Chapter 3

An Empirical Evaluation of Intermediaries’ Perceptions of Technology Transfer in the Logging Industry
(ABSTRACT)

Over 600 technology transfer intermediaries in the logging industry were surveyed. These intermediaries, pre-identified by loggers, included state agencies (foresters), industry foresters, marketing professionals in private companies, officers in trade associations, and extension specialists. This study identified that intermediaries from different professional groups do have different preferred sources for learning about new technology information, effective methods for disseminating new technology information, factors influencing their decisions to disseminate new technology information, and factors in the promotion of portable timber bridges. It is very difficult to develop a unified channel strategy to fit every intermediary. However, understanding the differences among those intermediaries is essential in order to promote portable timber bridge technology.

Overall, personal visits, trade shows, short courses, and workshops were preferred by respondents in terms of effective methods for disseminating new technology information. The Internet was rated lowest in this question. However, it appears that the Internet will play an increasingly important role in disseminating new technology information in the near future, but intermediaries appear not to recognize this method and developing trend.

State agencies (foresters) rated environmental issues as important factors in the promotion of portable timber bridge technology, but industry foresters and extension
specialists rated ease of installation and handling as the most important factors in the promotion of portable timber bridges. Promoters of portable timber bridge technology need to take note of the differing preferences when designing promotional materials for intermediaries.
Introduction

Market expansion is considered an important factor for long-term success by the forest industry. Success can be attained through new product introduction(s), improvement, innovations or extension of current product lines, or entering into new geographical areas. However, overall new products are more likely to fail than to succeed. Assael (1992) indicated that, on average, only one out of five new products that an organization develops and tests is successful. Therefore, in terms of new product diffusion, the majority of products (80 percent) are not adopted by end-users and diffused across groups (Assael 1992).

Forces that lead to technological innovation are not always from inside an industry. Often an industry receives technology (technology push) from outside sources. However, the transfer process is not always smooth. Public sector research represents an important source of technology. In the major Western industrial countries, government and university research organizations account for over 40 percent of the national research and development (R&D) expenditures (Large and Barclay 1992). But many technology transfer efforts between public (federal government) and private sectors have been disappointing (Piper and Naghshpour 1996).

In the past, technology transfer was viewed as a unilateral flow process (i.e., good technologies sell themselves). An example is the adoption-diffusion models developed in the 1950’s (Rogers 1983). However, these models did not provide much guidance for improving or speeding up technology transfer efforts and processes (Baldwin and
Haymond 1994). Yet, technology transfer processes and efforts are far more complex than most research recognizes (Baldwin and Haymond 1994). It has been suggested that it is necessary to overcome communication difficulties among groups for real success in technology transfer (Irwin and Moore 1991). However, the technology transfer process is not as simple as transferring technology directly from developers to end-users. It involves information transferred among different groups with differing viewpoints and agendas. Many individuals or groups (transfer intermediaries) play vital roles in this process in order to smooth or speed up the transferring efforts. Transfer intermediaries (channels) can provide information more efficiently than developers. In an attempt to better understand the technology transfer process in the logging industry, especially in portable timber bridge technology, this study investigated the communication behavior of important transfer intermediaries within the industry and provides needed information essential to technology transfer.

**Background of the Study**

Technology transfer from outside sources has been demonstrated recently in the market for timber bridges. The US Congress funded the Wood in Transportation Program (WIT) (formally known as the National Timber Bridge Initiative), which is administered by the USDA Forest Service (beginning in Fiscal Year 1989) to help rebuild local infrastructures and increase the use of underutilized or low-value timber species for bridge construction. Since that time, over $20 million has been authorized for research,
construction, and technology transfer of information regarding the use of timber for modern bridges (USDA 1995). This indicates a great interest and need for the WIT Program (USDA 1997).

It is essential that the WIT Program be accessible to the public, which includes highway officials, bridge engineers, and community decision-makers. In order for the WIT Program to be successful, information about uses of wood in transportation must be transferred and disseminated to others. Technology transfer has been conducted primarily under the direction of the Timber Bridge Information Resource Center (TBIRC) located at Morgantown, West Virginia. Transfer activities include a quarterly newsletter (Crossings), specific research reports, production of the Timber Bridge Manual, the sponsorship of several timber bridge workshops and training sessions, and a information library and staff ready to assist those who contact the TBIRC. The TBIRC also identifies emerging technologies, stores, retrieves, and disseminates information to meet the needs of managers, planners, designers, builders, engineers, and others (USDA 1997).

As previously mentioned, the adoption-diffusion models developed in the 1950s have not provided much guidance for improving or speeding up technology transfer efforts and processes. Recently, researchers have been exploring the issue of cultural differences and communication difficulties between groups in the process of technology transfer. Such an approach might help overcome many of the associated problems involved, particularly the communication difficulties occurring among technology developers, message senders, and technology users where different organizational
cultures clash (Irwin and More 1991). Therefore it is important to pay close attention to communication and information flow through different cultures involved in the technology transfer process. The marketing of technology requires new skills, styles, techniques, and ways of thinking. Communication competence and effective information flow in technology transfer needs to be recognized as a cornerstone of effective transfer (Irwin and Moore 1991).

Therefore, the WIT Program’s technology transfer process can be viewed as a communication network system that includes three major subgroups: 1) technology developers who develop new timber bridge technology, 2) end-users (loggers) who may potentially use the technology, and 3) transfer intermediaries (channels) who bridge these groups and provide necessary efforts for a smooth link between technologies and applications, and sometimes can speed up the transfer processes (Figure 3.1). This relationship has been presented in many technology transfer studies (e.g., Rogers 1983, Irwin and More 1991, Baldwin and Haymond 1994). The framework described is a step forward from the traditional diffusion models, which describe how information flow moves and is exchanged between diverse groups. Conversely, how information is received in (input) and how information is transferred out (output) can also be examined.
Problem Statement

Communication has been defined as “*the passing of information, the exchange of ideas, or the process of establishing a commonness of thought between a sender and a receiver*” (Schram 1955). It suggests that for communication to occur, there must be some common thinking between two parties and information must be passed from one individual or group to another (Belch and Belch 1995). However, the effectiveness of communication may not come from messages directly sent from senders to receivers. Sometimes it is necessary to go through third parties (intermediaries/channels) first and then transfer information to end-receivers. However, a thorough understanding of intermediary communication behavior is essential. Transfer intermediaries can bring sender and receiver together in an efficient and orderly fashion (Peter and Donnelly 1988).

Like all businesses, public organizations buy, sell, provide, and deliver ideas, services, and goods. They transact with suppliers, middlemen, and customers and they too are counseled by other specialists. Public organizations find it necessary to use other organizations and individuals to achieve their objectives because they have limited funding and personnel. As a result of the aforementioned factors, they seek to find others to aid in the diffusion of technologies. Clearly, it is challenging to find parties who are involved in purchase or usage decisions, and once the parties are identified, to elicit help from them. Public organizations today must grapple with a growing need for their services, shrinking funds, and fierce competition with other organizations. “*To achieve success in such an environment, a public organization must rely on an effective*
marketing strategy: an integrated communications program to present the organization and its services and/or programs to effective intermediaries who can assist the organization in reaching prospective users” (Kotler and Andreasen 1996).

To date, most of the WIT’s research emphasis has been placed on permanent bridge structures. There appears to be a large potential market existing for portable timber bridges and this market has not been explored. This market is the utilization of portable timber bridges as temporary stream crossing structures during forest management and timber harvesting operations. Little research by the USDA Forest Service has been conducted on how to facilitate technology transfer through effective intermediaries to the target end-users. This research utilized a specific example from an empirical study on the transfer of portable timber bridge technology to gain an understanding of communication behavior of important transfer intermediaries within the logging industry. This research detailed factors as to why intermediaries promote portable timber bridges, promotion methodologies, origin of new technology information, current promotion efforts, and subjects.
Objectives of the Study

The objectives of this study were to:

1) identify which sources are important for intermediaries in learning about new technology information;

2) evaluate the effective methods in dissemination of new technology information to end-users; and

3) identify which factors are important to influence the decision(s) in dissemination of new technology information to end-users.

Research Methods

Sample Frame

The sample frame of this study was technology transfer intermediaries in the forest industry within the Eastern United States. The region accounted for a major portion of the timber bridge studies which were funded by the WIT Program (Cesa 1997).

A mail survey was used for primary data collection. The mailing list was compiled from the following sources: 1) 1997-98 North American Factbook (1997), 2) Cooperative Extension Service Personnel in Forest Management and Wood Products (1995), 3) Membership Directory of the Society of American Foresters (1998), 4) Directory of the National Association of State Foresters (1997), and 5) Registration List of Expo Richmond ’98 Participants (1998). A sample frame of 628 individuals was obtained from the sources above. These individuals included state, regional or district foresters, local foresters, industry foresters, officers in forestry-related trade associations,
extension specialists, and marketing managers in private companies. These important technology transfer intermediaries (channels) were pre-identified by technology end-users (loggers) during the first part of this research.

Questionnaire Development and Data Collection

Data were collected using a mail survey. A mail survey is considered an efficient and cost-effective way of securing data from a wide geographical base (Churchill 1991). The first part of the questionnaire used categorical questions to identify profession type, current topics to be disseminated to loggers, percentage of time spent disseminating new technology information to loggers, whether they planned to disseminate portable timber bridge technology, types of portable timber bridge information disseminated, price ranges for portable timber bridges, and educational level. The second part of the questionnaire utilized rating scales to measure important sources for learning about new technology/innovation in the forest industry, effective methods for disseminating new technology information to loggers, factors influencing decisions for the dissemination of new technology information to loggers, important activities used to disseminate new technology information to loggers, importance of materials utilized in the selection of a portable bridge, and important factors used in the promotion of portable timber bridges. The third part of the questionnaire (open-ended questions) specifically asked where respondents learned about portable timber bridges, what areas of research needed to be addressed for improving portable timber bridge utilization, and what is required to increase the use of portable timber bridges for logging and forest management.
Before administering the survey, the questionnaire was evaluated by industry foresters and knowledgeable faculty members in forestry and forest products marketing at Virginia Tech. A pretest was conducted with state foresters, industry foresters, trade association officers, extension personnel, and marketing managers in private companies. The responses to the pretest were used to clarify question wording and to ascertain factors in the technology transfer process. The questionnaire, along with a hand signed cover letter, was mailed in August of 1998 to 628 individuals (Appendix B). This was followed two weeks later with a postcard requesting non-respondents to answer the questionnaire. Six weeks from the original mailing a second questionnaire and letter were mailed.

**Data Analysis**

Data analysis began with one-way and cross tabulations to examine, categorize, tabulate, or otherwise recombine the data to address the study proposition. Multivariate Analysis of Variance (MANOVA) was utilized to test for significant differences (overall effect) among different technology transfer intermediary groups. Once relationships had been determined using MANOVA, multivariate contrast analysis was followed up to further compare groups and variables simultaneously (e.g., group 1 vs. group 2, group 1 vs. group 3, and group 1 vs. group 4). In MANOVA, a linear combination of dependent variables that best separate the levels comprising independent variables was determined. The MANOVA test statistic for comparing groups is Wilks’ lambda, which can be transformed to an F-statistic to obtain a probability level (p-value) (Grimm and Yarnold
Wilks’ lambda expresses the proportion of unexplained variance in dependent measures (Johnson and Wichern 1992). The range of Wilks’ lambda is from zero to infinity. Lower Wilks’ lambda values indicate larger mean differences, therefore indicating stronger group separation (Grimm and Yarnold 1995). Follow up multivariate contrast analysis allowed the researcher to discern subsets of variables that might reveal some underlying constructs by which the groups differ (Grimm and Yarnold 1995). Multivariate contrasting produces a test statistic (in this case the multivariate version of a t-test, Hotelling’s $T^2$-Test) that compares two groups with a critical value (p-value) to obtain a significance level (Grimm and Yarnold 1995). A significance level of 0.05 was used throughout the study. The SPSS™ 8.0 for Windows™ (1997) software package was utilized to examine, categorize, and tabulate data. The SAS™ System for Windows™ Release 6.12 (1996) software was utilized to perform MANOVA and multivariate contrast analysis.

This research recognized an unbalanced sample size in the MANOVA test groups (Table 3.1) and some variables did not appear to meet multivariate normal distribution assumptions. Although multivariate statistics are robust enough to withstand minor violations of basic assumptions, it was necessary to perform nonparametric statistical tests to analyzing data under these circumstance (SPSS 1998). Nonparametric tests are known as distribution-free tests because they make no assumptions about the underlying distribution of the data and these tests are also utilized to analyze unbalanced data sets. The Kruskal-Wallis test was used to further analyze data under nonparametric statistic
assumptions. The Kruskal-Wallis test is a nonparametric analogue to one-way analysis of variance (ANOVA) and it was performed by using the SPSS™ software package.

Non-Response Bias

A common concern in survey research is non-response bias. However, relatively high response rates (such as the data obtained in this survey) reduce the chance of non-response bias being a problem (Churchill 1991). To test for non-response bias in this study, data obtained from non-respondents (via phone calls) were compared to data obtained from the original survey using student t-tests. Respondents were compared on several key areas which include: important sources for learning about new technology/innovation for the logging industry, important activities in disseminating new technology information to loggers, importance of materials utilized in the selection of a portable bridge, and important factors utilized in the promotion of portable timber bridges. No significant differences (at the $\alpha=0.05$ level) were found between the two sets of data, which indicated that non-response bias was not a problem in this study.
Results and Discussion

Three hundred and eighty six questionnaires were returned. There were 11 bad addresses and six respondents indicated that they did not interact with loggers. This resulted in 369 useable questionnaires. Furthermore, respondents were sorted by different professional groups. One hundred and ninety two respondents were state agencies (foresters), 66 industry foresters, 20 trade association officers, 28 extension specialists, 42 marketing or management professionals, and 21 were other type of professionals (e.g., log buyers or land managers) (Table 3.1). The adjusted response rate was 58 percent.

Section one of the questionnaire asked respondents to indicate the current topics they planned to disseminate to loggers, percentage of time spent disseminating new technology information to loggers, did they plan to disseminate portable timber bridge technology, types of portable timber bridges they disseminated, price ranges for portable timber bridges, age, and educational level. The most frequent topic planned to be disseminated to loggers was Best Management Practices (BMP), followed by logging safety issues, and environmental regulations. The most frequent percentage of time spent for the transfer of technology was 5 percent and the next most frequent response was 10 percent (Table 3.2). Approximately 49 percent of the respondents indicated that their organization does disseminate information regarding portable timber bridge technology (Table 3.3). The most frequently disseminated type of portable timber bridge information was for skidder bridges, followed by road or deck mats, and engineered portable timber bridges (Table 3.4). When asked what price range respondents quoted to interested
parties for portable timber bridges, nearly 41 percent of the respondents quoted under $2,000, 38 percent quoted between $2,000 and $3,500, and 7 percent of the respondents quoted over $7,500 (Table 3.5). Approximately 45 percent of the respondents were between ages 40 to 49. Nearly 90 percent of the respondents were four-year college educated.

Industry foresters were the highest percentage of respondents (66 percent) who disseminated portable timber bridge information to loggers, followed by state agencies (55 percent) (Table 3.3). Unless the company is actually producing portable timber bridges, this study found that only a small amount of portable timber bridge information has been transferred by marketing professionals.

Respondents were asked to rate which sources (on a scale of one to seven) were important in learning about new technology or innovation for the logging industry. The number one rated source was seminars or meetings, followed by trade shows, trade journal articles, technical or peer-reviewed journal articles, advertisements in magazines, and personal calls from technology developers (Table 3.6). The least important sources were the WIT Program and unsolicited sales literature. To determine if differences existed between professional groups in terms of important sources in learning new information regarding logging and forest management, MANOVA analysis was used. A significance level of 0.05 was used throughout the study. The multivariate null hypothesis tested in MANOVA was “There are no differences between professional group respondents in terms of important sources for learning about new technology information”.
This analysis resulted in a Wilk’s lambda value of 0.83 and produced a multivariate F of 1.44 with corresponding 40 and 1375 degrees of freedom ($F_{40, 1375} = 1.44$). The obtained probability (p-value) was 0.03, therefore, we rejected the null hypothesis and concluded that there is a significant multivariate effect for intermediaries in different professional groups (in terms of important sources for learning about new technology information). Multivariate contrast analysis was utilized to discern the group differences (e.g., state agencies vs. industry foresters, state agencies vs. extension specialists, state agencies vs. officers in trade associations). There were six groups in this analysis and this produced 15 pairs of comparison groups. This analysis revealed significant differences between state agencies vs. industry foresters (with $p < 0.01$) and state agencies vs. marketing professionals (with $p < 0.01$).

The variables which maximized group separation for state agencies vs. industry foresters were trade shows and the WIT Program (with $p < 0.01$). The variables which maximized group separation for state agencies vs. marketing professionals were advertisements in magazines and trade shows (with $p < 0.01$). Rating means for trade shows at each professional group were: state agencies (4.5), industry foresters (5.0), officers in trade associations (5.3), extension specialists (4.7), marketing professionals (5.5), and other professionals (5.4). This may indicate that trade shows were preferred sources for marketing professionals in learning about new technology information, but may not be preferred by state agencies and extension specialists. Rating means for advertisements in magazines at each professional group were: state (3.8), industry foresters (4.0), officers in trade associations (3.9), extension specialists (4.0), marketing
professionals (4.6), and other professionals (4.7). This could indicate that, because of the business-oriented environment, marketing professionals put more weight on advertisements in magazines than other professionals. Rating means for the WIT Program at each professional group were: state agencies (3.3), industry foresters (2.7), officers in trade associations (3.0), extension specialists (2.9), marketing professionals (3.1), and other professionals (3.4). This indicates that industry foresters did not prefer learning about new technology information from the WIT Program. And, in terms of the awareness level of the WIT Program, industry foresters also had the lowest rated level among other professionals in the Eastern United States. This may indicate that the WIT Program may want to increase its presence with this group.

A Kruskal-Wallis test was performed to further analyze data by nonparametric statistic assumptions. This analysis revealed significant differences between professional groups. The variables which maximized group separation were advertisements in magazines and trade shows (Table 3.6). These results corresponded to the results of the MANOVA. This indicates that the MANOVA was robust enough to withstand minor violations of normality assumptions.

To determine if differences existed between variables in this question, Figure 3.2 illustrates the mean and mean range (lower limit to upper limit) at 95 percent confidence interval (C.I.) for each variable. The variables of seminars, trade shows, and trade journal articles did not show differences from each other (means for these variables fell in each other’s mean ranges). However, these variables are different from other variables. This indicates that respondents viewed these variables (seminars, trade shows, and trade
journal articles) the same as an important source in learning about new technology information.

When asked what were the most effective methods for disseminating new technology information to loggers, respondents indicated that personal visits were the most effective method, followed by trade shows, workshops, and short courses (Table 3.7). The least effective methods for disseminating new technology information to loggers were video conferencing and the Internet. To determine if differences existed between professional groups, the multivariate null hypothesis tested was “There are no differences between professional groups in terms of effective methods for disseminating new technology information to end-users (loggers)”. This analysis resulted in significant differences between professional groups (Wilk’s lambda = 0.69, F \(_{60,1549} = 2.88\); p-value < 0.01). Multivariate contrast analysis was utilized in order to further discern group differences. This analysis revealed significant differences between state agencies vs. all other groups; industry foresters vs. extension specialists, marketing professionals, and other; and extension specialists vs. marketing professionals, and other professionals (all with p-value < 0.05). This indicates that in terms of effective methods for technology transfer, state agencies, industry foresters, and extension specialists had quite different views from other groups. The variables which maximized professional group separation were: manuals, trade journals, reviewed journals, the Internet, trade shows, and video conferencing.

Rating means for manuals at each group were: state agencies (3.6), industry foresters (3.4), officers in trade associations (3.8), extension specialists (3.8), marketing
professionals (4.0), and other professionals (4.6). This indicates that log buyers and land managers preferred manuals as an effective method for technology transfer as compared to other groups. Rating means for trade journals at each group were: state agencies (3.8), industry foresters (4.2), officers in trade associations (4.6), extension specialists (4.3), marketing professionals (4.7), and other professionals (4.8). This may indicate that state agencies did not prefer trade journals as an effective method for transferring new technology information. Rating means for peer-reviewed journals for each group were: state agencies (3.2), industry foresters (3.1), officers in trade associations (3.6), extension specialists (2.5), marketing professionals (4.4), and other professionals (4.2). This indicates that peer-reviewed journals were not preferred by extension specialists for transferring new information to loggers. However, marketing professionals rated peer-reviewed journals highest as compared to other groups. Rating means for the Internet for each group were: state agencies (2.8), industry foresters (2.3), officers in trade associations (2.9), extension specialists (2.4), marketing professionals (3.4), and other professionals (2.9). This indicates that marketing professionals viewed the Internet as an effective method to transfer new technology to users (maybe they have utilized this method previously), but other professionals did not prefer this method. Rating means for trade shows for each group were: state agencies (4.8), industry foresters (5.4), officers in trade associations (5.3), extension specialists (4.9), marketing professionals (5.6), and other professionals (5.5). This indicates that marketing professionals, log buyers/land mangers, and industry foresters preferred trade shows as an effective way to transfer new information, but this was not preferred by state agencies. Rating means for video
conferencing for each group were: state agencies (2.8), industry foresters (2.8), officers in trade associations (2.9), extension specialists (2.4), marketing professionals (3.5), and other professionals (3.2). This indicates that video conferencing was not preferred by technology transfer intermediaries, except marketing professionals.

A Kruskal-Wallis test was performed to further analyze data by nonparametic statistical assumptions. This analysis revealed significant differences between professional groups. The variables which maximized professional group separation were: manuals, trade journals, reviewed journals, the Internet, trade shows, video, and video conferencing (Table 3.7). These results were similar to the results of the MANOVA, with only one variable differing (video). Rating means for video for each group were: state agencies (4.5), industry foresters (4.9), officers in trade associations (4.9), extension specialists (4.5), marketing professionals (5.1), and other professionals (5.3). This indicates that marketing professionals and log buyers or land managers preferred video as an effective method for disseminating new information as compared to other groups of professionals.

To determine if differences existed between variables in this question, Figure 3.3 illustrates that the variable of personal visits is very different from other variables. This indicates that respondents viewed personal visits is the most effective method for disseminating new technology information to loggers. On the other end, the variables of video conferencing and the Internet did not show any differences.

When asked what method(s) (by the same variables listed on the previous question) respondents would choose to disseminate new technology information to
loggers, the most frequent response was personal visits, followed by short courses, workshops, and trade shows.

The most important factors influencing respondents’ decision to disseminate new technology information to loggers were reduction of environmental damage(s) to the forest, followed by increased adoption of BMP, and increased efficiency of logging practices (Table 3.8). The least important decisions for disseminating new technology information to loggers were the use of low-grade lumber and to meet market demands.

To determine if differences existed between professional groups, the multivariate null hypothesis tested was “There are no differences between professional groups in terms of important factors that influence the decision to disseminate new technology information to end-users (loggers)”. This analysis resulted in significant differences between professional groups (Wilk’s lambda = 0.46, F_{30, 1374} = 9.77; p-value < 0.01).

Multivariate contrast analysis was utilized in order to further discern group differences. This analysis revealed significant differences between state agencies vs. all other groups; industry foresters vs. extension specialists and marketing professionals; officers in trade associations vs. marketing professionals; extension specialists vs. marketing professionals and other professionals; and marketing professionals vs. other professionals. This indicates that, in terms of important factors influencing the decision to disseminate new technology information, state agencies were significantly different from other groups.

The variables which maximized professional group separation were: to meet market demand, increase efficiency of logging operation, reduce environmental damages to forest, to increase adoption of BMP, and to increase safety of forest operation. In
general, except for one variable (use of low-grade timber), all other variables contributed to group separation. This indicates that groups did have different factors that influenced their decision to disseminate new technology information. In general, in terms of important factors influencing decisions to disseminate new technology information, state agencies and extension specialists emphasized environmental issues and the adoption of BMP regulations; industry foresters and officers in trade associations emphasized safety and environmental issues; as well as log buyers and land managers. Obviously, marketing professionals focused on the need to meet market demands.

A Kruskal-Wallis test was performed to further analyze data under nonparametric statistical assumptions. This analysis revealed significant differences between professional groups. The variables which maximized group separation were identical to the results of the MANOVA (Table 3.8).

To determine if differences existed between variables in this question, Figure 3.4 illustrates the mean and mean range (lower limit to upper limit) at 95 percent confidence interval (C.I.) for each variable. The variables of reduce environmental damages to forest and to increase adoption of BMP regulation did not show any differences (means for these variables fell in each other’s mean ranges). However, these variables are different from other variables. This indicates that environmental considerations are the major factors influencing respondents’ decision in the dissemination of new information to loggers.

When asked what important activities the respondents’ organizations exercised to disseminate new technology information to loggers, respondents indicated that
educational seminars were the most important activity, followed by working through logging or trade associations, personal calls to loggers, and displays at trade shows (Table 3.9). To determine if differences existed between professional groups, the multivariate null hypothesis tested was “There are no differences between professional groups in terms of important activities in disseminating new information to end-users (loggers)”.

This analysis resulted in significant differences between professional groups (Wilk’s lambda = 0.49, $F_{40,1458} = 6.33$; p-value < 0.01). Multivariate contrast analysis was utilized in order to further discern group differences. Except for the following groups, state agencies vs. officers in trade associations, industry foresters vs. officers in trade associations, officers in trade associations vs. other professionals, and marketing professionals vs. other professionals; this analysis revealed significant differences between all other groups. The variables which maximized professional group separation were: advertisements in magazines, display at trade shows, personal calls to loggers, educational seminars, and work through logger or trade associations. Rating means for advertisements in magazines for each group were: state agencies (2.5), industry foresters (3.2), officers in trade associations (3.5), extension specialists (1.9), marketing professionals (4.8), and other professionals (4.5). This indicates that important activities for disseminating new information to loggers, marketing professionals and log buyers or land managers preferred to use advertisements in magazines, but this activity was not preferred by extension specialists or state agencies. Rating means for displays at trade shows or conventions for each group were: state agencies (4.0), industry foresters (4.2), officers in trade associations (4.7), extension specialists (3.1), marketing professionals
(5.8), and other professionals (5.4). This indicates that marketing professionals and log buyers or land managers preferred to use displays at trade show or convention, but this activity was not preferred by extension specialists and state agencies. Rating means for personal calls to loggers for each group were: state agencies (4.7), industry foresters (5.7), officers in trade associations (4.4), extension specialists (3.5), marketing professionals (5.0), and other professionals (5.0). This indicates that industry foresters and marketing professionals preferred to use personal calls to loggers as an important activity in disseminating new information to users, but this method was not preferred by extension specialists.

A Kruskal-Wallis test was performed to further analyze data under nonparametric statistical assumptions. This analysis revealed significant differences between professional groups. The variables which maximized professional group separation were: advertisements in magazines, display at trade shows, personal calls to loggers, educational seminars, promotional literature, and work through logger or trade associations. This results were similar to the results of the MANOVA, with only one variable being different (promotional literature) (Table 3.9). Rating means for promotional literature for each group were: state agencies (4.1), industry foresters (4.1), officers in trade associations (4.2), extension specialists (3.9), marketing professionals (4.9), and other professionals (4.0). This indicates that, in terms of important activities in the dissemination of new technology information, promotional literature played an important role for marketing professionals, but not for other groups of professionals.
Figure 3.5 illustrates that the variables of educational seminars, work through loggers or trade associations, and personal calls to loggers did not show any differences from each other. However, these variables did show the differences from other variables. This indicates that respondents viewed these variables (educational seminars, work through loggers or trade associations, and personal calls to loggers) as important activities in the dissemination of new information to loggers.

Respondents indicated that timber was the most important material, followed by steel, and aluminum (Table 3.10). To determine if differences existed between professional groups, the multivariate null hypothesis tested was “There are no differences between professional groups in terms of important materials in the selection of a portable bridge”. This analysis resulted in significant differences between professional groups (Wilk’s lambda = 0.83, F_{20, 1049} = 2.95; p-value < 0.01). Multivariate contrast analysis was utilized in order to further discern group differences. This analysis revealed significant differences between state agencies vs. industry foresters, state agencies vs. marketing professionals, industry foresters vs. marketing professionals, officers vs. marketing professionals, and extension specialists vs. marketing professionals. The variables which maximized professional group separation were timber and concrete. Rating means for timber for each group were: state agencies (5.9), industry foresters (6.1), officers in trade associations (5.6), extension specialists (6.0), marketing professionals (5.0), and other professionals (5.9). This indicates that, in terms of the important materials in the selection of a portable bridge, marketing professionals rated timber lowest among groups. The reason for this is that they are not familiar with the...
material or most of respondents’ companies did not sell timber bridges or related technology, or they sold steel bridges. Rating means for concrete for each group were: state agencies (2.2), industry foresters (1.9), officers in trade associations (2.4), extension specialists (2.2), marketing professionals (3.2), and other professionals (2.7). This indicates that marketing professionals held different views of material selection for a portable bridge.

A Kruskal-Wallis test was performed to further analyze data under nonparametric statistical assumptions. This analysis revealed significant differences between professional groups. The variables which maximized group separation were timber, aluminum, and concrete (Table 3.10). These results correspond to the results of the MANOVA.

To determine if differences existed between variables in this question, Figure 3.6 illustrates that the variable of timber is different from other variables. And all variables are different from each other. This indicates that respondent viewed timber as the best material in the selection of a portable bridge.

For those respondents who did disseminate information regarding portable timber bridges, the most important factor for the promotion of portable timber bridges was BMP regulations. This was followed by environmental considerations and ease of installation (Table 3.11). The least important factors were the availability of design information and use of low-grade lumber. Since only one respondent in the marketing/management professional group answered this question, the MANOVA and multivariate contrast tests did not include them in the analysis. To determine if differences existed between
professional groups, the multivariate null hypothesis tested was “There are no differences between professional groups in terms of important factors in the promotion of portable timber bridges”. This analysis resulted in significant differences between professional groups (Wilk’s lambda = 0.65, F\textsubscript{32,562} = 2.13; p-value < 0.01). Multivariate contrast analysis was utilized in order to further discern group differences. This analysis revealed significant differences between state agencies vs. industry foresters, state agencies vs. other professionals, industry foresters vs. extension specialists, industry foresters vs. other professionals, and extension specialists vs. other professionals. The variables which maximized profession group separation were: availability of design information and low cost. Rating means for availability of design information for each group were: state agencies (4.8), industry foresters (4.0), officers in trade associations (4.1), extension specialists (5.5), and other professionals (3.8). This may indicate that from the extension specialists’ point of view, the availability of design information was more important in the promotion of portable timber bridges as compared to other groups. Rating means for low-cost for each group were: state agencies (5.8), industry foresters (5.3), officers in trade associations (5.6), extension specialists (6.1), and other professionals (6.7). This indicates that log buyers or land managers and extension specialists rated low-cost as an important factor in the promotion of portable timber bridges as compared to other groups.

A Kruskal-Wallis test was performed to further analyze data by nonparametric statistical assumptions. This analysis revealed significant differences between professional groups. The variables which maximized group separation were availability of design information and use of low-grade timber (Table 3.11). These results were
similar to the results of the MANOVA, with only one variable being different (use of low-grade timber). Rating means for the use of low-grade timber for each group were: state agencies (4.3), industry foresters (3.5), officers in trade associations (3.9), extension specialists (4.0), and other professionals (5.2). Although the use of low-grade lumber was the least important factor in the promotion of portable timber bridges by all other groups, log buyers or land managers rated this factor quite high as compared to other profession groups.

To determine if differences existed between variables in this question, Figure 3.7 illustrates the mean and mean range (lower limit to upper limit) at 95 percent confidence interval (C.I.) for each variable. The variables of BMP regulations, environmental considerations, ease of installation, and ease of handling did not show any differences (means for these variables fell in each other’s mean ranges). However, these variables are different from other variables. This indicates that respondents viewed these variables as important factors in the promotion of portable timber bridge technology.

Responses to the open-ended question of where respondent learned about portable timber bridge technology indicated that respondents learned how to utilize bridge technology by attending workshops or seminars. The seminars and workshops were sponsored by universities, trade associations or state offices. This indicates that workshops or seminars which were sponsored by universities, trade associations or state offices could be a useful channel for disseminating portable timber bridges technology.

When asked what areas of research needed to be improved to increase the use of portable timber bridges in the US, respondents indicated that cost and information on
construction techniques were most needed. This indicates that initial cost and user-friendly products could be needed research areas for increasing the utilization of portable timber bridge technology.

Respondents were asked what methods were needed to increase the use of portable timber bridges in logging operations. Respondents stated that availability of portable timber bridges, low-cost bridges, incentives, mandatory regulations, and field demonstrations were necessary. This indicates that low-cost products along with intensified marketing efforts and necessary regulations are needed for effectively transferring portable timber bridges technology.

**Conclusion**

A large potential market for portable timber bridges, especially for engineered portable timber bridges, appears to exist in the United States. This can be achieved by effectively utilizing intermediaries to smooth the technology transfer process and ultimately speed up the adoption process.

The results of this study identified that intermediaries in different professional groups do have different preferred sources in learning about new technology information. It indicates that in order to utilize intermediaries for the successful transfer of portable timber bridge technology, utilizing different sources will be necessary. In general, seminars or meetings, trade shows, and trade journal articles were the preferred sources in learning about new technology information for intermediaries.
There were significant differences between professional groups in terms of effective methods for disseminating new technology information. Overall, personal visits was the highest rated variable. Trade shows, short courses, and workshops were preferred by respondents in terms of effective methods for disseminating new technology information. Utilizing these sources for disseminating new technology information to loggers could be more feasible than personal visits. The Internet was rated lowest, however, the Internet will play an increasingly important role in disseminating new technology information in the near future.

This study indicates that respondents at different professional groups have different factors influenced their decisions to disseminate new technology information. State agencies and extension specialists emphasized the environmental issues and adoption of BMP regulations; industry foresters and officers in trade associations emphasized the safety and environmental issues; as well as log buyers or land managers. Marketing professionals focused on meeting market demands far more as compared to other factors. Noticing these differences can help promoters of portable timber bridges to prepare different promotion or information literature for different channels in the transferring process. There were significant differences between professional groups in terms of important activities in the dissemination of new technology information. Although respondents rated educational seminars as the most important activities, work through logger or trade associations was also rated highly. This indicates that trade associations can play an important role in the technology transfer processes. However,
marketing professionals preferred to utilize trade shows and promotion literature as important activities in disseminating new technology information.

Industry foresters had the highest percentage (55 percent) for disseminating portable timber bridge information to loggers, followed by state agencies. This indicates that industry foresters may be a good channel in disseminating new technology information to loggers. However, in the logger study (Shiau 1999), loggers did not prefer to receive information from state agencies. The reason for this may be the dissemination efforts or approaches utilized by state agencies are less effective or the contents are less interesting to loggers. Unless the company is actually producing portable timber bridges, a minute quantity of portable timber bridge information has been transferred by company marketing managers. The most frequent percentage of time spent in transferring technology was 5 percent, followed by 10 percent. Marketing professionals reported the most frequent percentage of time spent in technology transfer as 10 percent and then 20 percent. This may indicate that they spent more time in marketing functions and this could conflict with the concept of technology transfer.

There were significant differences between professional groups in terms of important materials in the selection of a portable bridge. However, respondents rated timber as the best material when selecting a portable bridge. Marketing professionals rated steel quite close to timber. The reason for this is that they are not familiar with the material, respondents companies did not sell timber bridges or related technology, or they are promoting steel bridges. There were significant differences between professional groups in terms of important factors in the promotion of portable timber bridges. State
agencies rated environmental issues as important factors, but industry foresters and
extension specialists rated ease of installation and handling as the most important factors
in the promotion of portable timber bridges. It is essential for promoters of portable
timber bridges to notice these factors and differences among intermediaries in the
planning process for promotion of the technology.

Respondents stated that low-cost products, incentives, mandatory regulations,
field demonstrations, and availability of product information are needed for increasing
the adoption of portable timber bridge technology. This can be concluded that low-cost
products along with intensified marketing efforts and necessary regulations are necessary
for transferring portable timber bridges technology to the logging industry.
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