customer. The dimension **Lumber Performance** is self explanatory. Examples of items measuring this dimension are Stiffness/Strength of Lumber and Long Service Life of Lumber. **Lumber Characteristics** is a very appearance and aesthetic oriented dimension measured by items such as Neat, Undamaged Lumber Pack and Overall Lumber Appearance.

The five dimension model is the customer's definition of quality thereby satisfying the first objective. However, additional evidence was sought to determine if buyers truly perceive quality in softwood lumber to be made up of five dimensions. A second questionnaire was developed and mailed to each of the respondents to the original survey. In this questionnaire they were asked to rate the importance of each of the five dimensions rather than the items used to measure those

dimensions. Respondents were very consistent in their rating and the resulting ranking of quality dimensions. Although the direct rating of the dimension was generally higher than the average of the items used to measure it, the consistency of rating indicates that respondents recognized the dimensions of quality. This provides evidence that quality in softwood lumber is perceived to be made up of five dimensions.

Given the information gathered to accomplish the first objective, it was very simple to accomplish the second objective. This objective sought to determine if the definition of softwood lumber quality was different among the three user groups investigated in this study. Definition differences were assessed through the importance that the three groups placed on the five dimensions of quality. There were no differences among the three groups based on the dimensions **Supplier/Salesperson Characteristics** and **Lumber Characteristics**. However, appearances did appear on the other three dimensions. Truss manufacturers, as one would expect, placed more importance on **Lumber Performance** than either of the other groups. Wood treaters considered **Supplier Facilities** as more important than truss manufacturers, but there was no difference between treaters and home centers on this dimension. Finally, home centers considered **Supplier Services** to be significantly more important than did wood treaters or truss manufacturers.

The third objective of this study was simply to determine if buyers of softwood lumber use suppliers that do a good job of providing a quality total product. In the previously mentioned second questionnaire, respondents also rated the performance of their most and least preferred suppliers on the five dimensions of quality. On all five dimensions, most preferred suppliers were rated significantly higher than least preferred suppliers. In fact, several respondents failed to answer for a

least preferred supplier and commented that they have no such supplier. In other words, they only deal with the suppliers that perform well on the five dimensions of quality.

Beyond the specifically stated objectives, it was concluded from the evidence gathered in this study that suppliers of softwood lumber can not only differentiate themselves based on quality, but they can also command a higher price as a result. In the first questionnaire respondents were asked to agree or disagree (on a seven point scale) with the following three statements: Price is very important in your softwood lumber purchase decisions, You pay a higher price to suppliers of better quality softwood lumber, and You pay a higher price to suppliers that provide better service. The rating of these three statements was 6.01, 5.52, and 4.83; respectively. For a commodity type product like softwood lumber one would expect price to be very important, but one might not consider that buyers would be willing to more for better quality. The respondents to this questionnaire indicated exactly that.

The idea that quality can be used to differentiate a supplier of softwood lumber and that in turn that supplier can command a higher price introduces the idea of using quality in strategy development. Through monitoring both firm and competitor performance on the dimensions of quality a firm can plan their quality strategy to best differentiate themselves from their competitors in the eyes of their specific customers.

Study Benefits

It is apparent that quality is gaining importance in the wood products industry. As the consumer of wood products becomes more quality conscious it is imperative that suppliers

understand their customer's perceptions, wants, and needs. This study provides a means of bridging the gap between what producers believe consumers think about softwood dimension lumber quality and what they actually think.

This study also provides the softwood lumber industry with a synopsis of the items which their customers consider fundamental to total product quality. From this synopsis, suppliers can be better equipped to produce the type of product that consumers believe to exhibit quality. By utilizing the information obtained in this study, suppliers of softwood dimension lumber can improve their competitive position within the industry. In addition, the information gained through this study has the potential to raise softwood lumber quality, industry wide, providing the industry with an additional advantage over non-wood products.

Finally, this study provides an empirically derived set of total product quality dimensions. While the results are different from other similar studies, the newly created measure provides a step in the evolution of our understanding of quality as it relates to a total product.

Future Research

This study has addressed two issues: the general measurement of quality and specifically the measurement of quality in the commodity product softwood dimension lumber. Accordingly there are two specific areas that future research should investigate.

First, this study developed a model of quality that appears to apply to a commodity product. Further research should investigate the dimensionality of quality in other commodity products. Results similar to those found in this study would reinforce the usefulness of the assembled model

for achieving competitive advantage through a quality-based marketing strategy in commodity markets.

The second area that needs further refinement is the measurement of quality in general. This study developed a five dimension model of total product quality. These findings are not similar to past research. Factors that affect the dimensionality of quality should be investigated. Is it plausible that commodity products display fewer dimensions of quality than other types of products? If so, what is it about a commodity product that makes this so. More information is needed to determine if the dimensions of quality are product or possibly market specific. An enhanced understanding of the phenomenon acting on the dimensionality of quality will in turn allow improved quality-based marketing strategies to be developed. This is the first study that has investigated the quality of a total product rather than analyzing product and service quality separately. Further investigation of this concept is needed.

¹The quality movement has evolved over the years from quality control, to quality assurance, and finally to the present day with Total Quality Management (TQM). TQM has focussed on meeting the needs of customers. William Miller forecasts a paradigm change in which TQM evolves further, the result being Quantum Quality. This is how he describes the concept,

" . . . a new term is making the rounds in companies such as IBM, Proctor & Gamble, and Johnson & Johnson: 'delighting the customer.' This is one of the first times that a word suggesting an *emotion* has appeared in the quality-improvement vocabulary . . ."

¹The following paragraph is based upon the work of Miller, William C. 1993. *Quantum Quality: Quality Improvement Through Innovation, Learning, & Creativity*. Quality Resources. White Plains, New York.

Clearly these firms recognize the importance of providing quality and are continually seeking to improve the quality of their products. Customers are becoming more quality conscious and will continue to demand higher quality products and services. Those firms that recognize this will continually seek to increase the quality of their products and the sophistication of their performance evaluation systems. Firms which choose to ignore quality will be left behind as more aggressive and visionary firms move forward in their quality development efforts.

APPENDIX A:

**Prenotification Post Card, Cover Letters, Follow-up Post Cards, and
First Questionnaire**

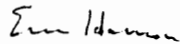
Dear Softwood Lumber Buyer:

Within the next two weeks you should receive a questionnaire from the Center for Forest Products Marketing at Virginia Tech University. The questionnaire is part of a study that will assess softwood lumber quality as perceived by you, the customer. I would greatly appreciate your help.

The study will help producers better understand and provide for your softwood lumber needs.

Please consider completing and returning the questionnaire. As only a limited number of companies can be contacted, your input is very important.

Sincerely,



Eric Hansen
Graduate Student

Eric Hansen

August 10, 1992

Mr. S. L. Buyer
Purchasing
ABC Company
Anywhere, USA 00000

Dear Mr. Buyer:

I recently sent you a postcard requesting your participation in a research project investigating softwood lumber quality. The study's objectives are to create a definition of quality specific to softwood lumber and its users and to determine the effect of quality on buyer's decisions. The information you provide will lead to a more efficient marketplace in which your needs, as a softwood lumber buyer, will be more closely met.

As only a limited number of buyers can be contacted, the success of this study, as well as the successful completion of my graduate studies depends upon your response. Filling out the questionnaire will take approximately fifteen minutes of your time. Please complete the questionnaire and return it as soon as possible (postage is prepaid).

The information you provide will be held in strict confidence. The number on the questionnaire is for administrative purposes and allows me to remove your name from the mailing list upon receipt of your response. Reports resulting from this study will contain only data combined from many responding companies; no information will be released about individual companies.

When completing the questionnaire please consider the quality of the 2x4, 2x6, 2x10, 2x12, and radius edge decking material that you purchase for your treating operations.

Thank you very much for your help! If you have any questions please contact me at 703/231-5876 (Fax: 703/231-8868).

Sincerely,

Eric Hansen
Graduate Student

August 10, 1992

Mr. S. L. Buyer
Purchasing
ABC Company
Anywhere, USA 00000

Dear Mr. Buyer:

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When completing the questionnaire please consider the quality of the 2x4, 2x6, 2x10, and 2x12 softwood lumber that you purchase for your truss operations.

Thank you very much for your help! If you have any questions please contact me at 703/231-5876 (Fax: 703/231-8868).

Sincerely,

Eric Hansen
Graduate Student

Eric Hansen

August 10, 1992

Mr. S. L. Buyer
Purchasing
ABC Company
Anywhere, USA 00000

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The information you provide will be held in strict confidence. The number on the questionnaire is for administrative purposes and allows me to remove your name from the mailing list upon receipt of your response. Reports resulting from this study will contain only data combined from many responding companies; no information will be released about individual companies.

When completing the questionnaire please consider the quality of the 2x4, 2x6, 2x10, and 2x12 softwood lumber that you purchase for retail sale.

Thank you very much for your help! If you have any questions please contact me at 703/231-5876 (Fax: 703/231-8868).

Sincerely,

Eric Hansen
Graduate Student

Softwood Lumber Quality Study

Center for Forest Products Marketing
Department of Wood Science & Forest Products
Virginia Polytechnic Institute and State University
Blacksburg, VA 24061-0503

Questions? Call: Eric Hansen
Phone: 703/231-5876
Fax: 703/231-8868

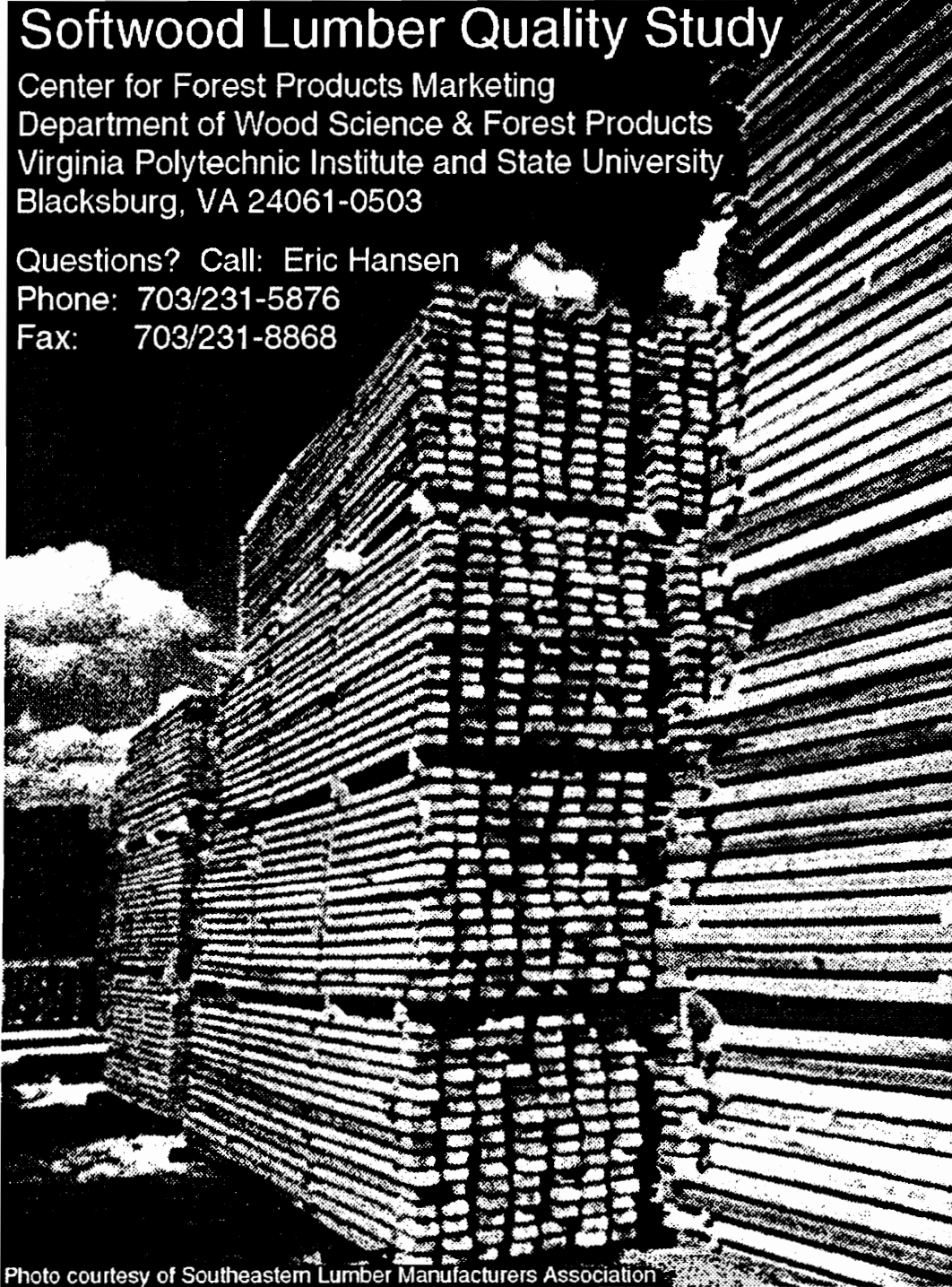


Photo courtesy of Southeastern Lumber Manufacturers Association

This survey is intended to gather information from buyers of untreated ("white wood") softwood dimension lumber. If you are NOT responsible for purchasing softwood dimension lumber for your company, please give this to the person that is.

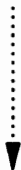
Does your company purchase softwood dimension lumber?

NO



Please return the questionnaire by following the directions on the back page. Postage is prepaid.

YES



The items that follow describe both physical aspects of softwood dimension lumber and characteristics of suppliers of softwood dimension lumber and the services they provide. Please rate each item based on how important you feel it is to the quality of softwood dimension lumber or the service you receive from your suppliers. Rate each item by circling the number you feel most accurately describes its importance to quality.

	Well Below Average Importance			Average Importance			Well Above Average Importance
	↓			↓			↓
Reputation of Supplier's Salesperson	1	2	3	4	5	6	7
Supplier's Ability to Understand Conditions of Special Orders	1	2	3	4	5	6	7
Reputation of Supplier	1	2	3	4	5	6	7
Supplier's Physical Facilities	1	2	3	4	5	6	7

Empirically Derived Dimensions of Quality for Softwood Lumber

	Well Below Average Importance			Average Importance			Well Above Average Importance	
	↓			↓			↓	
	1	2	3	4	5	6	7	
Durability of Lumber	1	2	3	4	5	6	7	
Absence of Heartwood (no wood from center of tree)	1	2	3	4	5	6	7	
Accuracy and Consistency of Grading	1	2	3	4	5	6	7	
Absence of Knots (no face or edge knots)	1	2	3	4	5	6	7	
Supplier's Salespeople Enjoy Their Job	1	2	3	4	5	6	7	
Eagerness of Supplier's Salespeople to Meet Your Needs	1	2	3	4	5	6	7	
Absence of Hard Sell Techniques by Supplier's Salespeople	1	2	3	4	5	6	7	
Knowledge and Skill of Supplier's Sales Personnel	1	2	3	4	5	6	7	
Anti-stain Treatment (lumber is chemically treated to prevent discoloration)	1	2	3	4	5	6	7	
Square End Trimming	1	2	3	4	5	6	7	
Tools/Equipment Used to Produce Lumber	1	2	3	4	5	6	7	
Correct Record Keeping by Supplier	1	2	3	4	5	6	7	
Supplier Handles Problems Professionally & Fairly	1	2	3	4	5	6	7	
Fastener Retention (lumber's ability to tightly hold truss plates, nails, etc.)	1	2	3	4	5	6	7	
End Coating of Lumber	1	2	3	4	5	6	7	
Absence of End Splits	1	2	3	4	5	6	7	

Eric Hansen

	Well Below Average Importance			Average Importance			Well Above Average Importance
	↓			↓			↓
Protective Wrapping of Lumber Packs	1	2	3	4	5	6	7
Consistent, on Schedule Delivery by Supplier	1	2	3	4	5	6	7
Firm Prices Quoted by Supplier	1	2	3	4	5	6	7
Supplier's Willingness to Fill Small Orders	1	2	3	4	5	6	7
Accuracy and Consistency of Moisture Content	1	2	3	4	5	6	7
Being Treated with Respect by Supplier's Salespeople	1	2	3	4	5	6	7
Precision End Trimming	1	2	3	4	5	6	7
Kiln Dried	1	2	3	4	5	6	7
The Ease with Which the Supplier Can be Contacted by Telephone	1	2	3	4	5	6	7
Supplier Arranged Shipping	1	2	3	4	5	6	7
Supplier Offering a Variety of Species	1	2	3	4	5	6	7
Dense/Nondense Classification (refers to # of growth rings per inch)	1	2	3	4	5	6	7
Trustworthiness of Supplier's Salesperson	1	2	3	4	5	6	7
Not Being Put on Hold Excessively when Telephoning Supplier	1	2	3	4	5	6	7
Previous Experiences with Supplier	1	2	3	4	5	6	7
Empathy by Supplier For Your Needs	1	2	3	4	5	6	7

Empirically Derived Dimensions of Quality for Softwood Lumber

	Well Below Average Importance			Average Importance			Well Above Average Importance
	↓			↓			↓
Supplier's Willingness to Learn Your Specific Requirements	1	2	3	4	5	6	7
Long Term Price Agreements Offered by Supplier	1	2	3	4	5	6	7
Absence of Planer Skip (no areas the planer failed to surface)	1	2	3	4	5	6	7
Long Service Life of Lumber	1	2	3	4	5	6	7
Absence of Shake (no separation along the growth rings)	1	2	3	4	5	6	7
Failure Rate of Lumber in Service (% of pieces that break under load)	1	2	3	4	5	6	7
Convenience of Supplier's Hours of Operation	1	2	3	4	5	6	7
Supplier Understanding Your Needs	1	2	3	4	5	6	7
Dealings with Supplier Being Held Confidential	1	2	3	4	5	6	7
Supplier Rapidly Responding to and Solving Problems	1	2	3	4	5	6	7
Clean Lumber/Pack	1	2	3	4	5	6	7
Location and Legibility of Grade Stamp	1	2	3	4	5	6	7
Ease of Nailing	1	2	3	4	5	6	7
Overall Lumber Appearance	1	2	3	4	5	6	7
Neat-Undamaged Lumber Pack	1	2	3	4	5	6	7
Credit Terms Offered by Supplier	1	2	3	4	5	6	7

Eric Hansen

	Well Below Average Importance			Average Importance			Well Above Average Importance
	↓			↓			↓
Supplier Anticipating Your Needs	1	2	3	4	5	6	7
Accuracy and Consistency of Machining	1	2	3	4	5	6	7
Product Availability	1	2	3	4	5	6	7
Manufacturing Expertise of Supplier	1	2	3	4	5	6	7
Electronic Data Interchange with Supplier	1	2	3	4	5	6	7
Personal Relationship with Supplier	1	2	3	4	5	6	7
Reliability of Lumber Strength Values	1	2	3	4	5	6	7
Stiffness/Strength of Lumber	1	2	3	4	5	6	7
Absence of Wane (no bark or lack of wood on face or edge)	1	2	3	4	5	6	7
Accuracy of Supplier's Billing System	1	2	3	4	5	6	7
Lumber Straightness (no warp, twist, crook, bow)	1	2	3	4	5	6	7
Supplier's Willingness to Supply Mixed Loads	1	2	3	4	5	6	7
Friendliness of Supplier's Salesperson	1	2	3	4	5	6	7
Absence of Tom Grain (no fuzzy short fibers on surface of lumber)	1	2	3	4	5	6	7
Candidness of Supplier's Salesperson	1	2	3	4	5	6	7
Supplier's Salesperson Giving Individualized Attention	1	2	3	4	5	6	7

Empirically Derived Dimensions of Quality for Softwood Lumber

	Well Below Average Importance			Average Importance			Well Above Average Importance
	↓			↓			↓
Machine Stress Rating (mechanical properties of lumber evaluated by a machine)	1	2	3	4	5	6	7
Supplier's Ability to Deliver Quickly on Short Notice	1	2	3	4	5	6	7
Quick Callbacks by Supplier's Salesperson	1	2	3	4	5	6	7
Absence of Stain (no discoloration of lumber)	1	2	3	4	5	6	7
"Just In Time" Delivery Offered by Supplier (an inventory management system)	1	2	3	4	5	6	7
Absence of Sloped Grain (sloped grain means the grain is not parallel to length of lumber)	1	2	3	4	5	6	7
Ease of Understanding Supplier's Salesperson	1	2	3	4	5	6	7
Bar Coding of Lumber	1	2	3	4	5	6	7
Supplier's Willingness to Fill Large Orders	1	2	3	4	5	6	7
Convenience of Supplier's Location	1	2	3	4	5	6	7
Being Recognized by Supplier's Salespeople as a Regular Customer	1	2	3	4	5	6	7
Personal Relationship with Supplier's Salesperson	1	2	3	4	5	6	7

What volume of softwood dimension lumber did your company purchase in 1991?

_____ Total Board Feet

How many full time employees did your company employ during 1991? _____

(Please include yourself and all full-time production, maintenance, management and sales employees; but exclude any part-time employees.)

What was your your company's total sales during 1991? \$ _____

How much of the softwood dimension lumber purchased by your company during 1991 was from each of the following species groups?

% of total board feet purchased

- _____ % Douglas Fir
- _____ % Southern Yellow Pine
- _____ % Ponderosa/Lodgepole Pine
- _____ % Hem/Fir
- _____ % Northern Pine (Red and Jack)
- _____ % Spruce or Fir (U.S.)
- _____ % Spruce/Pine/Fir (Canadian)
- _____ % White Pine
- _____ % Other: _____

Total = 100%

How much of the softwood dimension lumber purchased by your company during 1991 was from each of the following channels?

% of total board feet purchased

- _____ % Direct from Sawmill
- _____ % Company Owned Sawmill
- _____ % Buyer Co-ops
- _____ % Wholesaler/Broker/Distribution Center
- _____ % Reload Center
- _____ % Other: _____

Total = 100%

Please mark each of the following duties that you are responsible for.

- | | |
|--|--|
| <input type="checkbox"/> Buying | <input type="checkbox"/> Retail Management |
| <input type="checkbox"/> Quality Control | <input type="checkbox"/> Sales |
| <input type="checkbox"/> Production Management | <input type="checkbox"/> Engineering |

Please list the company names of the three suppliers from which you purchase the largest volumes of softwood lumber

1. _____
2. _____
3. _____

Please reply to the following three statements by circling the number that best describes your level of agreement.

Price is very important in your softwood lumber purchase decisions.

- | | | | | | | |
|-------------------|---|---|---------|---|---|----------------|
| Strongly Disagree | | | Neutral | | | Strongly Agree |
| ↓ | | | ↓ | | | ↓ |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

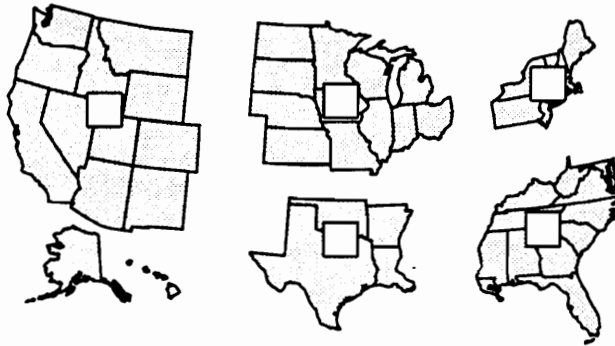
You pay a higher price to suppliers of better quality softwood lumber.

- | | | | | | | |
|-------------------|---|---|---------|---|---|----------------|
| Strongly Disagree | | | Neutral | | | Strongly Agree |
| ↓ | | | ↓ | | | ↓ |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

You pay a higher price to suppliers that provide better service.

- | | | | | | | |
|-------------------|---|---|---------|---|---|----------------|
| Strongly Disagree | | | Neutral | | | Strongly Agree |
| ↓ | | | ↓ | | | ↓ |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Please indicate, by checking the appropriate box, the major region(s) in which your company is located.



Comments:

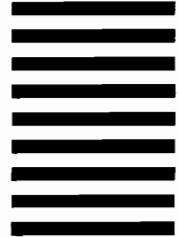
Is there anything about softwood lumber quality that you feel is important that I have failed to mention? Please use the space below if you have any additional comments.

Thank you for completing this questionnaire. Please fold, tape (with the address on the back page showing), and return by mail. The postage is prepaid.

Once again, **Thank you!**



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



BUSINESS REPLY MAIL
FIRST CLASS MAIL PERMIT NO. 10 BLACKSBURG, VA

POSTAGE WILL BE PAID BY ADDRESSEE

VIRGINIA TECH
THOMAS M. BROOKS FOREST PRODUCTS CENTER
ATTN: ERIC HANSEN
PO BOX 850
BLACKSBURG VA 24063-9985



Fold Along Dotted Line

PLEASE RETURN THE QUESTIONNAIRE, by FOLDING ONCE and TAPING so that the return address is showing. POSTAGE IS PREPAID!

THANK YOU!

Eric Hansen

Dear Softwood Lumber Buyer:

Recently a questionnaire concerning softwood lumber quality was sent to you from the Center for Forest Products Marketing. If you have already returned the questionnaire I want to thank you for your help. If not, I would like to again stress the importance of your participation and urge you to take a few minutes to complete and return the questionnaire. Postage is prepaid.

If you have any questions or if you did not receive a questionnaire, please contact me at 703/231-5876 (Fax: 703/231-8868). Thank you for your help!

Sincerely,

Eric Hansen

Eric Hansen
Graduate Student

September 1, 1992

Mr. S. L. Buyer
Purchasing
ABC Company
Anywhere, USA 00000

Dear Mr. Buyer:

I recently sent you a questionnaire concerning softwood lumber quality. It is part of a study designed to create a definition of quality specific to softwood lumber and it's users and to determine the effect of quality on buyer's decisions. The information you provide will lead to a more efficient marketplace in which your needs, as a softwood lumber buyer, will be more closely met.

If you have already returned the questionnaire, thank you for your help. If not, I would like to emphasize the importance of your response to the successful completion of the study, as well as my graduate degree! Filling out the questionnaire will take approximately fifteen minutes of your time, so please complete and return it as soon as possible (postage is prepaid).

The information you provide will be held in strict confidence. The number on the questionnaire is for administrative purposes only, allowing me to avoid further mailings to those firms that have already responded. Reports generated from this study will only contain data combined from many responding companies; no information will be released about individual companies.

When completing the questionnaire please consider the quality of the 2x4, 2x6, 2x10, 2x12, and radius edge decking material that you purchase for your treating operations.

Thank you very much for your help! If you have any questions, please contact me at 703/231-5876 (Fax: 703/231-8868).

Sincerely,

Eric Hansen
Graduate Student

Eric Hansen

September 1, 1992

Mr. S. L. Buyer
Purchasing
ABC Company
Anywhere, USA 00000

Dear Mr. Buyer:

I recently sent you a questionnaire concerning softwood lumber quality. It is part of a study designed to create a definition of quality specific to softwood lumber and its users, and to determine the effect of quality on buyer's decisions. The information you provide will lead to a more efficient marketplace in which your needs, as a softwood lumber buyer, will be more closely met.

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Thank you very much for your help! If you have any questions, please contact me at 703/231-5876 (Fax: 703/231-8868).

Sincerely,

Eric Hansen
Graduate Student

September 1, 1992

Mr. S. L. Buyer
Purchasing
ABC Company
Anywhere, USA 00000

Dear Mr. Buyer:

I recently sent you a questionnaire concerning softwood lumber quality. It is part of a study designed to create a definition of quality specific to softwood lumber and its users, and to determine the effect of quality on buyer's decisions. The information you provide will lead to a more efficient marketplace in which your needs, as a softwood lumber buyer, will be more closely met.

If you have already returned the questionnaire, thank you for your help. If not, I would like to emphasize the importance of your response to the completion of the study, as well as my graduate degree! Filling out the questionnaire will take approximately fifteen minutes of your time, so please complete the questionnaire and return it as soon as possible (postage is prepaid).

The information you provide will be held in strict confidence. The number on the questionnaire is for administrative purposes only, allowing me to avoid further mailings to those firms that have already responded. Reports generated from this study will only contain data combined from many responding companies; no information will be released about individual companies.

When completing the questionnaire please consider the quality of the 2x4, 2x6, 2x10, and 2x12 softwood lumber that you purchase for retail sale.

Thank you very much for your help! If you have any questions, please contact me at 703/231-5876 (Fax: 703/231-8868).

Sincerely,

Eric Hansen
Graduate Student

Eric Hansen

Dear Softwood Lumber Buyer:

Recently a second questionnaire concerning softwood lumber quality was sent to you from the Center for Forest Products Marketing.

Your response is critical to the success of this study.

If you have already responded, thank you. If not, please take a few minutes to complete and return the questionnaire. Postage is prepaid.

If you have any questions or if you did not receive a questionnaire, please contact me at (703) 231-5876 (Fax: (703) 231-8868). Thank you for your help!

Sincerely,



Eric Hansen

September 28, 1992

Mr. S. L. Buyer
Purchasing
ABC Company
Anywhere, USA 00000

Dear Mr. Buyer:

I am conducting a study of softwood lumber users, with the objective of defining softwood lumber quality and determining quality's effect on buyers decisions. I need your response to make this study successful. The study requires a minimum of 200 completed and returned questionnaires.

This is not the first time that I have mailed to your address, so if you have already returned a questionnaire, please accept my thanks and forgive this interruption. If you have not returned a questionnaire, please do so -- the study's successful completion and my graduate degree depend on your response.

I assure you that the information you provide will be held in strict confidence. The number on the questionnaire is for administrative purposes only, allowing me to avoid further mailings to those firms that have already responded. Reports generated from this study will only contain data combined from many responding companies; no information will be released about individual companies.

When completing the questionnaire please consider the quality of the 2x4, 2x6, 2x10, 2x12, and radius edge decking material that you purchase for your treating operations.

If you have any questions, please contact me at 703/231-5876 (Fax: 703/231-8868).

Sincerely,

Eric Hansen
Graduate Student

APPENDIX B:

Cover Letter, Follow-up Post Card, and Second Questionnaire



CENTER FOR FOREST PRODUCTS MARKETING

Department of Wood Science and Forest Products
1650 Ramble Rd., Blacksburg, Virginia 24061-0503
Phone: (703) 231-5876 Fax: (703) 231-8868

Mr. S. L. Buyer
Purchasing
ABC Company
Anywhere, USA 00000

Dear Mr. Buyer:

A little over a year ago you received and completed a questionnaire concerning the quality of the softwood dimension lumber that you purchase. I want to thank you for your help. Your participation has allowed me to gain a better understanding of how you as a buyer of softwood lumber perceive and evaluate quality.

Enclosed is a second questionnaire that I would like to ask you to complete. It is much shorter than the first and should take approximately five minutes of your time. The information you provide will allow me to obtain a better understanding of how quality influences your selection of a supplier. In turn it will allow suppliers to better supply the quality you require.

If you previously asked for a copy of the results of this study, I have your name and will provide those results as soon as they are available.

Again, as before, the number on the questionnaire is for bookkeeping only. Your answers on the questionnaire will be combined with many other respondents and your identity will never be revealed.

If you have any questions or comments please feel free to contact me at (703) 231-8835 (Fax: 231-8868).

Sincerely,

Eric Hansen
Graduate Student

Softwood Lumber Quality

**Virginia Polytechnic Institute and State University
Department of Wood Science and Forest Products
1650 Ramble Road
Blacksburg, VA 24060-0503**

**Questions? Call Eric Hansen
(703) 231-8835
Fax: (703) 231-8868**

This questionnaire is intended to gather information from buyers of untreated softwood dimension lumber ("white wood"). If you are NOT responsible for purchasing softwood dimension lumber for your company please give this to the person who is.

Please continue on the following page.

**Please rate the IMPORTANCE of the following
on their importance to total quality (both product and service quality)**

SUPPLIER/SALESPERSON CHARACTERISTICS (e.g., *Supplier handles problems professionally and fairly; Supplier understanding your needs; Consistent, on schedule delivery by supplier; and Supplier's salesperson giving individualized attention*)

<u>Well Below Average Importance</u>			<u>Average Importance</u>			<u>Well Above Average Importance</u>	
1	2	3	4	5	6	7	

SUPPLIER SERVICES (e.g., *Firm prices quoted by supplier; Supplier offering a variety of species; Supplier's willingness to supply mixed loads; Protective wrapping of lumber*)

<u>Well Below Average Importance</u>			<u>Average Importance</u>			<u>Well Above Average Importance</u>	
1	2	3	4	5	6	7	

SUPPLIER FACILITIES (e.g., *Tools and equipment used to produce lumber; Supplier's physical facilities*)

<u>Well Below Average Importance</u>			<u>Average Importance</u>			<u>Well Above Average Importance</u>	
1	2	3	4	5	6	7	

LUMBER PERFORMANCE (e.g., *Failure rate of lumber in service; Reliability of lumber strength values; Durability of lumber; Stiffness/strength of lumber*)

<u>Well Below Average Importance</u>			<u>Average Importance</u>			<u>Well Above Average Importance</u>	
1	2	3	4	5	6	7	

LUMBER CHARACTERISTICS (e.g., *Overall lumber appearance; Accuracy and consistency of grading; Lumber straightness; Neat, undamaged lumber pack*)

<u>Well Below Average Importance</u>			<u>Average Importance</u>			<u>Well Above Average Importance</u>	
1	2	3	4	5	6	7	

**How does your MOST PREFERRED SUPPLIER
perform on the following aspects of quality?**

SUPPLIER/SALESPERSON CHARACTERISTICS (e.g., *Supplier handles problems professionally and fairly; Supplier understanding your needs; Consistent, on schedule delivery by supplier; and Supplier's salesperson giving individualized attention*)

<u>Well Below Average Performance</u>			<u>Average Performance</u>			<u>Well Above Average Performance</u>	
1	2	3	4	5	6	7	

SUPPLIER SERVICES (e.g., *Firm prices quoted by supplier; Supplier offering a variety of species; Supplier's willingness to supply mixed loads; Protective wrapping of lumber*)

<u>Well Below Average Performance</u>			<u>Average Performance</u>			<u>Well Above Average Performance</u>	
1	2	3	4	5	6	7	

SUPPLIER FACILITIES (e.g., *Tools and equipment used to produce lumber; Supplier's physical facilities*)

<u>Well Below Average Performance</u>			<u>Average Performance</u>			<u>Well Above Average Performance</u>	
1	2	3	4	5	6	7	

LUMBER PERFORMANCE (e.g., *Failure rate of lumber in service; Reliability of lumber strength values; Durability of lumber; Stiffness/strength of lumber*)

<u>Well Below Average Performance</u>			<u>Average Performance</u>			<u>Well Above Average Performance</u>	
1	2	3	4	5	6	7	

LUMBER CHARACTERISTICS (e.g., *Overall lumber appearance; Accuracy and consistency of grading; Lumber straightness; Neat, undamaged lumber pack*)

<u>Well Below Average Performance</u>			<u>Average Performance</u>			<u>Well Above Average Performance</u>	
1	2	3	4	5	6	7	

How does your LEAST PREFERRED SUPPLIER perform on the following aspects of quality?

SUPPLIER/SALESPERSON CHARACTERISTICS (e.g., *Supplier handles problems professionally and fairly; Supplier understanding your needs; Consistent, on schedule delivery by supplier; and Supplier's salesperson giving individualized attention*)

<u>Well Below Average Performance</u>			<u>Average Performance</u>			<u>Well Above Average Performance</u>	
1	2	3	4	5	6	7	

SUPPLIER SERVICES (e.g., *Firm prices quoted by supplier; Supplier offering a variety of species; Supplier's willingness to supply mixed loads; Protective wrapping of lumber*)

<u>Well Below Average Performance</u>			<u>Average Performance</u>			<u>Well Above Average Performance</u>	
1	2	3	4	5	6	7	

SUPPLIER FACILITIES (e.g., *Tools and equipment used to produce lumber; Supplier's physical facilities*)

<u>Well Below Average Performance</u>			<u>Average Performance</u>			<u>Well Above Average Performance</u>	
1	2	3	4	5	6	7	

LUMBER PERFORMANCE (e.g., *Failure rate of lumber in service; Reliability of lumber strength values; Durability of lumber; Stiffness/strength of lumber*)

<u>Well Below Average Performance</u>			<u>Average Performance</u>			<u>Well Above Average Performance</u>	
1	2	3	4	5	6	7	

LUMBER CHARACTERISTICS (e.g., *Overall lumber appearance; Accuracy and consistency of grading; Lumber straightness; Neat, undamaged lumber pack*)

<u>Well Below Average Performance</u>			<u>Average Performance</u>			<u>Well Above Average Performance</u>	
1	2	3	4	5	6	7	

Please take a few minutes to comment on the following questions.

What changes in softwood lumber quality do you see taking place in today's market?

What changes in the service provided by suppliers do you see taking place in today's market?

Is there any aspect of quality that suppliers of softwood lumber generally fail to provide adequately?.

Eric Hansen



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THOMAS M BROOKS FOREST PRODUCTS CENTER
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PO BOX 850
BLACKSBURG VA 24063-9985



Fold Along Dotted Line

To return the questionnaire, just fold at the dotted line and tape, with the return address showing.
Postage is prepaid.

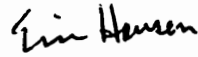
THANK YOU!

Dear Softwood Lumber Buyer:

Recently I mailed you a questionnaire concerning softwood lumber quality. If you have already returned the questionnaire I want to thank you for your help. If not, I would like to again stress the importance of your participation and urge you to take a few minutes to complete and return the questionnaire. Postage is prepaid.

If you have any questions, or if you did not receive a questionnaire, please contact me at 703/231-8835 (Fax: 703/231-8868). Thank you for your help!

Sincerely,



Eric Hansen
Graduate Student

VITA

Eric Hansen was born in Ontario, Oregon and raised in Cambridge, Idaho. He attended the University of Idaho in Moscow, Idaho and received a B.S. degree in Forest Products Business Management (1990). Upon completion of his B.S. degree he immediately began work on his Ph.D. at Virginia Tech. He has been married to Tamra Zumwalt Hansen for six years.

Eric Hansen