

Status of the Minnesota Logging Sector in 2016¹

by

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Abstract

A mail survey was conducted in 2017 to assess the status of Minnesota's logging sector during 2016. Minnesota's logging businesses continue to be characterized by a disparity between business size and percentage of total annual production volume. A small percentage of the businesses were classified as harvesting greater than 15,000 cords annually. However, those businesses produced a high percentage of the total harvest volume. Conversely, a large percentage of the businesses were classified as harvesting fewer than 5,000 cords annually, but produced a low percent of total reported volume harvested. The median production level, 4,000 cords annually, is unchanged from the 2011 and 2003 surveys. Businesses which reported producing 10,001 to 15,000 cords compared in a disadvantageous way to one or both of the adjacent volume categories (i.e., 5,001-10,000 and more than 15,000 cords) for a number of factors. The average age of businesses continues to age and a third of the owners are more than 60 years old. The feller-buncher is still the most commonly reported method of felling timber in the state. As the level of production increases, equipment age decreases. While respondents tended to be more positive about their performance in 2016 than was reported in the 2011 survey, they didn't identify any factors which would encourage others to join the logging profession.

Introduction

Logging businesses play a critical role in the wood supply chain, providing wood to mills for use in the manufacture of various forest products. As such, access to information about logging businesses is important to policy makers, wood-using mills, land management agencies, logger training organizations, and trade associations for logging and forest products.

Logging business information has been collected and summarized throughout many states within the United States. A national assessment was conducted in 2011 (Anonymous 2011) and several states have collected baseline and/or ongoing information about logging businesses (e.g., Egan and Taggart 2004a,b; Goldstein et al. 2005; Rickenbach et al. 2005; Milauskas and Wang 2006; Allen et al. 2008; Baker and Greene 2008; Egan 2009, 2011; Traver 2012; Traver et al. 2013, Abbas et al. 2014, Blinn et al. 2014, Conrad et al. 2018).

Perhaps the first summary of Minnesota loggers was provided in 1977 by Harry Fisher, then president of North Shore Forest Products and vice president of the Minnesota Timber Producers Association. Fisher wrote “Today’s modern lumberjack is thirty-five years old. He is married and has at least two children. He is a homeowner with a mortgage and is probably making car payments. He is a highly skilled equipment operator and is capable of operating sophisticated logging machinery under adverse conditions. He is willing to work long hours in all kinds of weather because he has found a quality of life worth living in this area.”

To provide an understanding of Minnesota’s logging businesses, various entities have surveyed loggers over time and summarized their findings. The first summary was done by Bolstad (1980) who profiled Minnesota’s logging and trucking business operations in 1978 and 1979. As a part of the Generic Environmental Impact Statement (GEIS) on timber harvesting and forest management in Minnesota, a second survey was conducted to assess status of logging businesses in 1990 and 1991 (Jaakko Pöyry Consulting, Inc. 1992). Subsequent studies assessed operations for 1996 (Puettmann et al. 1998), 2003 (Powers 2004), and 2012 (Blinn et al 2014). Assessments have also been conducted in neighboring states. Rickenbach et al. (2005) summarized information for a 2003 assessment of loggers in Michigan and Wisconsin. Traver (2012) and Traver et al. (2013) assessed the 2010 status of Wisconsin loggers. Abbas et al. 2014 summarized information for Michigan harvesting and transportation operations in 2009 – 2011.

The objectives of this study were (1) to update our understanding of Minnesota’s logging sector as of 2016, (2) where appropriate, to compare those results to previous and current surveys in Minnesota and Wisconsin and Michigan, and (3) to gain insight into what the current status of the logging industry and markets in Minnesota may mean for the future of Minnesota’s logging sector.

Approach

A mail survey was developed to solicit information from logging businesses. The Minnesota Logger Education Program (MLEP) defines a logging business as a sole-proprietorship, partnership or corporation that purchases stumpage and/or is an independent contract logger, controls timber harvesting and owns timber harvesting equipment.

The survey was designed to collect information similar to previous surveys of Minnesota logging businesses (Blinn et al. 2014) as well as collect new information. It was designed in coordination with researchers in Wisconsin and Michigan who were developing surveys to collect information from logging businesses in their own states at the same time as the Minnesota study. To develop a composite assessment and to facilitate comparisons of logging businesses across the Lake States, several Google Hangouts were conducted with academic and Department of Natural Resources (DNR) contacts in Michigan and Wisconsin in 2016 and 2017. During those meetings, new questions were proposed and discussed to create consistent language across the three states for comparative questions. In addition to the comparative questions, each state's survey included additional questions which were pertinent to that state.

Drafts of Minnesota's survey were shared with representatives from the Minnesota Forest Industries, MLEP, Minnesota DNR (MnDNR), and others for review and comment. The final survey included forty-five questions which assessed factors such as business demographics, stumpage sources, business operations during each season, experience with salvage harvesting, equipment and future plans, capacity to harvest, additional family history in logging, and use of technology within the business. Respondents were asked to answer questions on these topics using 2016 as the reference year. A copy of the questionnaire is provided in Appendix 1. The 2016 survey included questions that were modified from previous surveys (i.e., questions 7, 16, and 36) as well as several new questions (i.e., questions 3, 5, 9, 11 - 13, 19, 24 - 26, 28, 30, 31, 34, and 37 - 44).

The survey was sent to the 383 business owners on MLEP's March 2016 membership list. MLEP estimates that nearly all commercially active loggers in Minnesota are included in their membership list. It can be assumed that a number of one-person, part-time or hobby business operations were not included as they wouldn't be members of MLEP. The survey was designed as a double-blind study, where MLEP created a unique three letter code which was printed on each survey. Surveys were to be returned to the University of Minnesota where MLEP was notified of the codes as surveys were received.

The survey documentation received an exemption from review through the Institutional Review Board at the University of Minnesota. It was designed and conducted during the spring of 2017 following standard mail survey procedures (Dillman 2000). This design included a 4.25 x 5.5-inch pre-survey postcard to announce the study and to encourage participation (Appendix 2) in March, an initial full mailing (i.e., cover letter, questionnaire, postage-paid return envelope) (Appendix 3) in mid-May, a follow-up reminder/thank you postcard sent to all firms in the sample about two weeks after the initial mailing (Appendix 4), a second full mailing which was sent to non-respondents one month after the initial full mailing (Appendix 5), and a final letter to all MLEP members to thank respondents and to encourage non-respondents to submit a completed survey (Appendix 6).

The mailings of the full survey were sent on University of Minnesota letterhead. The letters encouraging participation were sent on MLEP letterhead. The survey was mailed as an 8.5 x 11-inch packet (printed on 11 x 17-inch paper) with a green cover. The mailing address was printed on the cover. A pre-addressed 6 x 9-inch white return envelope with pre-paid postage was stitched into the inside of survey. The instructions for returning the survey, as printed on the green cover sheet, indicated that the respondent was to remove the cover sheet, fold the survey in half, and to return the survey in the prepaid envelope. JS Print Group in Duluth (<http://jsprintgroup.com/>) printed, assembled and mailed each of the survey mailings. Expenses for the MLEP pre-survey postcard and final letter are included in Appendix 7. Mailing invoices from JS Print Group for the two survey mailings are included in Appendix 8.

Analysis

Data from returned surveys were entered into an Excel template. After entry, 49 surveys were randomly selected for error checking. Every entry for each of those 49 surveys was error checked. A total of 44 errors were found and fixed. A second round of error checking was conducted where all entries for every survey were reviewed. Any remaining errors were corrected during that process.

Non-response bias tests were conducted, comparing the early to late responders (e.g., the first quarter we received to the last quarter) for the following questions:

- A. Total cords harvested in 2016,
- B. Percent aspen harvested in 2016,
- C. Average tract size,
- D. Percent of volume harvested during the winter,
- E. Percent of volume transported in-woods using a grapple skidder,
- F. Percent of volume transported to mills by trucks owned by the business, and
- G. Years in operation.

T-tests, which were conducted to compare means, did not identify any statistically significant differences for these variables. As only two of the variables were normally distributed, nonparametric tests (Wilcoxon Rank Sum test) were performed and verified that none of the variables showed statistically significant differences between early and late responders.

All production volume was converted to cords for the analysis using the following conversions: 1 cord = 500 board feet (2 cords/MBF) and 2.25 green tons/cord (assumes that quaking aspen is the primary species being shipped) (MnDNR 2013).

Basic summary statistics and figures were calculated using Excel. The unit of analysis was the individual respondent. Outlier analyses were only conducted for the questions related to fuel consumption (Questions 22a and 22b). Where comparable data was collected in the past, comparisons with previous survey results are presented. When making comparisons between surveys, the reader should be cautious as response rates and the percent of total statewide harvest volume differ and it is unknown if the same businesses have responded over time. For some questions, data were also segmented by factors such as MnDNR region and harvest volume in response to requests from users and to assess whether differences existed between the groups.

To better understand the effects of annual production level (Question 2), percentage of stumpage purchased by someone else (e.g., a mill, a broker) (Question 4), and in-woods transportation method from the stump to the landing (Question 18) on various factors, one-way ANOVA or Pearson Chi-squared tests were performed and individual treatment means were subsequently compared using Tukey's multiple comparison procedure if an *F*-test yielded a significant result. All statistical tests were conducted at $\alpha = 0.05$ using the R statistical package (R Development Core Team 2012). The factors evaluated in each analysis are shown in Table 1.

Table 1. Summary of factors included in the analyses of levels of stumpage purchaser type, annual production level and in-woods transportation systems.

Factor	Survey question number	Type of analysis		Statistical analysis performed
		Production level	In-woods transportation	
Volume produced (cords)	2	NA	X	ANOVA ^a
Years in operation	32	X	X	ANOVA
Average tract size harvested (acres)	6	X	X	ANOVA
Percent of total stumpage from family forest lands	10	X	X	ANOVA
Percent of total stumpage from county forest lands	10	X	X	ANOVA
Percent of total stumpage from state forest lands	10	X	X	ANOVA
Percent of volume produced during the summer	8	X	X	ANOVA
In-woods fuel/cord (gallons/cord)	22a	X	X	ANOVA
Percent reporting profitability was slightly/much better in 2016 vs. 2013	27	X	X	Chi-square ^b
Percent reporting their profitability was average (broke even), good, or excellent in 2016	26	X	X	Chi-square
Percent operating at full capacity	28	X	X	Chi-square
Percent who expect to be in business in 5 years	33	X	X	Chi-square
Percent who plan to increase or maintain volume within 5 years	35	X	X	Chi-square
Percent who harvested wood from one or more salvage sales	11	X	X	Chi-square

^aOne-way analysis of variance. Post-hoc tests were conducted using Tukey's multiple comparison procedures.

^bPearson's Chi-squared contingency table tests. Post-hoc tests were conducted using Tukey's multiple comparison procedures.

Results

Of the 383 mailed questionnaires, the following were removed from the sample after a review of MLEP's mailing list – eight businesses because they were brokers who didn't own any logging equipment, one who is only a trucker, three who were identified as not owning any logging equipment, and two who lived in Wisconsin. As the survey was designed to obtain information from businesses who own and operate in woods logging equipment for the purposes of harvesting timber in Minnesota, one broker who did return a survey indicated owning and operating logging equipment was retained. One hundred and forty-five respondents returned the survey for an overall response rate of 39.4%. Of those responding businesses, three indicated that they did not harvest any timber in 2016. Surveys were then screened and only those firms producing 100 cords or more in 2016 were included in subsequent analyses (two surveys were thus excluded from the analysis). There were 140 useable responses.

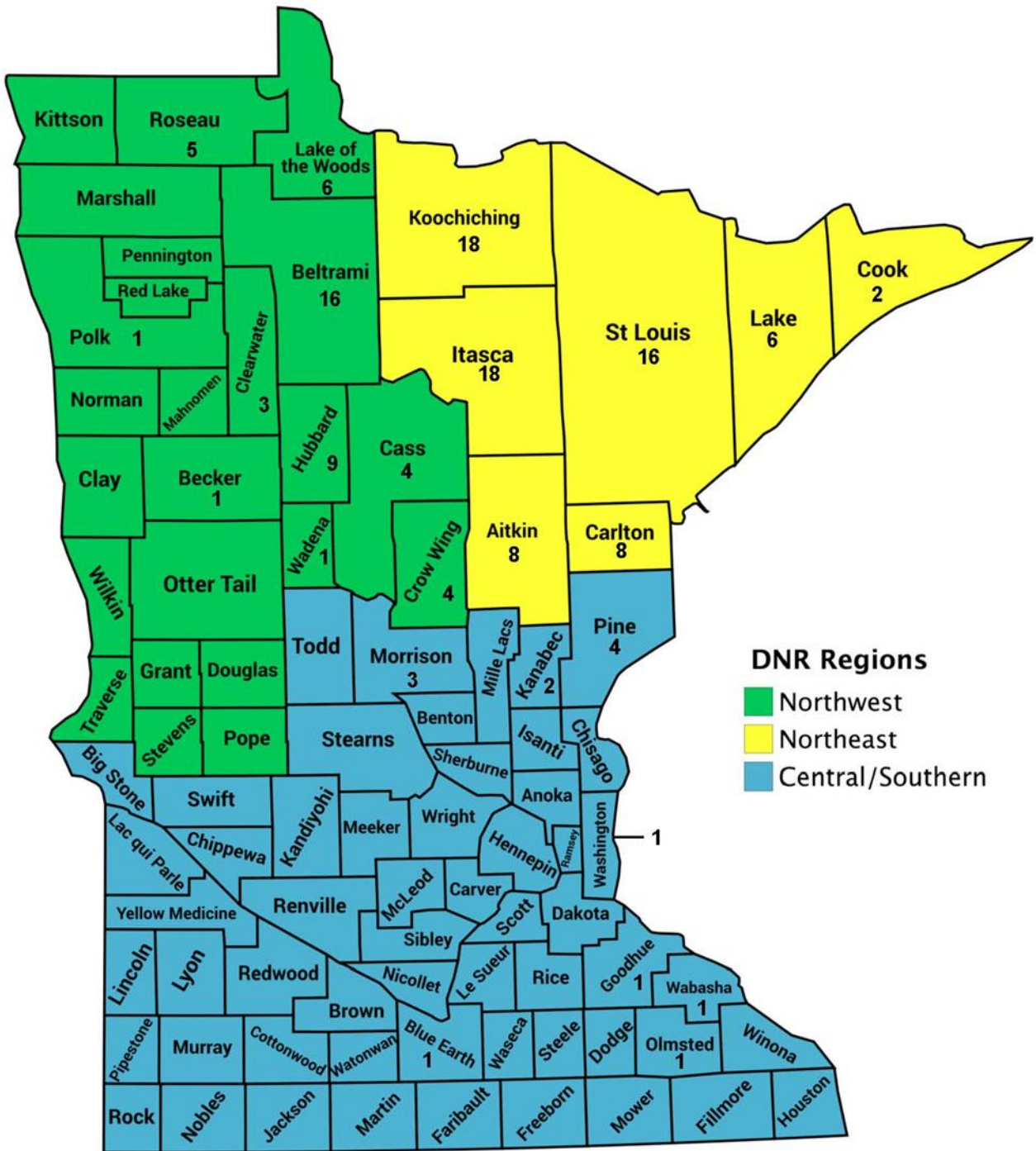
Results are presented below in the following two sections.

- Summary of mail survey results. This section provides a summary (e.g., number of responses, averages) for each survey question and compares those responses to previous surveys (where appropriate). For some of the survey questions, responses are categorized based on data from a second survey question.
- Summary of how various factors are influenced by purchaser type, annual production and in-woods transportation method.

Mail Survey Results

County where the business is based (Question 1)

The distribution of responses indicating where the respondent's logging business was located (and not where their timber was harvested) by county and Minnesota Department of Natural Resources Division of Forestry (MnDNR) regions is shown in Figure 1 and Table 2. Because of the relatively low number of MLEP members in the central and southern regions and thus responses, data from those regions were combined for analysis and reporting purposes.



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Figure 1. Distribution of respondents by Minnesota county and MnDNR Forestry region.

Table 2. Summary of number of respondents by MnDNR Forestry region and county (n = 140).

County	Number of respondents
DNR Northwest Region	
Becker	1
Beltrami	16
Cass	4
Clearwater	3
Crow Wing	4
Hubbard	9
Lake of the Woods	6
Polk	1
Roseau	5
Wadena	1
DNR Northeast Region	
Aitkin	8
Carlton	8
Cook	2
Itasca	18
Koochiching	18
Lake	6
St. Louis	16
DNR Central/Southern Region	
Blue Earth	1
Goodhue	1
Kanabec	2
Morrison	3
Olmsted	1
Pine	4
Wabasha	1
Washington	1

The highest concentration of responses was from the northeast region (n = 76 respondents, 54.3 percent of respondents) and the least from the central/southern region (n = 14 respondents, 10.0 percent of respondents). The response rates across MnDNR regions are very similar to the distribution of MLEP’s logging business owner membership across Minnesota (Figure 2). It is also comparable to the 2003 assessment where nearly 57 percent of the respondents were in the northeastern region and 31 percent were from the northwest region (Powers 2004) and the 2011 assessment where 58 percent of the respondents were in the northeastern region and 32 percent were from the northwest region (Blinn et al. 2014).

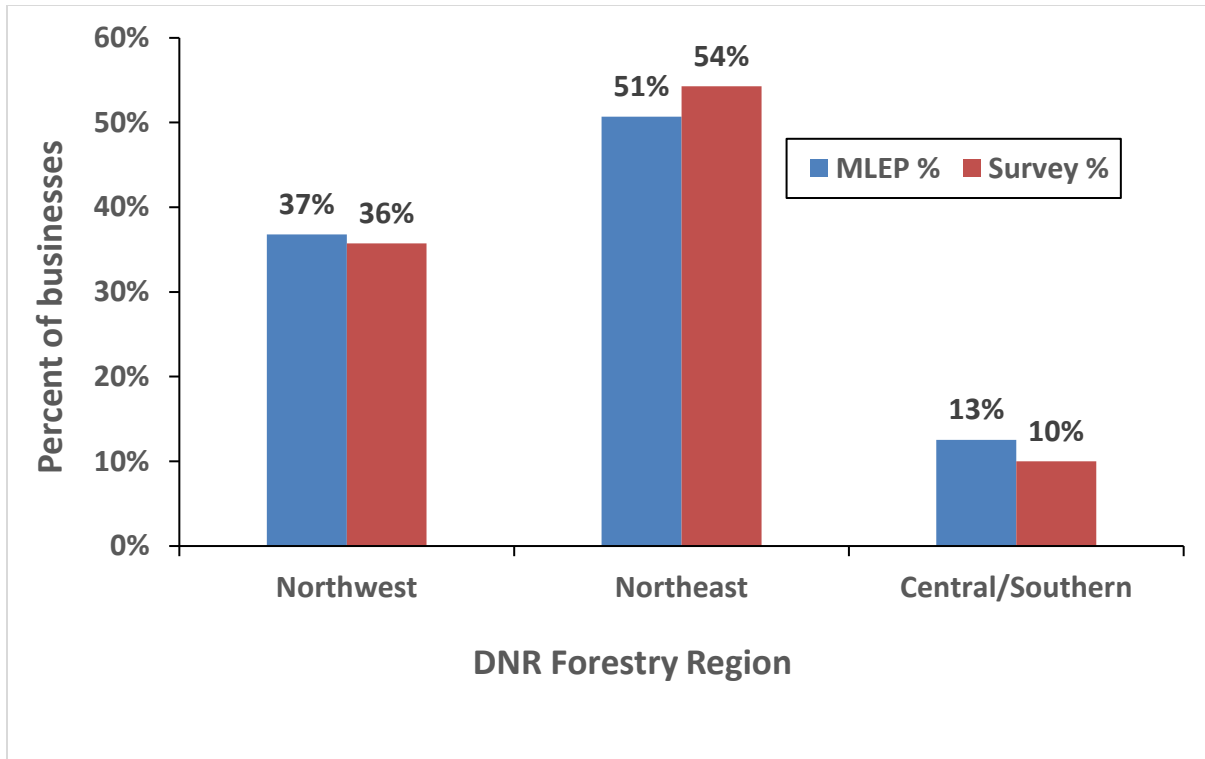


Figure 2. Summary of respondent’s business location by MnDNR Forestry region (n=140; with percentages within each region) and the distribution of the MLEP entire logging business owner membership (n=367) during 2016.

Volume produced (Question 2)

Respondents produced 1,475,995 cord equivalents in 2016 (n=133). That production represents approximately 51 percent of the estimated 2016 statewide production of 2.88 million cords (MnDNR 2017). Respondents reported a considerable range in their production from 100 to 216,000 cords.

Survey response data were compared to MLEP’s 2016 membership by harvest volume categories. MLEP members voluntarily report their annual production volume to that organization as it is used to determine their annual membership fee. As there is a reduced membership rate for businesses which produce 1,000 or fewer cords, there may be an incentive for some businesses to report lower production levels. The MLEP database information may be over-representing the percentage of loggers producing up to 1,000 cords.

MLEP’s and survey response data were fairly comparable for all but the smallest and largest volume producers where the survey reported approximately 24.6 percent of respondents produced 1,000 or fewer cords and MLEP’s membership reports 38.4 percent of its members are at that level of production (Figure 3). While 12.1 percent of MLEP’s membership reported producing more than 15,000 cords, 17.7 percent of the respondents reported producing at that level. MLEP’s membership database includes 32 additional members who are classified as being “Large Lgr”, a business producing more than 1,000 cords. However, without specific information about their level of production, those 32 members are not accounted for in Figure 3.

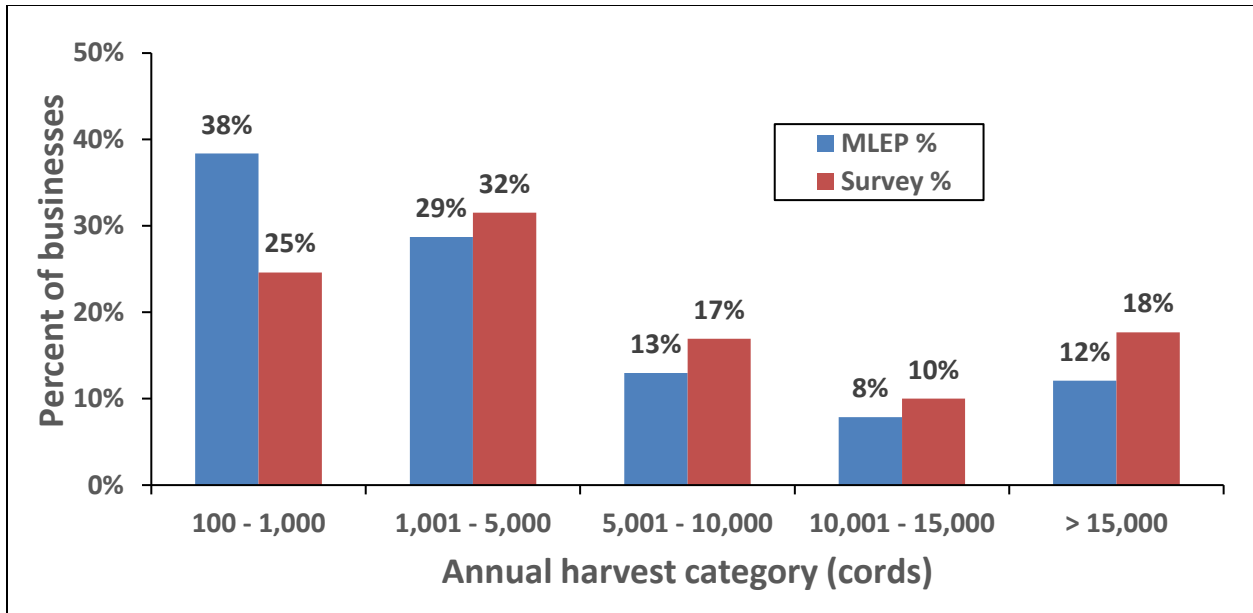


Figure 3. Comparison of volume produced by survey respondents in 2016 to production volume (cords) reported by MLEP membership.

The average respondent produced 11,267 cords in 2016 (median = 4,000 cords). The average Minnesota respondent produced 3,444 cords in 1978 (Bolstad 1980), 4,225 cords for full-time firms and 1,175 cords for part-time firms in 1979 (Bolstad 1980), 9,100 cords in 1991 (Jaakko Pöyry Consulting, Inc. 1992), 4,150 cords in 1996 (Puettmann et al. 1998), and 9,518 cords in 2011 (Blinn et al. 2014). In Michigan and Wisconsin, the average firm produced slightly more than 5,900 cords in 2003 (Rickenbach et al. 2005). In 2010, the average responding Wisconsin firm produced 6,893 cords (Traver 2012).

While respondents in northeast Minnesota produced 57.7 percent of the total volume reported, those in the central region produced 13.6 percent of the reported volume. Average annual production was 11,986 cords in the MnDNR's northeast region, 9,412 cords in the MnDNR's northwest region, and 13,429 cords in the MnDNR's central/southern region. Of the 23 respondents who reported producing more than 15,000 cords in 2016, 15 were from the MnDNR's northeast region. Those 23 respondents (17.6 percent of all respondents) produced 67.6 percent of the total volume reported by respondents (Table 3).

Table 3. Summary of annual harvest production by respondents in 2016 (n = 131), 2011 (n = 209), 2003 (n = 101) and 1996 (n = 361). Percentages may not total 100 due to rounding error.

Annual production (cords)	2016 Survey		2011 Survey (Blinn et al. 2014)		2003 Survey (Powers 2004)	1996 Survey (Puettmann et al. 1998)
	Percent of respondents (%)	Percent of total volume (%)	Percent of respondents (%)	Percent of total volume (%)	Percent of respondents (%)	
≤ 1,000	24.4	1.0	26.3	1.5	15.8	44
1,001 – 2,500	17.6	2.8	12.9	2.6	17.8	31
2,501 – 5,000	13.7	4.7	19.1	7.6	20.8	--
5,001 – 10,000	16.8	12.1	15.3	12.6	20.8	13
10,001 – 15,000	9.9	11.7	8.1	11.1	15.8	8
15,001 – 20,000	4.6	7.3	3.8	7.6	8.9	1
20,001 – 30,000	6.1	13.1	9.6	24.3	--	2
30,001 – 40,000	2.3	7.9	1.9	6.7	--	1
40,001 – 50,000	2.3	8.9	0.5	2.3	--	--
> 50,000	2.3	30.4	2.4	23.6	--	--

In general, the sector continues to be characterized by a large number of firms which produce relatively small volumes annually and few firms with high levels of production (Table 3, Figure 4). The 23 largest producers (each produced more than 15,000 cords in 2016), representing 18 percent of the respondents, harvested 67.6 percent of the reported volume in 2016. The 10 largest producers (each reported producing at least 30,000 cords) harvested 49.2 percent of the reported volume in 2016. In contrast, the 73 smallest producers (each produced 5,000 or fewer cords in 2016), representing 56 percent of the respondents, harvested 8.6 percent of the reported volume.

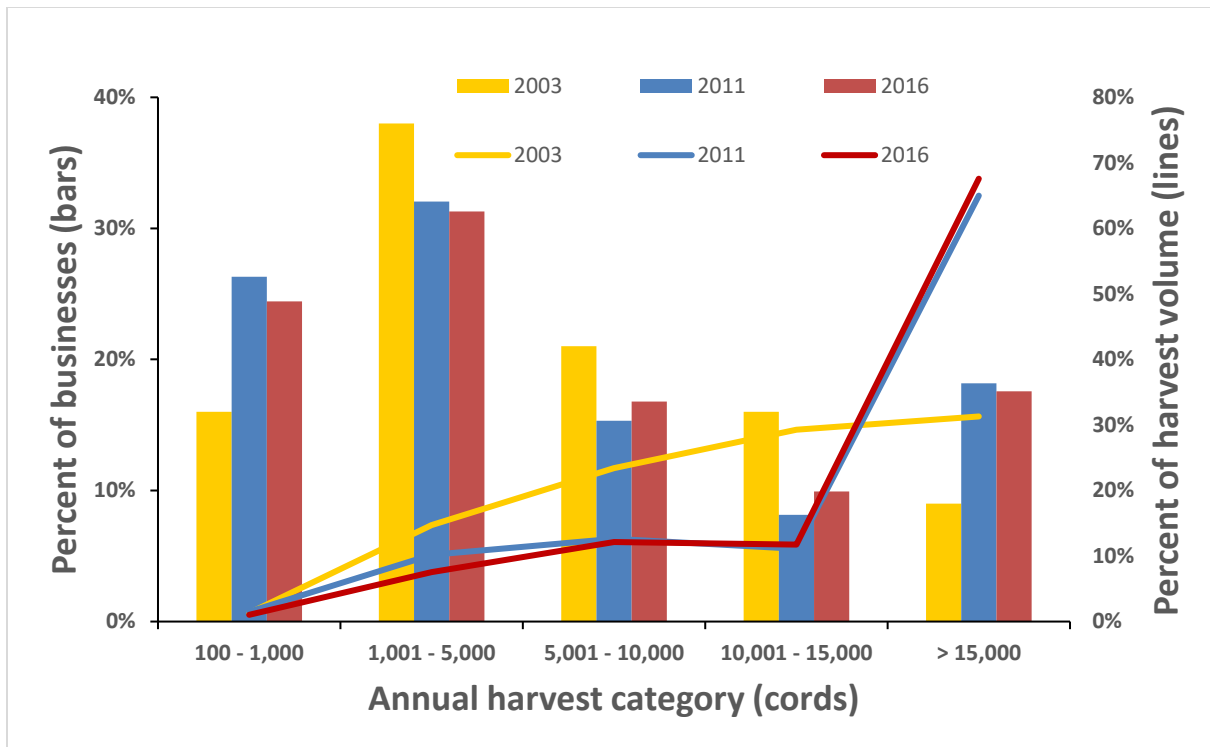


Figure 4. Number of businesses by annual volume harvested in Minnesota during 2016 (n = 131), 2011 (n = 209) and 2003 (n = 101).

Species harvested (Question 3)

The average respondent (n = 132) harvested timber from 3.1 species' groups (Table 4) in 2016. Nearly 75 percent of that volume were aspen (52.8 percent) and other hardwoods (21.9 percent). There was a positive relationship between annual volume produced and the average number of species groups harvested. Spruce was a small component (1.9 percent) of the average volume harvested for the smallest volume category (i.e., up to 1,000 cords harvested).

Table 4. Summary of percent of volume harvested in 2016 by species group (n = 132) and annual harvest category (cords).

Annual production (cord)	Average number of species groups	Aspen	Other hardwoods	Pine	Spruce	Other softwoods
Average	3.1	52.8%	21.9%	12.7%	7.0%	5.6%
100 – 1,000(n = 32)	2.2	45.6%	29.1%	18.0%	1.9%	5.4%
1,001 – 5,000 (n = 41)	2.9	51.6%	25.7%	8.5%	9.2%	5.0%
5,001 – 10,000 (n = 22)	3.5	57.0%	16.1%	15.5%	5.9%	5.5%
10,001 – 15,000 (n = 12)	4.2	64.9%	11.3%	10.3%	7.3%	6.2%
> 15,000 (n = 22)	4.0	53.6%	18.2%	11.7%	10.4%	6.1%

Purchaser type (Question 4)

The average respondent purchased 71.7 percent of their stumpage and 28.3 percent was purchased by someone else (e.g., broker, a mill) (Table 5). More than half of the respondents (53.7 percent) purchased 100 percent of their stumpage and 7.5 percent reported that all of their stumpage was purchased by someone else. These values are similar to those reported for the 2011 survey (Blinn et al. 2014). In the 1991 and 1996 surveys, 47 and 61 percent, respectively, of the stumpage was purchased by the logging business (Jaakko Pöyry Consulting, Inc. 1992; Puettmann et al. 1998).

Table 5. Summary of stumpage purchaser type data according to various criteria in 2016 (n = 134) and 2011 (n = 213).

Criteria	2016		2011 Survey (Blinn et al. 2014)	
	Stumpage purchased by respondent	Stumpage purchased by someone else	Stumpage purchased by respondent	Stumpage purchased by someone else
Average	71.7%	28.3%	74.6%	25.4%
100% of their stumpage is provided by source	53.7%	7.5%	53.5%	6.1%
At least 75% of their stumpage is provided by source	62.7%	20.1%	67.1%	17.4%
At least 50% of their stumpage is provided by source	72.4%	31.3%	74.6%	27.7%
At least 25% of their stumpage is provided by source	81.3%	38.1%	84.0%	34.3%

Respondents who harvested up to 5,000 cords in 2016 indicated that more than 80 percent of their volume was purchased by their logging business (Table 6). While respondents who produced 5,001 – 10,000 cords or more than 15,000 cords both indicated that approximately 60 percent of their harvested volume was purchased by their logging business, respondents who produced 10,001 – 15,000 cords indicated that slightly more than 65 percent of their volume was purchased by someone else.

Table 6. Summary of source of stumpage harvested during 2016 by annual harvest category (n = 130)

Annual harvest category (cords)	Number of respondents	Stumpage source by percent (%)	
		Purchased by others	Purchased by logging business
100 - 1,000	32	13.8	86.3
1,001 - 5,000	40	16.3	83.7
5,001 - 10,000	22	38.4	61.6
10,001 - 15,000	13	65.7	34.3
> 15,000	23	43.0	57.0

Target/goal for controlling wood under purchased contracts (Question 5)

To ensure a steady supply of stumpage into the future, logging business owners purchase public and/or private stumpage with varying expiration dates. However, capital may be tied up when purchasing timber sales as agencies may require a 15 percent deposit or letter of credit when selling their stumpage. The average respondent reported controlling nearly half of their future stumpage volume (48.2 percent) within the current year with decreasing percentages over time (n = 93) (Table 7). Perhaps because they had less capital available to hold stumpage into the more distant future, respondents who reported producing up to 1,000 cords in 2016 indicated the highest percentage of volume controlled within the current year and only 3 percent controlled more than two years into the future. Respondents who produced more than 10,000 cords in 2016 reported controlling an average of about 21 percent of their stumpage volume 3 or 4 years into the future.

Table 7. Summary of target/goal for controlling stumpage volume under purchased contracts by time period and annual harvest category (n = 93).

Annual production (cords)	Target percent of volume controlled by year				
	Current year	One year in the future	Two years in the future	Three years in the future	Four years in the future
Average	48.2%	24.4%	16.6%	5.6%	5.0%
Median	50.0%	25.0%	10.0%	0.0%	0.0%
100 – 1,000 (n = 23)	66.3%	19.6%	11.1%	0.4%	2.6%
1,001 – 5,000 (n = 27)	46.3%	25.2%	20.9%	3.1%	4.4%
5,001 – 10,000 (n = 13)	45.8%	31.2%	15.8%	4.6%	2.7%
10,001 – 15,000 (n = 6)	42.5%	18.3%	16.7%	12.5%	10.0%
> 15,000 (n = 22)	38.3%	22.9%	18.0%	12.3%	8.6%

Average tract size (Question 6)

Tract size can impact a logging business' profitability. Larger tracts allow firms to spread their fixed costs over more acres and units of production (e.g., cords) while also reducing the need to move frequently from one jobsite to another. Moving equipment creates additional costs for the operation. Costs are incurred in a variety of ways: In-woods equipment is not productive while being moved (downtime), charges associated with transportation of equipment (e.g., oversize transport trailers, permits, contracted haulers), costs related to employee time needed to trailer the in-woods equipment from one site to the next, as well as time to set up and begin work at the new site (e.g., access development, landing construction). For some businesses, it may not be worthwhile moving into a tract that is too small for their normal operations unless the site has unique characteristics (e.g., inexpensive stumpage, proximity to another nearby harvest site they have already contracted to harvest or mill where deliveries are made).

While there are several advantages associated with larger tracts, they can also be a disadvantage to a business which doesn't harvest much timber annually. Those smaller businesses may not be able to harvest all of the timber on a larger tract within the length of the contract and/or may not have enough market options for the timber on a larger sale.

The average and median tract sizes were 37.6 and 30 acres, respectively, with a range of 2 to 300 acres. The median value (30 acres) from the 2011 survey is similar to the results of the 2008 assessment of silvicultural practices in Minnesota (D'Amato et al. 2009) which reported that the approximate average

clearcut size was 29 acres and the average partial cut was 25 acres. More than half (54.0 percent) of the respondents to the 2016 survey indicated that their average tract size was 40 acres or less (Table 8). The average tract size was similar for businesses which harvested up to 15,000 cords (i.e., 33.8 acres for businesses which harvested up to 1,000 cords, 29.2 acres for businesses which harvested 1,001–5,000 cords, 35.2 acres for businesses which harvested 5,001-10,000 cords, and 36.9 acres for businesses which harvested 10,001-15,000 cords). However, the average tract size was 60.6 acres for businesses which harvested more than 15,000 cords.

Table 8. Summary of approximate average tract sizes harvested by respondents in 2016 (n = 124) and 2011 (n = 183). Percentages may not total 100 due to rounding error.

Average tract size (acres)	2016		2011 Survey (Blinn et al. 2014)	
	Percent of respondents (%)	Average tract size of respondents in category (acres)	Percent of respondents (%)	Average tract size of respondents in category (acres)
1 – 5	4.8	3.8	0.5	4.0
6 – 10	8.1	9.8	9.3	9.7
11 – 20	14.5	19.6	25.7	18.0
21 – 40	54.0	33.8	49.2	33.2
41 – 80	15.3	58.7	15.3	63.1
> 80	3.2	202.8	--	--

For the 2011 survey, the median tract size was 30 acres and the average 31.6 acres with a range of 4 to 80 acres (Blinn et al. 2014). The average tract size reported from 1991 was 33 acres (Jaakko Pöyry Consulting, Inc. 1992). The median and average tract size reported for 1996 were 29 and 79 acres, respectively, although there were concerns reported that the number may not be accurate due to an issue with the wording of the question (Puettmann et al. 1998). Rickenbach et al. (2005) reported that the average tract size in Michigan and Wisconsin during 2003 was 59 acres.

Number of sales completed and partially completed by tract size (Question 7)

Respondents reported completing a total of 993 timber sales in 2016 (n = 108, average of 9.2 timber sales per respondent, median of 6 timber sales and a range of 0 to 43) and partially completing 86 timber sales (n = 66, average of 1.3 timber sales per respondent, median of 1 timber sales and a range of 0 to 6). Seventy-two percent of the completed sales were 40 acres or smaller as compared to 44.2 percent of the partially completed sales (Table 9). The number of tracts completed increased by harvest volume category (i.e., 2.9 tracts completed for businesses which harvested up to 1,000 cords, 5.3 tracts completed for businesses which harvested 1,001–5,000 cords, 11.4 tracts completed for businesses which harvested 5,001-10,000 cords, 11.5 tracts completed for businesses which harvested 10,001-15,000 cords, and 23.1 tracts completed for businesses which harvested more than 15,000 cords).

Table 9. Summary of number of timber sales where harvesting was completed (n = 108) or partially completed (n = 66) in 2016 by various acreage categories. Percentages may not total 100 due to rounding error.

Acreage range	Sales completed		Sales partially completed	
	Number	Percent (%)	Number	Percent (%)
0 – 5	64	6.4	4	4.7
6 – 10	106	10.7	4	4.7
11 – 20	205	20.6	11	12.8
21 – 40	340	34.2	19	22.1
41 – 80	180	18.1	23	26.7
81 – 160	68	6.8	12	14.0
161+	30	3.0	13	15.2
Total sales	993		86	

A total of 11.1 percent of the 108 respondents reported completing the harvest on only one timber sale in 2016 and nearly half of the respondents (48.1%) reported harvesting five or fewer sales (Table 10). A total of 69.7 percent of the respondents reported partially completing as many as one timber sale in 2016. The average and median number of tracts completed and partially completed increased as the annual volume harvested increased (Table 11).

Table 10. Summary of number of timber sales per respondent where harvesting was completed (n = 108) or partially completed (n = 66) in 2016 by various number of sale categories. Percentages may not total 100 due to rounding error.

Number of sales	Sales completed		Sales partially completed	
	Number of respondents	Percent (%)	Number of respondents	Percent (%)
0 – 1	12	11.1	46	69.7
2 – 5	40	37.0	19	28.8
6 – 10	22	20.4	1	1.5
11 – 15	16	14.8	0	0.0
16 – 20	5	4.6	0	0.0
21 – 40	12	11.1	0	0.0
41 - 60	1	0.9	0	0.0
61+	0	0.0	0	0.0

Table 11. Summary of total, average and median number of sales completed and partially completed in 2016 by annual harvest category (cords) (n = 111).

Annual production (cords)	Number of responses	Average number of sales	Median number of sales
100 – 1,000	27	3.3	3.0
1,001 – 5,000	38	6.2	5.0
5,001 – 10,000	18	11.7	9.0
10,001 – 15,000	13	12.0	13.0
> 15,000	15	24.0	26.0

To better understand the interaction of tract size and annual production level (Question 2), Table 12 reports operations on “small (i.e., tracts 20 acres or less in size)” and “large (i.e., tracts which are more than 20 acres in size)” tracts. Looking only at tracts that were 20 acres or smaller, respondents in all harvest volume categories harvested a greater percentage of 11 – 20 acre tracts than the two smaller tract sizes. Respondents from the smallest harvest category (100 – 1,000 cords) reported the highest percentage of their tracts were less than 5 acres and the lowest percentage of tracts that were 11 – 20 acres in size. Respondents who harvested more than 10,000 cords reported that more than 70 percent of their “small” tracts were 11 – 20 acres in size.

Looking at all tracts harvested in 2016, respondents from the smallest harvest category (100 – 1,000 cords) averaged 42.9 percent of their tracts in the 20 acres or less size category (Table 12). Respondents who harvested more than 10,000 cords indicated that less than 30 percent of their tracts were 20 acres or less in size.

Table 12. Summary of total number of sales completed and partially completed in 2016 for small tracts (tracts less than or equal to 20 acres in size) by annual harvest category (cords).

Annual production (cords)	Harvest activity in tracts \leq 20 acres				Harvest activity in all tracts	
	Number of responses	Percent of tracts 0-5 acres (%)	Percent of tracts 6 - 10 acres (%)	Percent of tracts 11-20 acres (%)	Number of responses	Average percent of tracts harvested \leq 20 acres (%)
100 – 1,000	15	33.1	21.9	45.0	27	42.9
1,001 – 5,000	25	19.3	22.6	58.1	38	35.6
5,001 – 10,000	15	2.7	38.3	59.0	18	36.1
10,001 – 15,000	8	12.5	13.3	74.2	13	15.7
> 15,000	13	8.6	20.1	71.2	15	28.5

Season of harvest (Question 8)

Fifty-three percent of the volume harvested during 2016 was reported to be produced during winter (December to February)³ (Table 13). The smallest percentage of wood was harvested during the spring (March to May). It is unknown how much of that spring wood was harvested during frozen conditions prior to spring breakup. There was a continued trend toward a higher percentage of wood being harvested during winter and a decreasing percentage during the summer, as compared to the 1991 (Jaakko Pöyry Consulting, Inc. 1992), 1996 (Puettmann et al. 1998), and 2011 (Blinn et al. 2014) surveys.

³ The authors recognize that winter in northern Minnesota does not end in February and that harvest activities under winter/frozen soil conditions continue into March. However, to maintain continuity with previous surveys, the seasons were defined as in the past.

Table 13. Summary of season of harvest by percent of respondents and percent of volume harvested during 2016 (n=121), 2011 (n = 205), 1991 and 1996 (n = 361) in Minnesota. Percentages may not total 100 due to rounding error.

Season of harvest	2016 Survey		2011 Survey (Blinn et al. 2014)		1991 survey (Jaakko Pöyry Consulting, Inc. 1992)	1996 survey (Puettmann et al. 1998)
	Average percent across all respondents (%) (n = 131)	Percent of volume harvested (%) (n = 127)	Average percent across all respondents (%)	Percent of volume harvested (%)	Percent of volume harvested (%)	Percent of volume harvested (%)
Winter (Dec – Feb)	59	53	61	51	43	47
Spring (Mar – May)	7	6	5	8	9	9
Summer (Jun – Aug)	17	21	16	20	23	21
Fall (Sep – Nov)	17	20	18	21	25	23

While the average business operated during 3.03 seasons, businesses which produced up to 5,000 cords operated during 2.73 seasons as compared to 3.65 seasons for businesses which produced more than 5,000 cords. Thirteen businesses (9.9 percent) indicated that they produced 100 percent of their volume during winter (Table 14). A total of 66.4 percent of the respondents indicated that at least half of their volume was produced during the winter. While two respondents indicated that none of their production occurred during winter, 64 (48.9 percent) indicated that they did not produce any volume during the spring and 32 (24.4 percent) indicated that they didn't produce any volume during the summer. Nearly 49 percent (48.9 percent) of the respondents didn't operate during the spring, 24.4 percent didn't operate during the summer and 20.6 percent didn't operate during the fall. Percentages derived from Table 14 are similar to those reported for the 2011 survey (Blinn et al. 2014).

Table 14. Summary of number of logging businesses by season of harvest according to various volume criteria in 2016 (n = 131)

Criteria	Number of logging businesses by season			
	Winter	Spring	Summer	Fall
Produce 100% of volume during that season	13	0	2	0
At least 75% of volume produced during that season	36	2	2	0
At least 50% of volume produced during that season	87	3	2	0
At least 25% of volume produced during that season	127	13	47	47
No volume produced during that season	2	64	32	27

¹Winter was defined as being December to February, Spring was defined as March to May, Summer was defined as June to August, and Fall was defined as September to November.

Other activities when not harvesting (Question 9)

As reported above for Question 8, some businesses choose not to operate during one or more the seasons. When they weren't harvesting timber, businesses engaged in a variety of different activities (Tables 15 and 16). While the survey included seven specific activities as optional responses, the "Other" category received the most responses for every season except summer when "Farmed crops" was the most frequently cited category. Many different activities were handwritten by respondents within the "Other" category with some variation between seasons, as noted below.

- "Other" winter activities reported for 2016 were employment outside of logging (4 respondents), hauling wood (1 respondent), retired/clean up blowdown (1 respondent), and equipment repair/maintenance (1 respondent).
- "Other" spring activities were equipment repair/maintenance (26 respondents), employment outside of logging (8 respondents), hauling wood (3 respondents), yardwork (2 respondents), firewood processing (1 respondent), retired/clean up blowdown (1 respondent), traveled (1 respondent), and road restrictions/spring thaw (1 respondent).
- "Other" summer activities were employment outside of logging (6 respondents), equipment repair/maintenance (5 respondents), and hauling wood (1 respondent).
- "Other" fall activities were employment outside of logging (7 respondents), equipment repair/maintenance (5 respondents), hauling wood (1 respondent), retired/clean up blowdown (1 respondent), and traveled (1 respondent).

After removing responses for "Harvested timber in every season", agricultural-related activities ("Farmed crops" and "Livestock production") were cited by at least 25 percent of the respondents within each season (Table 16). Doing "Nothing" in spring was a common response. "Construction" and "Road building" were cited by at least 30 percent of the respondents during the summer and fall.

Table 15. Summary of other activities by percent of respondents when they didn't harvest timber by season with details for the "Other" category (n = 126). Includes respondents who indicated that they harvested timber in every season. Percentages may not total 100 due to rounding error.

Activity	Season							
	Winter (Dec – Feb)		Spring (Mar – May)		Summer (Jun - Aug)		Fall (Sep – Nov)	
	Percent of responses within this season	Percent of responses across all seasons and activities	Percent of responses within this season	Percent of responses across all seasons and activities	Percent of responses within this season	Percent of responses across all seasons and activities	Percent of responses within this season	Percent of responses across all seasons and activities
Recovered from injury or illness	1.9	0.2	1.4	0.5	0.9	0.2	2.1	0.5
Farmed crops	0.0	0.0	8.5	2.9	17.1	4.9	7.2	1.7
Livestock production	7.7	1.0	14.1	4.9	12.8	3.7	10.3	2.5
Installed septic systems	0.0	0.0	0.0	0.0	0.9	0.2	1.0	0.2
Construction	1.9	0.2	2.1	0.7	12.0	3.4	12.4	2.9
Road building	3.8	0.5	2.8	1.0	11.1	3.2	10.3	2.5
Nothing	0.0	0.0	13.4	4.7	3.4	1.0	4.1	1.0
Harvested timber in every season	71.2	9.1	23.9	8.3	29.1	8.3	35.1	8.3
Other (please specify)	13.5	1.7	33.8	11.8	12.8	3.7	17.5	4.2
Details for "other" category by season (number of responses)								
Equipment repair/maintenance	1		26		5		5	
Employed outside of logging	4		8		6		7	
Hauled wood	1		3		1		1	
Yardwork	0		2		0		0	
Firewood processing	0		1		0		0	
Retired/cleaned up blowdown	1		1		0		1	
Traveled	0		1		0		1	
Road restrictions/spring thaw	0		1		0		0	

Table 16 (continued). Summary of other activities conducted by percent of respondents when they didn't harvest timber by season with details for the "Other" category (n = 101). Excludes respondents who indicated that they harvested timber in every season. Percentages may not total 100 due to rounding error.

Activity	Season							
	Winter (Dec – Feb)		Spring (Mar – May)		Summer (Jun - Aug)		Fall (Sep – Nov)	
	Percent of responses within this season	Percent of responses across all seasons and activities	Percent of responses within this season	Percent of responses across all seasons and activities	Percent of responses within this season	Percent of responses across all seasons and activities	Percent of responses within this season	Percent of responses across all seasons and activities
Recovered from injury or illness	6.7	0.4	1.9	0.7	1.2	0.4	3.2	0.7
Farmed crops	0.0	0.0	11.1	4.5	24.1	7.4	11.1	2.6
Livestock production	26.7	1.5	18.5	7.4	18.1	5.6	15.9	3.7
Installed septic systems	0.0	0.0	0.0	0.0	1.2	0.4	1.6	0.4
Construction	6.7	0.4	2.8	1.1	16.9	5.2	19.0	4.5
Road building	13.3	0.7	3.7	1.5	15.7	4.8	15.9	3.7
Nothing	0.0	0.0	17.6	7.1	4.8	1.5	6.3	1.5
Other (please specify)	46.7	2.6	44.4	17.8	18.1	5.6	27.0	6.3
Details for "other" category by season (number of responses)								
Equipment repair/maintenance	1		26		5		5	
Employed outside of logging	4		8		6		7	
Hauled wood	1		3		1		1	
Yardwork	0		2		0		0	
Firewood processing	0		1		0		0	
Retired/cleaned up blowdown	1		1		0		1	
Traveled	0		1		0		1	
Road restrictions/spring thaw	0		1		0		0	

Stumpage sources (Question 10)

Averaged across all respondents 31.7 percent of their volume harvested was from private woodlands (median 66 percent) (Table 17). However, private woodlands only provided 20.1 percent of the total volume reported by respondents. The average respondent harvested 58.4 percent of their volume from public sources (county/municipal, state, US Forest Service) and 41.6 percent from private (private nonindustrial, American Indian, industrial) and other sources. Those totals are comparable to data reported for 2014 which shows that 39.0 percent of the volume harvested was from private and industrial lands and 61.0 percent from public lands (MnDNR 2017). The percent of volume harvested for most landowner groups was generally similar to the 1996 (Puettmann et al. 1998) and 2011 (Blinn et al. 2014) data.

Table 17. Summary of percent of stumpage harvested from each timberland ownership category by average percent across respondents and percent of volume produced in 2016, 2011 (n = 204) and 1996 (n = 361). Percentages may not total 100 due to rounding error.

Timberland ownership category	2016 Survey			2011 Survey (Blinn et al. 2014)		1996 survey (Puettmann et al. 1998)
	Percent of respondents who harvested by timberland ownership category (%) (n = 134)	Average percent across respondents (%) (n = 134)	Percent of total volume harvested (%) (n = 130)	Average percent across respondents (%)	Percent of total volume harvested (%)	Percent of total volume harvested (%)
Private woodlands	80.0	31.7	20.1	31.6	21.3	36
Industrial or corporate owned forests	22.2	10.5	15.4	6.6	13.6	13
National forests	14.1	2.4	6.5	3.6	3.4	10
State forests	63.0	26.4	26.6	33.5	33.7	22
County forests	60.7	27.1	24.3	23.0	27.2	18
Municipal forests ¹	3.7	0.7	1.0			
Tribal forests	4.4	0.6	1.2	1.1	0.4	1
Other ²	1.5	0.7	4.8	0.7	0.5	---

¹The “Municipal forests” category was combined with the “County forests” category in the 2011 and 1996 surveys.

²In 2016, “Other” ownerships cited were mining property and other sources.

Sixteen respondents (11.9 percent) harvested all of their timber in 2016 from private woodland sources and 41 respondents (30.6 percent) harvested at least half of their volume from that source (Table 18). All but 27 respondents reported harvesting some of their volume from private woodlands. Thirty respondents (22.4 percent) harvested at least half of their timber in 2016 from MnDNR lands. Relatively few respondents harvest timber from National forests, municipal forests or tribal forests.

Table 18. Summary of number and percent of logging businesses which harvested from each timberland ownership category according to various volume criteria in 2016 (n = 134) and 2011 (n = 204).

Criteria	Number (and percent) of logging businesses harvest from timberland owner category in 2016							
	Private woodlands	Industrial or corporate owned forests	National forests	State forests	County forests	Municipal forests	Tribal forests	Other ¹
Harvest 100% of volume from that source	16 (11.9%)	2 (1.5%)	0 (0.0%)	6 (4.5%)	6 (4.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Harvest at least 75% of volume from that source	22 (16.4%)	10 (7.5%)	1 (0.7%)	18 (13.4%)	15 (11.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Harvest at least 50% of volume from that source	41 (30.6%)	12 (9.0%)	2 (1.5%)	30 (22.4%)	37 (27.6%)	0 (0.0%)	0 (0.0%)	1 (0.7%)
Harvest at least 25% of volume from that source	55 (41.0%)	19 (14.2%)	3 (2.2%)	52 (38.8%)	58 (43.3%)	2 (1.5%)	0 (0.0%)	2 (1.5%)
No volume harvested from that source	27 (20.1%)	103 (76.9%)	117 (87.3%)	50 (37.3%)	52 (38.8%)	129 (96.3%)	128 (95.5%)	132 (98.5%)
Criteria	Number (and percent) of logging businesses harvest from timberland owner category in 2011 (Blinn et al. 2014)							
	Private nonindustrial	Industrial or corporate owned forests	National forests	State forests	County / Municipal forests	Tribal forests	Other	
Harvest 100% of volume from that source	19 (9.3%)	1 (0.5%)	1 (0.5%)	10 (4.9%)	5 (2.5%)	1 (0.5%)	0 (0.0%)	
Harvest at least 75% of volume from that source	34 (16.7%)	4 (2.0%)	2 (1.0%)	30 (14.7%)	15 (7.4%)	2 (1.0%)	1 (0.5%)	
Harvest at least 50% of volume from that source	60 (29.4%)	14 (6.9%)	8 (3.9%)	63 (30.9%)	40 (19.6%)	2 (1.0%)	1 (0.5%)	
Harvest at least 25% of volume from that source	88 (43.1%)	23 (11.3%)	11 (5.4%)	109 (53.4%)	81 (39.7%)	3 (1.5%)	1 (0.5%)	
No volume harvested from that source	42 (20.6%)	171 (83.8%)	183 (89.7%)	53 (26.0%)	89 (43.6%)	199 (97.5%)	199 (97.5%)	

¹“Other” ownerships cited were mining property and other sources.

Family forests are an important source of stumpage for respondents who reported harvesting as many as 5,000 cords in 2016 (Figure 5). For respondents who harvested as many as 1,000 cords, private woodlands comprised 47% of the reported volume harvested in 2016. For respondents who harvested more than 5,000 cords, private woodlands comprised 13 – 22 percent of their reported volume in 2016. While private woodlands are an important stumpage source for producers who harvested as many as 5,000 cords in 2016, the total reported volume for those respondents is relatively small (Figure 6).

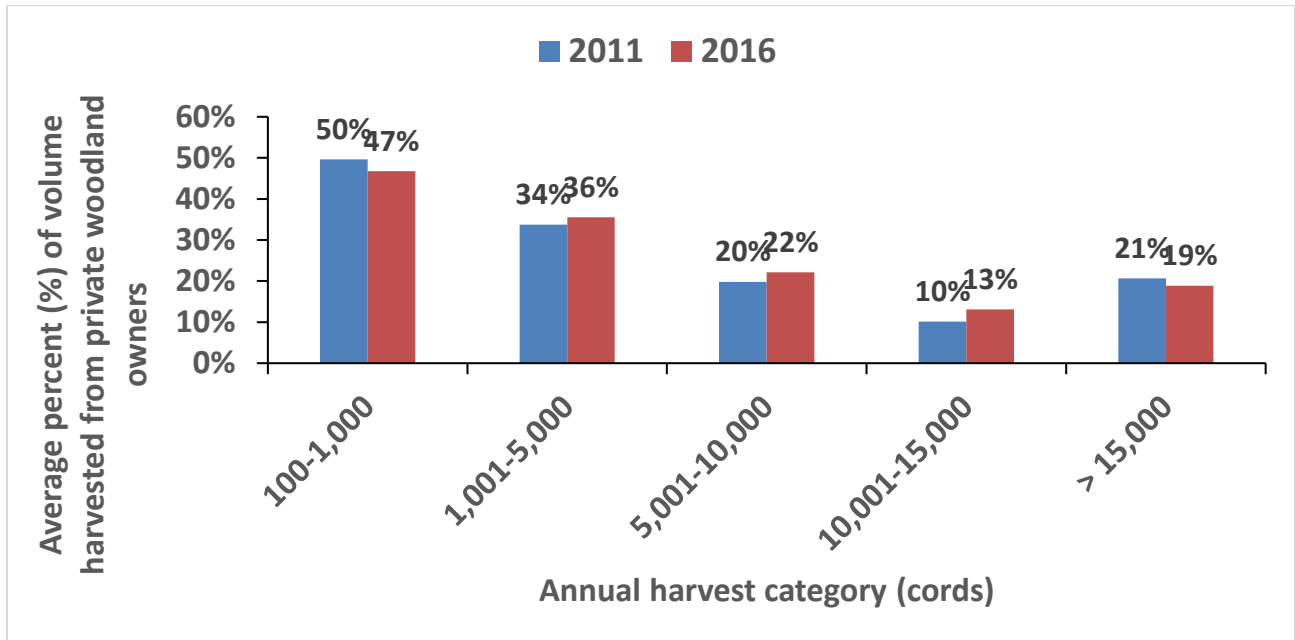


Figure 5. Average percent of volume harvested from family forests in 2016 (n = 130) and 2011 (n = 204) by various annual harvest categories (cords).

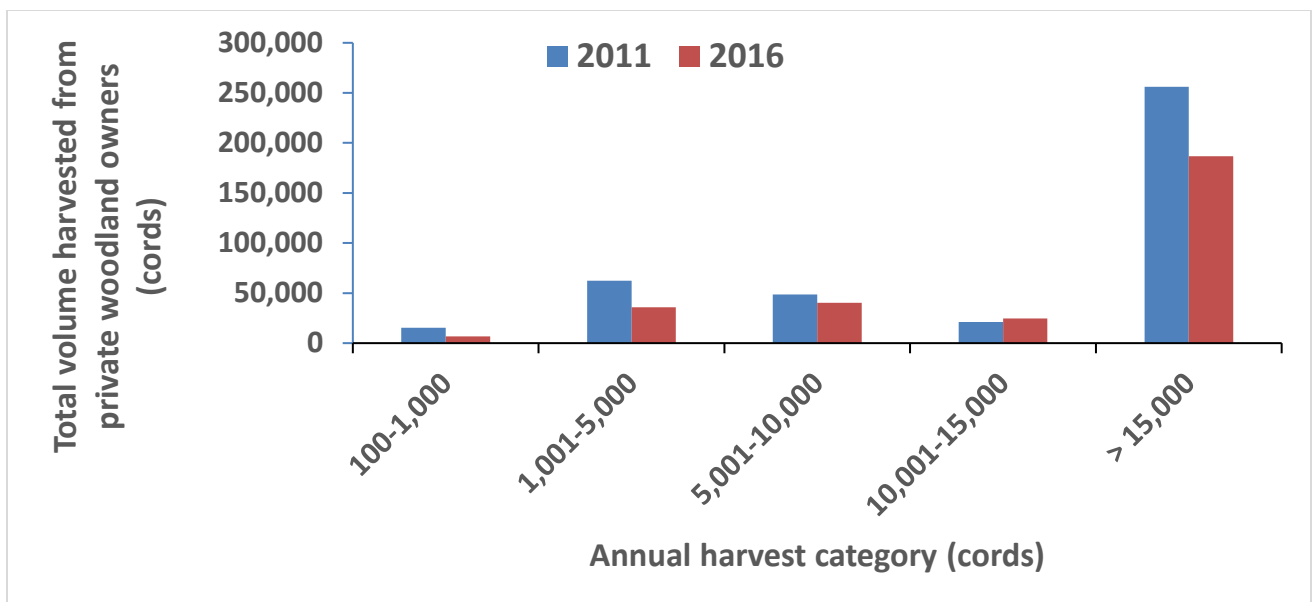


Figure 6. Total volume harvested from private woodlands in 2016 (n = 130) and 2011 (n = 204) by various annual harvest categories (cords).

Salvage harvesting in 2015 or 2016 (Yes/No) (Question 11)

Businesses were asked if they had harvested wood from one or more salvage sales in 2015 or 2016. Of the 129 respondents to this question, 54 (41.9 percent) did report having harvested wood from at least one salvage sale in 2015 or 2016 while 75 respondents (58.1 percent) reported that they didn't harvest wood from salvage sales during that period of time. Businesses which reported harvesting 5,001 to 10,000 cords and more than 15,000 cords were most likely to have harvested wood from salvage sales in 2015 or 2016 (Table 19).

Table 19. Summary of percent of respondents who harvested wood from salvage sales in 2015 or 2016 by annual harvest category (n = 123).

Annual production (cords)	Yes (n)	No (n)	Percent Yes (%)
100 – 1,000	11	19	36.7%
1,001 – 5,000	7	30	18.9%
5,001 – 10,000	13	7	65.0%
10,001 – 15,000	5	8	38.5%
> 15,000	16	7	69.6%

Concerns when operating on salvage sales (Question 12)

Respondents who reported harvesting from one or more salvage sales in 2015 or 2016 were asked whether any of eight listed issues were a concern for their logging business when operating on salvage sales. For five of the eight issues, more than 50 percent of the respondents indicated that it was an issue when operating on salvage sales. Reduced in-woods productivity (88.9 percent of respondents), reduced wood quality (87.0 percent of respondents), and higher levels of safety concerns and higher levels of impacts to equipment (72.2 percent each) were the four highest rated responses (Table 20). The two concerns that ranked lowest for all businesses were higher stumpage prices (27.8%) and fewer markets for salvage timber (33.3% of respondents).

Table 20. Summary of number and percent of respondents who identified issues that are a concern for their logging business when harvesting wood from salvage sales in 2015 or 2016 (n =54).

Issue	Number (and percent) of respondents who reported issue
Higher level of safety concerns	39 (72.2%)
Higher level of impacts to equipment	39 (72.2%)
Higher level of impacts to site	20 (37.0%)
Reduced in-woods productivity	48 (88.9%)
Reduced wood quality	47 (87.0%)
Reduced value of delivered wood	28 (51.9%)
Higher stumpage prices for salvage timber	15 (27.8%)
Fewer markets for salvage timber	18 (33.3%)
Other	0 (0.0%)

Amount of time to operate on salvage sales as compared to non-salvage sales (Question 13)

Respondents who reported that they had harvested wood from one or more salvage sales in 2015 or 2016 were asked whether harvesting salvage timber took longer, shorter or the same amount of time as

compared to what it would take to harvest the same tract under non-salvage conditions for three salvage condition scenarios. The three scenarios are identified below.

- Sale affected by a severe windstorm (snapped trees and downed trees)
- Sale affected by an insect or disease outbreak (standing dead trees)
- Sale affected by a recent fire (standing dead trees)

Nearly all of the respondents (98.1 percent) indicated that it took longer to operate on a salvage sale affected by a severe windstorm (Table 21). The additional time was likely related to working with trees that were snapped (i.e., potentially more “stems” to process within a tree), downed (i.e., mechanized felling equipment is generally designed to fell standing trees), or piled/stacked on top of each other due to how they fell during the windstorm. One respondent to that scenario indicated that it took the same amount of time as compared to a non-salvage sale. Respondents to the other two scenarios, both of which dealt with salvaging standing dead trees, were more split in their responses. To harvest a sale affected by an insect or disease outbreak, slightly more than half of the respondents (57.5 percent) indicated that it took the same amount of time and 37.5 percent indicated that it took longer as compared to non-salvage sales of that type. To harvest a sale affected by a recent fire, slightly more than half of the respondents (51.3 percent) indicated that it took more time and 43.6 percent indicated that it took the same amount of time compared to non-salvage sales of that type.

Table 21. Summary of amount of time to harvest salvage timber as compared to non-salvage conditions for various scenarios.

Scenario	Total number of respondents	Number (and percent) of logging businesses by impact to their business		
		Longer compared to non-salvage sale	Same amount of time compared to non-salvage sale	Shorter compared to non-salvage sale
Sale affected by a severe windstorm (snapped trees and downed trees)	54	53 (98.1%)	1 (1.9%)	0 (0.0%)
Sale affected by an insect or disease outbreak (standing dead trees)	40	15 (37.5%)	23 (57.5%)	2 (5.0%)
Sale affected by a recent fire (standing dead trees)	39	20 (51.3%)	17 (43.6%)	2 (5.1%)

Number of pieces and newest piece of in-woods equipment (Question 14)

Many pieces of equipment were reported as being owned and actively used in-woods within the reporting businesses (Table 22). For many types of in-woods equipment, respondents reported owning more pieces than in the 2011 survey (Blinn et al. 2014).

Table 22. Summary of average number of pieces of in-woods equipment and average age of the newest piece of equipment in 2016 (n = 133), 2011 (n = 220) and the average age of equipment in 1996 and

1991. The number of respondents for each in-woods equipment type in the 2016, 2011 and 1996 surveys are shown in parentheses.

In-woods equipment type	2016 Survey		2011 Survey (Blinn et al. 2014)		Average age (years) of equipment in 1996 (Puettmann et al. 1998)	Average age (years) of equipment in 1991 (Jaakko Pöyry Consulting, Inc. 1992)
	Average number of pieces per respondent	Average age (years) of newest piece of equipment	Average number of pieces per respondent	Average age (years) of newest piece of equipment		
Chainsaw/hand delimiting	3.4 (111)	3.3 (107)	3.1 (165)	3.4 (151)	---	---
Feller-bunchers	1.9 (94)	14.3 (88)	1.3 (149)	14.8 (138)	11 (236)	8
Cut-to-length (CTL) harvesters	1.4 (33)	7.1 (32)	1.4 (39)	7.6 (37)	---	---
Cable skidders	2.4 (32)	35.9 (31)	1.2 (58)	33.7 (52)	---	---
Grapple skidders	2.5 (102)	16.8 (96)	1.8 (166)	13.8 (152)	---	---
Forwarders	1.5 (35)	11.5 (32)	1.3 (41)	11.3 (40)	---	---
Skidders and forwarders	---	---	---	---	16 (465)	10
Mechanical delimiters	1.8 (53)	12.8 (51)	1.4 (80)	11.4 (73)	10 (95)	7
Chippers	1.3 (15)	12.5 (15)	1.3 (24)	11.6 (23)	10 (6)	10
Grinders	1.0 (3)	9.3 (3)	1.1 (8)	4.3 (8)	---	---
Slashers	1.6 (85)	16.2 (81)	1.4 (125)	14.0 (115)	9 (146)	7
Loaders	2.0 (86)	15.9 (82)	2.0 (124)	14.4 (116)	---	---
Hahn harvesters	1.3 (8)	30.9 (8)	---	---	---	---
Flail debarkers	2.5 (2)	1.0 (1)	---	---	---	---
Bulldozers	1.4 (77)	20.0 (73)	---	---	---	---
Other ¹	1.2 (12)	17.4 (11)	1.3 (45)	20.4 (40)	---	---

¹The "Other" in-woods equipment reported for 2016 were skid steers (4 pieces), Bobcat (1 piece), excavator (1 piece), track hoe (1 piece), HUD-SON trailer loader (1 piece), Siirto slasher/delimiter (1 piece), log truck (1 piece), off-road truck to haul loader (1 piece), and grader (1 piece).

As in the 2011 survey (Blinn et al. 2014), the average age of the newest piece of equipment for much of the equipment was 11 to 14 years old (Table 22). Cut-to-length harvesters are the exception as the average age of the newest harvesters was 7.1 years. The item of equipment that respondents have in the greatest number, on average, are chainsaws. Responding businesses which reported using chainsaws have 3.4 saws on average with respondents who produced up to 1,000 cords having the most chainsaws (3.9 on average) and respondents who produced 10,001-15,000 cords the least (2.8 chainsaws). The average age of those saws is 3.3 years. Cable skidders are the oldest type of in-woods equipment in 2016, averaging 35.9 years.

The 1991 (Jaakko Pöyry Consulting, Inc. 1992) and 1996 (Puettmann et al. 1998) surveys asked respondents to indicate the age of each piece of equipment, not the age of the newest piece of equipment as was asked in the 2011 and 2016 survey. For feller-bunchers, delimiters, slashers, and chippers, the average age of all reported equipment in 1996 and 1991 is lower than the average age of

the newest piece of equipment in 2011 and 2016 (Table 22). In general, the trend across all four surveys has been to hold onto equipment longer than in the past.

As equipment ages, the general trend is for maintenance requirements to increase and breakdown occurrences to become more prevalent. This can lead to decreased production as repairs are needed to fix machinery. Older machines are also more prone to experiencing oil leaks and hydraulic hose failures. While newer machines require loan payments to a lender to pay for the equipment, they do not tend to break down as often and thus have lower maintenance costs.

As the annual production rate increases, the average age of the newest piece of mechanized felling machinery (i.e., a cut-to-length harvester or a feller-buncher) generally decreases (Table 23). On average, the average age of the newest piece of mechanized felling machinery for businesses which produce up to 1,000 cords annually is more than 3.5 times as old as it is for businesses which produce more than 15,000 cords annually. Thus, higher production businesses see advantages and/or have the capital resources to maintaining a younger equipment mix than smaller producers.

Table 23. Summary of average age of newest piece of mechanized felling machinery by annual production (cords) in 2016 (n = 115) and 2011 (n = 150). The number of respondents for each over-the-road equipment type is shown in parentheses.

Annual production (cords)	Average age of newest piece of mechanized felling machinery in years	
	2016 Survey	2011 Survey (Blinn et al. 2014)
100 - 1,000	20.8 (13)	25.9 (22)
1,001 - 5,000	16.9 (37)	16.9 (54)
5,001 - 10,000	11.5 (20)	10.0 (27)
10,001 - 15,000	6.2 (14)	6.5 (13)
> 15,000	5.7 (31)	5.3 (34)

Number of pieces and newest piece of over-the-road equipment (Question 15)

As was reported for the 2011 survey (Blinn et al. 2014), responding businesses which reported their over-the-road equipment have 3 to 4 tractors and trailers, on average (Table 24). The average age of the newest piece of over-the-road equipment is generally 11 to 19 years old. Many other pieces of equipment were reported as being owned and actively used over-the-road within the reporting businesses.

Table 24. Summary of average number of pieces of over-the-road equipment and average age of the newest piece of equipment in 2016 (n = 93) and 2011 (n = 159). The number of respondents for each over-the-road equipment type is shown in parentheses.

Over-the-road equipment type	2016 Survey		2011 Survey (Blinn et al. 2014)	
	Average number of pieces per respondent	Average age of newest piece of equipment (years)	Average number of pieces per respondent	Average age of newest piece of equipment (years)
Tractor (semi)	4.0 (77)	12.5 (73)	3.4 (141)	12.1 (131)
Pulp/sawtimber trailer	3.3 (66)	14.8 (65)	4.1 (131)	13.9 (118)
Lowboy	1.3 (80)	19.0 (73)	1.2 (131)	16.8 (115)
Van/walking floor trailers	5.4 (16)	11.1 (16)	5.6 (28)	11.3 (27)
Self-loading truck/trailer	1.8 (50)	17.3 (47)	---	---
Pole trailer	3.1 (29)	18.2 (27)	---	---
Other ¹	2.8 (4)	6.5 (4)	1.6 (18)	24.5 (15)

¹The “Other” over-the-road equipment reported for 2016 were firewood trailer/cart (1 piece), 550 Ford w/33 gooseneck trailer 2011 (1 piece), and a small haul truck (1 piece).

Equipment replacement plans in the next three years (Question 16)

The period of time over which equipment can operate at an acceptable cost and level of production, or economic life, for most in-woods logging equipment is 3 to 6 years (Brinker et al 2002). Economic life depends on various factors, including physical deterioration (e.g., corrosion, wear and tear), functional impairment (e.g., unable to meet demands, becoming economically or technologically obsolete), fuel prices, tax investment incentives, and interest rates (Miyata 1980, Akay and Sessions 2004). Equipment is generally traded/replaced when down time causes the entire logging system to lose productive time, or when the cost of lost production exceeds the cost of owning a new piece of equipment.

Of the 115 respondents to the question about replacing existing equipment or purchasing new equipment within the next three years, 44 (38.3 percent) indicated that they didn’t plan to replace or purchase any equipment (Table 25). Respondents identified 268 pieces of equipment that they planned to replace within the next three years with 76.8 percent of that equipment being replacements. As was reported for the 2011 survey (Blinn et al. 2014), approximately two-thirds of those replaced pieces of equipment are planned as used purchases. Given the current age of logging equipment (Tables 21 and 23), used equipment may be beyond its economic life by the time a business tries to replace it. Thus, while most businesses indicated that they were considering replacing current equipment with used equipment, the quality of that equipment may be suspect when it becomes available. Feller-bunchers were the most frequently cited piece of in-woods equipment to be replaced with nearly 75 percent of those equipment replacements to be used equipment. Only one respondent reported planning to purchase either a chipper or a grinder. Of the 62 pieces of equipment that were reported to be purchased to expand the business, 95.2% were to expand using used equipment. A tractor (semi) was the most frequently cited over-the-road piece of equipment to be replaced (58.3 percent as used equipment).

Table 25. Summary of equipment which was reported by respondents in the 2016 (n = 125) and 2011 (n = 146) surveys to be replaced or purchased within the next three years.

Equipment type	2016 Survey				2011 Survey (Blinn et al. 2014)	
	Replace existing equipment		Purchase to expand business		Replacement	
	New	Used	New	Used	New	Used
Cut-to-length (CTL) harvesters	8	7	0	4	9	8
Feller-bunchers	8	23	1	9	---	---
Drive to tree feller-buncher	---	---	---	---	5	18
Reach to tree feller-buncher	---	---	---	---	11	12
Cable skidders	0	1	0	1	0	7
Grapple skidders	7	17	0	11	15	44
Forwarders	8	7	0	6	5	8
Delimbers	6	8	1	4	7	17
Chippers	0	0	0	0	0	3
Grinders	0	0	0	1	0	2
Slashers	7	11	0	4	13	19
Hahn harvesters	0	0	0	2	---	---
Flail debarkers	0	0	0	1	---	---
Loaders	6	10	0	3	12	20
Bulldozer	3	8	0	4	---	---
Tractor (semi)	14	10	0	3	23	37
Pulp/sawtimber trailer	3	4	0	2	9	18
Self-loading truck/trailer	5	4	0	2	---	---
Lowboy	6	7	0	2	4	18
Pole trailer	2	2	0	0	---	--
Van/walking floor trailer	0	2	1	0	5	6
Other ¹	2	0	0	0	4	0
Total	85	121	3	59	122	237
Do not plan to replace or purchase any equipment	44				---	---

¹The "Other" equipment replacements reported for 2016 were chainsaws (1 respondent) and wheel loader (1 respondent).

Twenty-nine businesses (20.7% of respondents) plan to purchase equipment to expand their business. Of those businesses, 63.0 percent produced up to 5,000 cords. Thus, smaller businesses were more likely planning to expand their business through additional equipment than larger businesses.

Felling methods (Question 17)

About half of the reported volume (46.1 percent) was felled with a reach to tree feller-buncher (Table 26). While 42.5 percent of respondents indicated that they fell some of their timber with a chainsaw, the total volume represented by that felling method is small (1.7 percent of the total). While about 37 percent of the respondents use more than one method to fell their timber, there is no way to determine if mixed equipment businesses have multiple crews with a different felling approach on each site (e.g., a feller-buncher on one site and a cut-to-length harvester on another site) and/or are using two types of felling equipment on one site.

Table 26. Summary of percent of volume felled in 2016 (n = 134), 2011 (n = 204), 2003, 1996 (n = 361) and 1991 by felling method. Respondents could use more than one felling method. Percentages may not total 100 due to rounding error.

Felling method	2016 Survey		Percent of volume (%)			
	Number (and percent) of respondents using that method	Percent of total respondent volume (%)	2011 survey (Blinn et al. 2014)	2003 survey (Powers 2004)	1996 survey (Puettmann et al. 1998)	1991 survey (Jaakko Pöyry Consulting, Inc. 1992)
Chainsaw	57 (42.5%)	1.7	2.4	1.0	16	27
Drive to tree feller-buncher	67 (50.0%)	27.8	30.8	62.4	46	73 (feller-buncher)
Reach to tree feller-buncher	47 (35.1%)	46.1	51.1	22.3	33	--
Cut-to-length (CTL) harvester	31 (23.1%)	24.4	15.7	14.3	5	0

The percent of volume felled using a chainsaw has continued to drop over time, from 27 percent in the 1991 survey (Jaakko Pöyry Consulting, Inc. 1992), to 16 percent in 1996 (Puettmann et al. 1998), to 1 percent in 2003 (Powers 2004) to 2.4 percent in 2011 (Blinn et al. 2014) and 1.7 percent in 2016 (Table 26). The percent of volume felled with a feller-buncher remained relatively constant between the 1991, 1996, 2003 2011 and 2016 (73.9 percent) surveys, ranging between 73 to 85 percent. While the percent of volume felled with a reach to tree feller-buncher increased from 33 percent in 1996 to 22.3 percent in 2004 to 51.1 percent in 2011, it was down slightly in 2016 (46.1 percent). The percent of volume felled with a cut-to-length harvester in 2016 (24.4 percent) increased from the 2011 and 2003 rates when it was 15.7 and 14.3 percent, respectively.

For those respondents who indicated that they felled all of their timber using a chainsaw, the percentage of respondents in 2016 (14.2 percent) was comparable to the percentages for the 2011 (14.7 percent) (Blinn et al. 2014) and 2003 (14.3 percent) (Powers 2004) surveys (Table 27). The percent of respondents from the 2016 survey who felled zero (none) percent of their volume with a chainsaw (57.5

percent) was higher than in 2011 (49.5 percent) or 2003 (50.4 percent). Of the 18 respondents who reported felling all of their timber using a chainsaw, nine (50%) were in the MnDNR's northwest region, five (27.8 percent) were in the northwest region and four (22.2 percent) were in the central/southern region.

For those respondents who indicated that they felled all of their timber using a drive to tree feller-buncher, the percentage of respondents in 2016 (16.4 percent) was comparable to the 2011 results (15.7 percent) which were both lower than the 2003 survey (32.2 percent) (Table 27). Similarly, the percent of respondents who felled none of their volume with a drive to tree feller-buncher were similar in 2016 (50.0 percent) and 2011 (54.4 percent) which were both higher than the 2003 survey (38.8 percent). For those respondents who indicated that they felled all of their timber using a reach to tree feller-buncher, the percentage of respondents in 2016 (14.2 percent) was lower than the 2011 rate (19.6 percent) but higher than was reported in the 2003 survey (8.3 percent).

The percent of respondents who felled none of their timber with a reach to tree feller-buncher was comparable for the 2016 (64.9 percent) and 2011 (65.7 percent) surveys, both of which were lower than was reported for the 2003 survey (80.8 percent) (Table 27). For those respondents who indicated that they felled all of their timber using a cut-to-length harvester, the percentage of respondents in 2016 (9.7 percent) was higher than in 2011 (5.9 percent) or 2003 (3.3 percent for drive to tree cut-to-length harvesters and 1.7 percent for reach to tree cut-to-length harvesters). The percentage of respondents who reported that none of their volume was felled using a cut-to-length harvester was higher in 2016 (76.9 percent) than in 2011 (54.4 percent).

Table 27. Summary of number of logging businesses that felled timber according to various volume criteria in 2016 (n = 134) and 2011 (n = 204).

Criteria	Number (and percent) of logging businesses by felling method in 2016			
	Chainsaw	Drive to tree feller-buncher	Reach to tree feller-buncher	Cut-to-length (CTL) harvester
Fell 100% of volume with that equipment	18 (14.2%)	22 (16.4%)	19 (14.2%)	13 (9.7%)
At least 75% of volume felled with that equipment	20 (14.9%)	47 (35.1%)	28 (20.9%)	21 (15.7%)
At least 50% of volume felled with that equipment	25 (18.7%)	51 (38.1%)	37 (27.6%)	25 (18.7%)
At least 25% of volume felled with that equipment	27 (20.1%)	60 (44.8%)	41 (30.6%)	26 (19.4%)
No volume felled with that equipment	77 (57.5%)	67 (50.0%)	87 (64.9%)	103 (76.9%)
Criteria	Number (and percent) of logging businesses by felling method in 2011 (Blinn et al. 2014)			
	Chainsaw	Drive to tree feller-buncher	Reach to tree feller-buncher	Cut-to-length (CTL) harvester
Fell 100% of volume with that equipment	30 (14.7%)	32 (15.7%)	40 (19.6%)	32 (15.7%)
At least 75% of volume felled with that equipment	34 (16.7%)	76 (37.3%)	52 (25.5%)	76 (37.3%)
At least 50% of volume felled with that equipment	39 (19.1%)	83 (40.7%)	57 (27.9%)	83 (40.7%)
At least 25% of volume felled with that equipment	45 (22.1%)	87 (42.6%)	61 (29.9%)	87 (42.6%)
No volume felled with that equipment	101 (49.5%)	111 (54.4%)	134 (65.7%)	111 (54.4%)

Businesses which felled all of their volume using a cut-to-length (CTL) harvester or which used two or more of the felling methods (e.g., feller-buncher and CTL) harvested more timber sales in 2016 than businesses which felled all of their volume with a chainsaw or using a feller-buncher (Table 28). There was little difference in average tract size reported by the various felling methods (Table 29).

Table 28. Summary of average volume harvested (cords) and total number of sales completed and partially completed in 2016 by felling method (n = 110).

Felling method ¹	Average volume harvested (cords)	Total number of sales completed and partially completed	
		Average	Median
Chainsaw (n = 13)	592	3.8	3.0
Feller-buncher (n = 41)	11,377	8.5	6.0
Cut-to-length (CTL) harvester (n = 11)	7,300	11.0	8.0
Mixed (n = 45)	10,019	11.6	8.0

¹Respondents were categorized by the percent of volume felled into the following four groups: Chainsaw – business felled 100% of their volume using a chainsaw, Feller-buncher – business felled 100% of their volume using a feller-buncher, Cut-to-length – business felled 100% of their volume using a cut-to-length (CTL) harvester, Mixed – business felled their volume using two or more of the felling methods.

Table 29. Summary of average tract size (acres) harvested in 2016 by felling method (n = 122).

Felling method ¹	Average tract size (acres)	Median tract size (acres)
Chainsaw (n = 17)	39.3	30.0
Feller-buncher (n = 48)	41.1	37.5
Cut-to-length (CTL) harvester (n = 12)	42.3	37.5
Mixed (n = 45)	32.6	30.0

¹Respondents were categorized by the percent of volume felled into the following four groups: Chainsaw – business felled 100% of their volume using a chainsaw, Feller-buncher – business felled 100% of their volume using a feller-buncher, Cut-to-length – business felled 100% of their volume using a cut-to-length (CTL) harvester, Mixed – business felled their volume using two or more of the felling methods.

In-woods transportation methods (Question 18)

For those who used only one in-woods transport method (e.g., 100 percent of their volume was skidded using a grapple skidder), the average reported volume harvested in 2011 and 2016 were comparable (Table 30). On average, the 32 respondents (23.9% of respondents) who used two or more in-woods transportation methods (e.g., grapple skidding and forwarding) harvested 17,658 cords in 2016.

Table 30. Summary of average volume harvested by in-woods transport method in 2016 (n = 134) and 2011 (n = 162) by businesses who transported 100 percent of their volume using one in-woods transport method (Blinn et al. 2014).

In-woods transportation method	2016 survey		Average volume harvested in 2011 (Blinn et al. 2014) (cords)
	Number (and percent) of respondents who only used that method	Average volume harvested in 2016 (cords)	
Cable skidder	11 (8.2%)	793	1,063
Grapple skidder	72 (53.7%)	10,910	10,744
Forwarder	19 (14.2%)	7,400	7,100
Mixed ¹	--	17,658	11,804

¹A mixed approach used two or more in-woods transportation methods (e.g., grapple skidding and forwarding).

Thirty respondents indicated that they use two methods to transport material in-woods from the stump to the landing (e.g., grapple skid and forwarder) and two respondents indicated that they use three methods (i.e., cable skid, grapple skid and forwarder). Twelve respondents reported a mixture of grapple skidding and forwarding, 9 reported using both cable and grapple skidding, 3 reported using both cable skidders and forwarders, 6 reported using cable or grapple skidders with some other method (i.e., Bobcat, dozer, shortwood tracked skid steer).

More than 70 percent of the reported volume was transported from the stump to a landing using a grapple skidder (Table 31). A forwarder transported the second highest percent of total volume. Approximately 73 percent of the responding businesses use a grapple skidder to transport some of their volume to a landing (Table 32). Approximately 73 percent of the businesses do not use a forwarder in their operation.

Table 31. Summary of percent of volume transported in-woods from the stump to the landing in 2016 (n = 134), 2011 (n = 204), 2003, 1996 (n = 361) and 1991 by transport method. Respondents could use more than one in-woods transport method. Percentages may not total 100 due to rounding error.

In-woods transportation method	2016 survey		Percent of volume transported in-woods (%)			
	Number of respondents using that method	Percent of volume transported in-woods (%)	2011 survey (Blinn et al. 2014)	2003 survey (Powers 2004)	1996 survey (Puettmann et al. 1998)	1991 survey (Jaakko Pöyry Consulting, Inc. 1992)
Cable skidder	29	1.1	2.4	0.7	15	30
Grapple skidder	98	72.6	81.3	87.3	79	69
Forwarder	36	26.3	16.3	12.0	5	1
Other ¹	5	<0.1	<0.1	<0.1	<2	---

¹The "Other" in-woods transportation methods noted for the 2016 survey were a Bobcat (2 respondents), tracked skid steer, dozer, and transported by someone else. For the 2011 survey, they were a Bobcat, a low ground pressure Bombardier and a short wood skidder. The components of the "Other" category were not described in the 2003 survey. For the 1996 survey, they included a farm tractor and a bulldozer.

Table 32. Summary of number and percent of logging businesses by type of in-woods transport method according to various volume criteria in 2016 (n = 134) and 2011 (n = 205).

Criteria	Number (and percent) of logging businesses by in-woods transportation method in 2016			
	Cable skidder	Grapple skidder	Forwarder	Other ¹
Transport 100% of volume with that equipment	11 (8.2%)	72 (53.7%)	19 (14.2%)	0 (0.0%)
At least 75% of volume transported with that equipment	13 (9.7%)	85 (63.4%)	23 (17.2%)	1 (0.7%)
At least 50% of volume transported with that equipment	21 (15.7%)	90 (67.2%)	28 (20.9%)	2 (1.5%)
At least 25% of volume transported with that equipment	21 (15.7%)	92 (68.7%)	31 (23.1%)	2 (1.5%)
No volume transported with that equipment	105 (78.4%)	36 (26.9%)	98 (73.1%)	129 (96.3%)
Criteria	Number (and percent) of logging businesses by in-woods transportation method in 2011 (Blinn et al. 2014)			
	Cable skidder	Grapple skidder	Forwarder	Other ¹
Transport 100% of volume with that equipment	22 (10.7%)	121 (59.0%)	19 (9.3%)	0 (0.0%)
At least 75% of volume transported with that equipment	24 (11.7%)	140 (68.3%)	25 (12.2%)	0 (0.0%)
At least 50% of volume transported with that equipment	31 (15.1%)	146 (71.2%)	30 (14.6%)	1 0.5%)
At least 25% of volume transported with that equipment	34 (16.6%)	151 (73.7%)	34 (16.6%)	1 (0.5%)
No volume transported with that equipment	156 (76.1%)	51 (24.9%)	167 (81.5%)	202 (98.5%)

¹The “Other” in-woods transportation methods noted for the 2016 survey were a Bobcat (2 respondents), tracked skid steer, dozer, and transported by someone else. For the 2011 survey, they were a Bobcat, a low ground pressure Bombardier and a short wood skidder.

Similar to felling operations, the percent of volume transported in-woods using a cable skidder has continued to drop over time, going from 30 percent in the 1991 survey (Jaakko Pöyry Consulting, Inc. 1992), to 15 percent in 1996 (Puettmann et al. 1998), to 0.7 percent in 2003 (Powers 2004) to 2.4 percent in 2011 (Blinn et al. 2014) and 1.1 percent in 2016 (Table 31). The percent of volume transported with a grapple skidder remained relatively constant between the 1991, 1996, 2003, 2011 and 2016 surveys, ranging between 69 to 87 percent. The percent of volume transported in-woods with a forwarder continued the trend of increasing from the 1991 to 1996 to 2003 to 2011 to the 2016 survey, more than doubling the percentage of the 2003 survey.

The percentages of respondents who either transported in-woods none (zero) or 100 percent of their volume with a cable skidder (Table 32) was relatively unchanged from the 2003 (Powers 2004) and 2011 surveys (Blinn et al. 2014). The percent of respondents who transported all of their volume with a grapple skidder continued to decrease in 2016 (53.7 percent) as compared to the 2011 (59.0 percent) and 2003 (66.9 percent) surveys. The percent of respondents who transported 100 percent of their volume with a forwarder continued to increase in 2016 (14.3 percent) as compared to the 2011 (9.3 percent) and 2003 (5.9 percent) surveys.

A summary of responses by in-woods transport method by MnDNR region in 2016 and 2011 is presented in Table 33. In that summary the cable skid, grapple skid, and forwarding businesses transported 100 percent of their in-woods volume using that one method. As compared to the overall response rate in 2016, a higher percentage of the cable skidding, large grapple skidding and forwarding businesses are in the MnDNR's northeast region. In 2011, a higher percentage of the cable skidding and large grapple skidding businesses were in the MnDNR's northeast region as compared to the overall response rate. In both 2016 and 2011, there was a higher percentage of mixed businesses in the central/southern region as compared to the overall response rate.

Table 33. Summary of number and percent of logging businesses by type of in-woods transport method by MnDNR region in 2016 (n = 129) and 2011 (n = 203). Percentages may not total 100 due to rounding error.

In-woods method ¹	Number of businesses	Percent of businesses by MnDNR Region in 2016 (%)		
		Northwest	Northeast	Central/Southern
Overall response rate	140	35.7	54.3	10.0
Cable skid	10	10.0	70.0	20.0
Grapple skid (total)	69	37.7	53.7	8.7
≤ 5,000 cords	37	35.1	54.1	10.8
5,001 – 15,000 cords	11	72.7	27.3	0.0
> 15,000 cords	21	23.8	66.7	9.5
Forward	18	33.3	66.7	0.0
Mixed ¹ (total)	32	31.3	50.0	18.8
≤ 5,000 cords	19	26.3	42.1	31.6
> 5,000 cords	13	38.5	61.5	0.0
Overall in-woods transportation total	129	33.3	55.8	10.9
In-woods method ¹	Number of businesses	Percent of businesses by MnDNR Region in 2011 (%) (Blinn et al. 2014)		
		Northwest	Northeast	Central/Southern
Overall response rate	226	32.3	58.0	9.7
Cable skid	22	18.2	77.3	4.5
Grapple skid (total)	121	37.2	57.9	5.0
≤ 5,000 cords	64	40.6	53.1	6.3
5,001 – 15,000 cords	29	48.3	48.3	3.4
> 15,000 cords	28	17.9	78.6	3.6
Forward	19	21.1	57.9	21.1
Mixed ¹ (total)	41	29.3	51.2	19.5
≤ 5,000 cords	24	20.8	50.0	29.2
> 5,000 cords	17	41.2	52.9	5.9
Overall in-woods transportation total	203	32.0	58.6	9.4

¹The cable skid, grapple skid, and forwarding businesses transported 100 percent of their in-woods volume using that one method. For the respondents who use a mixed method, two or three different methods to transport material in-woods from the stump to the landing were reported (e.g., grapple skidding and forwarding).

Average one-way travel distance from business to timber harvest site (Question 19)

Approximately half (51.9 percent) of the respondents indicated that the average one-way travel distance from their primary business location to their timber harvest site(s) was 31 – 60 miles (Table 34). More than 85 percent (86.5 percent) of the respondents indicated that the average one-way travel distance was up to 60 miles. Few respondents (3.1 percent) indicated that their average one-way travel distance was more than 90 miles. For the smallest category of respondents (i.e., those who reported producing up to 1,000 cords), the most common response was up to 30 one-way miles between the respondent’s primary business location and their timber harvest site(s) in 2016 (62.5% of respondents). For all other production categories, the most common response was 31-60 one-way miles.

Table 34. Summary of average one-way travel distance in miles between the respondent’s primary business location and their timber harvest site(s) in 2016 (n = 133). Percentages may not total 100 due to rounding error.

Mileage range	Number of respondents	Percent of respondents (%)
Up to 30 miles	46	34.6
31 – 60 miles	69	51.9
61 – 90 miles	14	10.5
91 – 120 miles	3	2.3
121 – 150 miles	1	0.8
More than 150 miles	0	0.0

Between 80.3 – 88.7 percent of the respondents in the three MnDNR regions indicated that their average one-way travel distance from their business’ primary location to their timber harvest site(s) was up to 60 miles (Table 35). Placement in a MnDNR region was based on where the business was located during 2016. None of the respondents in the central/southern region indicated that the average one-way travel distance to their harvest sites was more than 90 miles.

Table 35. Summary of one-way travel distance in miles for traveling from the respondent’s primary business location to their timber harvest site(s) in 2016 by MnDNR region in which the business is located (n = 133). Placement in a MnDNR region was based on where the business was located during 2016. Percentages may not total 100 due to rounding error.

Mileage range	Percent of respondents by MnDNR Region (%)		
	Northwest Region (n = 48)	Northeast Region (n = 71)	Central/Southern Region (n = 14)
Up to 30 miles	33.3	39.4	14.3
31 – 60 miles	50.0	49.3	71.4
61 – 90 miles	12.5	8.5	14.3
91 – 120 miles	4.2	1.4	0.0
121 – 150 miles	0.0	1.4	0.0
More than 150 miles	0.0	0.0	0.0

Average one-way travel distance from timber harvest site(s) to the consuming mill(s) (Question 20)

Seventy-four percent of the respondents indicated that the average one-way haul distance from their timber harvest sites to their consuming mill(s) was between 31 to 90 miles (Table 36). For 83.2 percent of the respondents, the average one-way haul distance was up to 90 miles. As compared to the 2011 survey, a smaller percentage of 2016 respondents indicated that their average-one-way haul distance was more than 90 miles. For respondents who produced 5,001-10,000 cords, the most common response was 31-60 one-way miles between the respondent’s timber harvest site(s) and their consuming mill(s) in 2016 (40.9% of respondents). For all other production categories, the most common response was 61-90 one-way miles.

Table 36. Summary of average one-way travel distance in miles between the respondent’s timber harvest site(s) and their consuming mill(s) in 2016 (n = 131) and 2011 (n = 216). Percentages may not total 100 due to rounding error.

Mileage range	2016 Survey		2011 Percent of respondents (%) (Blinn et al. 2014)
	Number of respondents	Percent of respondents (%)	
Up to 30 miles	12	9.2	8.8
31 – 60 miles	41	31.3	35.6
61 – 90 miles	56	42.7	31.5
91 – 120 miles	19	14.5	19.4
121 – 150 miles	2	1.5	3.2
More than 150 miles	1	0.8	1.4

Between 30.8 – 32.6 percent of the respondents in the MnDNR’s central/southern and northwest regions, respectively, indicated that their average one-way travel distance to their consuming mill(s) was up to 60 miles (Table 37). Placement in a MnDNR region was based on where the business was located

during 2016. More than 30 percent (30.8 percent) of the respondents in the central/southern region indicated that their average one-way travel distance to their mill was more than 90 miles.

Table 37. Summary of one-way distance in miles for traveling from the respondent’s timber harvest site(s) to the mill(s) in 2016 by MnDNR region in which the business is located (n = 131). Placement in a MnDNR region was based on where the business was located during 2016. Percentages may not total 100 due to rounding error.

Mileage range	Percent of respondents by MnDNR Region (%)		
	Northwest Region (n = 46)	Northeast Region (n = 72)	Central/Southern Region (n = 13)
Up to 30 miles	6.5	11.1	7.7
31 – 60 miles	26.1	36.1	23.1
61 – 90 miles	50.0	38.9	38.5
91 – 120 miles	17.4	11.1	23.1
121 – 150 miles	0.0	1.4	7.7
More than 150 miles	0.0	1.4	0.0

Harvest volume transported on owned vs. contracted trucks (Question 21)

The percentages of harvest volume transported by hauling method (i.e., owned vs. contracted trucks) were comparable between the 2016 and 2011 data (Blinn et al. 2014) (Table 38). While nearly three quarters of the respondents (74.4 percent in 2016 and 78.7 percent in 2011) use contract hauling for some portion of their hauled wood, that transportation method only transports 36.4 percent of the total volume (36.1 percent in 2011). While 62.8 percent of the respondents indicated that they used their own trucks for some portion of their hauled wood, 63.6 percent of the wood was hauled on respondent-owned trucks.

Table 38. Summary of method of hauling harvested material (trucks owned vs. hauling contracted) during 2016 (n = 129) and 2011 (n = 197) by number of respondents and percent of volume produced.

Hauling method	2016		2011 (Blinn et al. 2014)	
	Number (and percent) of respondents who use hauling type	Percentage of volume produced (%)	Number (and percent) of respondents who use hauling type	Percentage of volume produced (%)
Trucks owned	81 (62.8%)	63.6	129 (65.5%)	63.9
Contracted	96 (74.4%)	36.4	155 (78.7%)	36.1

As was reported for the 2011 survey (Blinn et al. 2014), approximately one-third of the respondents did not have any of their wood hauled using trucks they own and one-quarter of the respondents did not use any contract hauling (Table 39). Forty-eight respondents (37.2 percent) use a mixture of both trucks owned by the business as well as contract hauling to transport their wood to mills (44.2 percent for the 2011 survey). The 1979 survey of Minnesota logging businesses found reported that 40 percent of the wood was contact hauled for full-time firms and 45 percent by part-time firms (Bolstad 1980).

Table 39. Summary of percent of volume hauled by logging businesses in 2016 (n = 129) and 2011 (n = 197) according to various volume criteria.

Criteria	Number (and percent) of logging businesses by hauling method			
	2016		2011 (Blinn et al. 2014)	
	Trucks owned	Hauling contracted	Trucks owned	Hauling contracted
Respondents who use that method to haul 100% of their volume	33 (25.6%)	48 (37.2%)	42 (32.6%)	68 (43.9%)
Respondents who use that method to haul at least 75% of their volume	57 (44.2%)	56 (43.4%)	87 (67.4%)	84 (54.2%)
Respondents who use that method to haul at least 50% of their volume	68 (52.7%)	67 (51.9%)	108 (83.7%)	96 (61.9%)
Respondents who use that method to haul at least 25% of their volume	74 (57.4%)	74 (57.4%)	115 (89.1%)	113 (72.9%)
No volume hauled using that method	48 (37.2%)	33 (25.6%)	68 (34.5%)	42 (21.3%)

For both the 2016 and 2011 surveys (Blinn et al. 2014), the percent of wood which was contract hauled tended to decrease as the production level of responding logging businesses increased (Table 40). While respondents who produced 5,000 cords or less tended to contract out approximately 60 percent of their volume for hauling (56.3 percent in 2016 and 60.3 percent in 2011) that percentage was less than 40 percent for businesses producing more than 15,000 cords (37.6 percent in 2016 and 33.0 percent in 2011).

Table 40. Summary of average percent of volume transported to mills by trucks owned by the logging business vs. through contract trucking for various production levels in 2016 (n = 125) and 2011 (n = 197).

Volume harvested (cords)	Number of respondents	2016		2011 (Blinn et al. 2014)	
		Trucks owned	Trucking contracted	Trucks owned	Trucking contracted
		Average percent of volume (%)	Average percent of volume (%)	Average percent of volume (%)	Average percent of volume (%)
≤ 1,000	28	46.1	53.9	34.5	65.5
1,001 – 5,000	39	41.4	58.6	45.0	55.0
5,001 – 10,000	22	46.3	53.7	64.1	35.9
10,001 – 15,000	12	45.8	54.2	46.9	53.1
> 15,000	23	62.4	37.6	67.0	33.0

Off-road and over-the-road fuel consumption (Question 22)

An outlier analysis identified eight off-road responses that were major outliers which were deleted from the analysis of those data. For the 96 remaining responses, the average respondent used 14,590 gallons of off-road fuel within their business in 2016 (median 5,000 gallons). An average of 1.55 gallons/cord (median 1.50 gallons/cord) of off-road fuel were consumed per respondent. In 2011, an average of 1.92 gallons/cord (median of 7,500 gallons/respondent) was reported (n = 169) (Blinn et al. 2014).

The 69 respondents who reported over-the-road fuel consumption in 2016 indicated an average of 37,424 gallons consumed (median 7,000 gallons). An average of 2.64 gallons/cord (median 2.00 gallons/cord) of over-the road fuel were consumed. In 2011, an average of 34,177 gallons were consumed per respondent with 2.72 gallons/cord (median 2.04 gallons/cord) for over-the-road fuel consumption (n = 115) (Blinn et al. 2014).

For the 23 respondents who reported that all of their 2016 volume (Question 2) was transported using trucks they owned (Question 21) and who also reported their over-the-road fuel consumption (Question 22), 3.96 gallons of over-the-road fuel were consumed per delivered cord (median 2.29 gallons/cord, average 8,500 gallons consumed and median of 4,000 gallons). For the 33 respondents who reported that all of their 2011 volume was transported using trucks they owned and who also reported their over-the-road fuel consumption, 2.72 gallons of over-the-road fuel were consumed per delivered cord.

Amount of capital invested in the business (Question 23)

A logging business can have capital invested in their business through a number of different categories as identified in Question 24 (e.g., harvesting equipment, off-road transportation equipment, over-the-road hauling equipment, stumpage, other). In 2016, the question about financial investment asked, "In 2016, in total, how much capital was invested in your logging business? Check only one response." Whereas the most comparable question in the 2011, 2003 and 1996 surveys asked "Please estimate the current value as of December 31, 2011 of all of your in-woods logging equipment. (Check only one response.)" Thus, the two questions aren't worded exactly alike with the 2016 question being potentially broader in scope.

Nearly eighty percent of the respondents (78.9 percent) in 2016 estimated that they had less than \$500,000 of capital invested in their logging business (Table 41). For the differently worded question, approximately 71.4 percent of the 2011 respondents (Blinn et al. 2014), 79 percent of the 2003 respondents (Powers 2004) and 94 percent of the 1996 respondents (Puettmann et al., 1998) estimated that the current value of their equipment was less than \$500,000.

Table 41. Summary of estimated amount of capital invested in the logging business in 2016 (n = 133) and estimated current value of in-woods logging equipment on December 31, 2011 (n = 217), in 2003 (n = 119) and in 1996 (n = 368). Dollar values are not adjusted for inflation. Percentages may not total 100 due to rounding error.

Value range	Number of respondents (2016 survey)	Percent of respondents (%)			
		2016 survey	2011 survey (Blinn et al. 2014)	2003 survey (Powers 2004)	1996 survey (Puettmann et al. 1998)
Less than \$100,000	63	47.4	34.1	36.1	63
At least \$100,000 but less than \$250,000	21	15.8	22.6	42.9 (100-500k)	19
At least \$250,000 but less than \$500,000	21	15.8	14.7		12
At least \$500,000 but less than \$750,000	9	6.8	7.4	16.0 (500k-1 million)	3
At least \$750,000 but less than \$1,000,000	6	4.5	4.1		1
At least \$1,000,000 but less than \$1,250,000	4	3.0	2.8	5.0 (> 1 million)	2 (> 1 million)
At least \$1,250,000 but less than \$1,500,000	2	1.5	2.8		
At least \$1,500,000 but less than \$1,750,000	2	1.5	3.7		
At least \$1,750,000 but less than \$2,000,000	1	0.8	0		
At least \$2,000,000 but less than \$2,250,000	0	0.0	2.8		
At least \$2,250,000 but less than \$2,500,000	0	0.0	1.8		
At least \$2,500,000 but less than \$2,750,000	0	0.0	1.4		
At least \$2,750,000 but less than \$3,000,000	0	0.0	0		
More than \$3,000,000	4	3.0	1.8		

In the 2016 survey, 3.8 percent of the respondents estimated that they had more than \$1 million of capital invested in their business (Table 41). In the 2011 survey, 17.1 percent of the respondents estimated that the current value of their equipment was at least \$1 million. Five percent of the 2003 respondents (Powers 2004) and two percent of the respondents to the 1996 survey (Puettmann et al. 1998) estimated that the current value of their equipment was at least \$1 million.

By assigning an integer to each value range in Table 41 for the 2016 survey (e.g., 1 = Less than \$100,000; 2 = At least \$100,000 but less than \$250,000, 14 = more than \$3,000,000), it is possible to compare the estimated average capital investment of different equipment configurations. For those businesses which used a cable skidder to transport all of their volume from the stump to a landing, their average value was 1.0 (n = 11). For grapple skidding businesses, the average value was 2.7 (n = 71). For forwarding businesses, the average value was 2.2 (n = 18). For mixed businesses, the average value was 3.3 (n = 31). For the 2011 survey where values were only for in-woods equipment, businesses which use a cable skidder to transport all of their volume from the stump to a landing had an average value of 1.1 (n = 22), grapple skidding businesses averaged 3.7 (n = 117), forwarding businesses averaged 3.0 (n = 19) and mixed businesses averaged 3.7 (n = 41).

How capital was invested in the business (Question 24)

On average, nearly half of the capital that was reported to be invested within the respondent’s businesses was in their harvesting equipment (47.5 percent) and another 33.0 percent was in stumpage (Table 42). Respondents weren’t asked to specify what they might have invested in within the “Other” category.

Table 42. Summary of how respondents reported investing capital by percentage within various categories during 2016 (n = 112).

Investment category	Average (%)	Median (%)
Harvesting equipment	47.5	42.5
Off-road transport equipment	4.4	0.0
Over-the-road hauling equipment	9.6	0.0
Stumpage	33.0	25.0
Other	5.5	0.0

Logging businesses that transported all of their volume from the stump to the landing using a cut-to-length system (i.e., a forwarder) invested 63.7 percent of their capital in their harvesting equipment, approximately 20 percent higher than for the other in-woods transport methods (Table 43). On average, businesses which used a grapple skidder to transport all of their volume from the stump to the landing and businesses which used more than one in-woods method (i.e., mixed) reported that 35.8 percent and 37.1 percent, respectively, of their capital was invested in stumpage.

Table 43. Summary of percentages of capital respondents reported investing within various categories by in-woods transport method during 2016 (n = 112).

Investment category	Percent of capital (%) invested by in-woods transport method from the stump to the landing			
	Cable skid (n = 9)	Grapple skid (n = 58)	Cut-to-length (CTL) (n = 16)	Mixed (n = 29)
Harvesting equipment	44.2%	47.1%	63.7%	40.6%
Off-road transport equipment	8.9%	3.0%	3.3%	6.3%
Over-the-road hauling equipment	10.9%	8.1%	11.4%	11.2%
Stumpage	24.9%	35.8%	19.7%	37.1%
Other	11.1%	6.0%	1.9%	4.8%

¹The cable skid, grapple skid, and forwarding businesses transported 100 percent of their in-woods volume using that one method. For the respondents who use a mixed method, two or three different methods were reported to transport material in-woods from the stump to the landing (e.g., grapple skidding and forwarding).

Difficulty in accessing capital (Question 25)

Having ready access to capital to fuel business growth and job creation will help a business succeed. Slightly more than one-third (36.4 percent) of respondents indicated that their access to capital was very easy and only 16.6 percent of the respondents said that their access to capital was either somewhat hard or very hard (Table 44).

Table 44. Summary of difficulty in accessing capital in 2016 by number and percent of respondents (n = 132)

Category	Number (and percent) of respondents
Very easy	48 (36.4%)
Somewhat easy	33 (25.0%)
Neither easy nor hard	29 (22.0%)
Somewhat hard	13 (9.8%)
Very hard	9 (6.8%)

Each response category was assigned a numeric value with Very easy = 1, Somewhat easy = 2, Neither easy nor hard = 3, Somewhat hard = 4, and Very hard = 5, and mean response values were calculated by annual production levels and MnDNR regions. While there was general agreement across all annual harvest categories that access to capital in 2016 was between somewhat easy and neither easy nor hard (average rating was 2.3 and the median rating was 2.0), businesses which harvested 5,001 – 10,000 cords or more than 15,000 cords in 2016 reported the easiest access to capital (Table 45). Access to capital was easiest in the MnDNR’s Northwest region and most difficult in their Central/Southern region (Table 46).

Table 45. Summary of difficulty in accessing capital in 2016 by annual harvest category (cords) (n = 127). Percentages may not total 100 due to rounding error.

Annual production (cords)	Number of respondents	Difficulty in accessing capital						
		Average rating ¹	Median rating ¹	1	2	3	4	5
100 - 1,000	32	2.4	2.0	37.5%	15.6%	25.0%	12.5%	9.4%
1,001 - 5,000	38	2.5	2.0	28.9%	23.7%	26.3%	13.2%	7.9%
5,001 - 10,000	22	2.0	2.0	45.5%	31.8%	13.6%	0.0%	9.1%
10,001 - 15,000	12	2.3	2.0	41.7%	16.7%	16.7%	16.7%	8.3%
> 15,000	23	2.0	2.0	34.8%	39.1%	21.7%	4.3%	0.0%

¹Accessing capital coded values: 1 = Very easy, 2 = Somewhat easy, 3 = Neither easy nor hard, 4 = Somewhat hard, and 5 = Very hard.

Table 46. Average and median ratings for access to capital by MnDNR region in 2016 (n = 132).

DNR Region	Number of respondents	Average rating for access to capital ¹	Median rating for access to capital ¹
Northwest	47	1.9	2.0
Northeast	71	2.4	3.0
Central/Southern	14	2.9	3.0

¹Accessing capital coded values: 1 = Very easy, 2 = Somewhat easy, 3 = Neither easy nor hard, 4 = Somewhat hard, and 5 = Very hard.

Rating of profitability in 2016 (Question 26)

Respondents were asked to rate their perception of their business’s profitability in 2016. While slightly more than one-quarter of the respondents (25.6 percent) indicated that their profitability in 2016 was either very poor or poor, 39.5 percent indicated that their profitability was either good or excellent (Table 47).

Table 47. Summary of profitability in 2016 by number and percent of respondents (n = 129)

Category	Number (and percent) of respondents
Very poor	9 (7.0%)
Poor	24 (18.6%)
Average (broke even)	45 (34.9%)
Good	47 (36.4%)
Excellent	4 (3.1%)

Each response category was assigned a numeric value with Very poor = 1, Poor = 2, Average (broke even) = 3, Good = 4, and Excellent = 5, and mean response values were calculated by annual production levels and MnDNR regions. While there was general agreement across all annual harvest categories that their profitability in 2016 was between average (broke even) and good (average rating was 3.1 and the median rating was 3.0), businesses which harvested 5,001 – 10,000 cords reported the highest average rating of their profitability (Table 48). Profitability in 2016 was similar in all three of MnDNR regions (Table 49).

Table 48. Summary of profitability in 2016 by annual production (cords) (n = 125). Percentages may not total 100 due to rounding error.

Annual production (cords)	Number of respondents	Profitability response category in 2016						
		Average rating ¹	Median rating ¹	1	2	3	4	5
100 - 1,000	32	3.1	3.0	6.3%	15.6%	37.5%	40.6%	0.0%
1,001 - 5,000	36	3.1	3.0	5.6%	25.0%	30.6%	36.1%	2.8%
5,001 - 10,000	22	3.5	3.5	0.0%	9.1%	40.9%	40.9%	9.1%
10,001 - 15,000	12	2.8	3.0	16.7%	16.7%	41.7%	25.0%	0.0%
> 15,000	23	3.0	3.0	13.0%	17.4%	26.1%	39.1%	4.3%

¹Likert scale values for profitability of business in 2016: 1 = Very poor, 2 = Poor, 3 = Average (broke even), 4 = Good, and 5 = Excellent.

Table 49. Average and median profitability in 2016 by MnDNR region (n = 129).

MnDNR Region	Number of respondents	Average profitability rating ¹	Median profitability rating ¹
Northwest	47	3.1	3.0
Northeast	68	3.1	3.0
Central/Southern	14	3.0	3.0

¹Likert scale values for profitability of business in 2016: 1 = Very poor, 2 = Poor, 3 = Average (broke even), 4 = Good, and 5 = Excellent.

Profitability in 2016 as compared to 2013 (Question 27)

In the 2016 survey, respondents were asked to compare their profitability in 2016 vs. 2013. In the 2011 survey, respondents were asked to compare their 2011 profitability to their 2008 profitability. In the 2011 survey, the rationale for selecting 2008 as the comparison year was that: 1) there had been several mill closures prior to 2008 (so it was important to assess profitability once some semblance of stability had been reestablished (MnDNR 2010)), 2) statewide harvest levels in 2008 were down nearly 800,000 cords as compared to 2005 levels (MnDNR 2011), and 3) asking respondents to recall their profitability more than three years in the past seemed unlikely to provide reliable comparisons (Blinn et al. 2014). To be able to compare the results from the two surveys and believing that the three recall period was still appropriate, the 2016 survey asked respondents to compare their profitability in 2016 and 2013.

Results from the two surveys are shown in Table 50. On average, respondents generally felt that the 2016 comparison was better for them than the 2011 comparison. In 2016, 38.6 percent of respondents felt that 2016 was much or slightly worse than 2013 while 60.8 percent of respondents in the 2011 survey felt the same way in 2011 about 2008. While 36.9 percent of respondents felt that their profitability was slightly or much better in 2016 than in 2013, 20.5 percent felt the same way in 2011 about 2008.

Table 50. Summary of logging business’ profitability in a) 2016 as compared to 2013 (n = 122) and b) 2011 as compared to 2008 (n = 214). Percentages may not total 100 due to rounding error.

Profitability comparison ¹	2016 as compared to 2013		2011 as compared to 2008 (percent of respondents (%)) (Blinn et al. 2014)
	Number of respondents	Percent of respondents (%)	
Much worse in assessment year as compared to three years prior	23	18.9	37.4
Slightly worse in assessment year as compared to three years prior	24	19.7	23.4
Same in assessment year as compared to three years prior	30	24.6	18.7
Slightly better in assessment year as compared to three years prior	27	22.1	18.2
Much better in assessment year as compared to three years prior	18	14.8	2.3

¹The assessment year is either 2016 or 2011 and the corresponding time three years earlier is either 2013 or 2008, respectively.

Each response category was assigned a numeric value with Much worse in 2016 as compared to 2013 = 1, Slightly worse in 2016 as compared to 2013 = 2, Same in 2016 as compared to 2013 = 3, Slightly better in 2016 as compared to 2013 = 4, and Much better in 2016 as compared to 2013 = 5. Mean response values were calculated by annual production levels and MnDNR regions. While the average overall value was 3.0, the average value for respondents who produced between 5,001 – 10,000 cords and more than 15,000 cords was 3.3 (Table 51), the highest of the annual harvest categories examined.

Table 51. Summary of profitability in 2016 as compared to 2013 by annual production (cords) (n = 119). Percentages may not total 100 due to rounding error.

Annual production (cords)	Number of respondents	Profitability response category in 2016 as compared to 2013 ¹						
		Average	Median	1	2	3	4	5
100 - 1,000	31	3.0	3.0	16.1%	19.4%	29.0%	22.6%	12.9%
1,001 - 5,000	36	2.7	3.0	22.2%	25.0%	27.8%	11.1%	13.9%
5,001 - 10,000	21	3.3	3.0	14.3%	9.5%	28.6%	28.6%	19.0%
10,001 - 15,000	10	2.6	2.5	30.0%	20.0%	10.0%	40.0%	0.0%
> 15,000	21	3.3	4.0	14.3%	19.0%	14.3%	28.6%	23.8%

¹Response categories: 1 = Much worse in 2016 as compared to 2013, 2 = Slightly worse in 2016 as compared to 2013, 3 = Same in 2016 as compared to 2013, 4 = Slightly better in 2016 as compared to 2013, and 5 = Much better in 2016 as compared to 2013.

Operate at full capacity (Y/N) in 2016 (Question 28)

A business operates at full capacity when its current equipment, workers, capital and other resources are producing at their full potential. Businesses will aim to make the most productive use of its existing capacity to spread their fixed costs across more units of production while retaining labor. Of the 130 responses that were received for this question, 45 (34.4 percent) said that they did operate at full capacity and 85 respondents (65.6 percent) indicated that they did not operate at full capacity. Of the 13 respondents who harvested all of their volume during the winter, 30.8 percent indicated that they operated at full capacity. Of the 114 respondents who harvested in multiple seasons, 36.0% reported operating at full capacity. More than 45 percent of the respondents who harvested either 5,001 – 10,000 or more than 15,000 cords in 2016 indicated that they operated at full capacity (Table 52).

Table 52. Summary of number and percent of respondents who operated at full capacity in 2016 by annual production (cords) (n = 125). Percentages may not total 100 due to rounding error.

Annual production (cords)	Number of respondents	Number (and percent) of respondents who operated at full capacity	
		Yes	No
100 - 1,000	32	10 (31.3%)	22 (68.8%)
1,001 - 5,000	38	12 (31.6%)	26 (68.4%)
5,001 - 10,000	22	10 (45.5%)	12 (54.5%)
10,001 - 15,000	11	2 (18.2%)	9 (81.8%)
> 15,000	22	10 (45.5%)	12 (54.5%)

For those respondents who felled all of their volume using a chainsaw, 44.4 percent reported operating at full capacity in 2016. Respondents who felled all of their volume using a feller-buncher reported that 27.1 percent operated at full capacity. Businesses which felled all of their timber using a cut-to-length harvester reported the highest percent of respondents operating at full capacity (69.2 percent). For

businesses which used mixed methods to fell their timber in 2016 (e.g., feller-buncher and cut-to-length harvester), 30.0 percent reported operating at full capacity.

Additional volume they could have produced to reach full capacity (Question 29)

The respondents who indicated they didn't operate at full capacity in 2016 (Question 28) were asked how much additional volume they could have harvested. The 79 respondents could have harvested an additional 423,940 cords, an average of 5,435 cords per respondent (median of 3,000 cords). The range was 100 – 50,000 cords. Of the additional 423,940 cord equivalents, 88.3% is in additional cord volume, 1.3% additional MBF volume, 5.3% additional biomass green tons, and 5.1% additional clean chip green tons. The 423,940 cords of additional volume would be equivalent to 28.7% of the volume reported by respondents in this survey and 14.8% of the total volume harvested statewide in 2016, as reported by the MnDNR (MnDNR 2017).

For those who didn't operate at full capacity in 2016, the average "efficiency" (Efficiency = Reported volume / (Reported volume + Additional capacity)) was 59.8 percent but varied by level of production (Table 53). On average, respondents who harvested 5,000 or fewer cords in 2016 indicated that they could have more than doubled their production in 2016. Respondents who harvested more than 10,000 cords indicate that they could have harvested 35 percent more volume, on average. The additional volume that could have been harvested in 2016 is similar to that reported in the 2011 survey (Blinn et al. 2014) across the various in-woods transport methods (Table 54). Businesses which used a grapple skidder to transport all of their volume from the stump to a landing and businesses which used multiple methods for that in-woods transport (e.g., grapple skid and forwarder) had the highest additional capacity.

Table 53. Summary of efficiency¹ and average and median additional volume in cords respondents could have produced to reach full capacity in 2016 by annual harvest category (cords) (n = 76).

Annual production (cords)	Number of respondents	Average additional volume as a percent of 2016 volume (%)	Additional volume to operate at full capacity (cords)		Efficiency (%)
			Average volume	Median volume	
100 - 1,000	20	296%	858	450	47.6%
1,001 - 5,000	24	138%	3,052	2,000	54.7%
5,001 - 10,000	11	67%	5,400	4,000	65.8%
10,001 - 15,000	9	39%	5,249	5,000	73.4%
> 15,000	12	35%	14,208	10,000	74.6%

¹Efficiency = Reported volume / (Reported volume + Additional capacity)

Table 54. Additional volume in cords respondents could have produced to reach full capacity in 2016 (n = 78) and 2011 (n = 172) by method transporting volume from the stump to the landing.

In-woods transport method ¹	2016		2011 (Blinn et al. 2014)	
	Number of respondents	Additional volume to reach full capacity (cords)	Number of respondents	Additional volume to reach full capacity (cords)
Cable skidding	6	743	17	949
Grapple skidding	42	6,417	104	6,583
Forwarding	8	2,731	16	2,349
Mixed	22	5,823	35	5,996

¹For cable skidding, grapple skidding and forwarding, 100% of the volume transported in-woods by a business was moved using the single method. For mixed, two or more methods were used to transport volume in-woods (e.g., grapple skidding and forwarding).

Summer vs. winter ability to produce additional volume to reach full capacity (Question 30)

The respondents who indicated that they didn't operate at full capacity in 2016 (Question 28) were asked what percent of their additional volume they could have harvested in the summer and winter with the total equaling 100. Of the respondents who indicated cordwood volumes, 44.6 percent of the volume was in summer and 55.4 percent in winter (Table 55). Some businesses indicated that all of their additional volume was in either summer or winter but not some in both seasons. While nearly 55 percent of the additional capacity was in winter, businesses which harvested more than 5,000 cords had a higher percentage of their additional available capacity during the summer (Table 57).

Table 55. Summary of percent of additional volume which could be produced to reach full capacity by season (summer vs. winter) (n=69).

Volume unit	Number of respondents	Average percent by season (%)	
		Summer	Winter
Cords	67	44.6	55.4
MBF	4	40.0	60.0
Green tons (biomass)	4	52.5	47.5
Green tons (clean chips)	1	60.0	40.0

Table 56. Summary of season of harvest when respondents who had additional capacity could produce cordwood volume (n = 69)

Criteria	Number of logging businesses by season	
	Summer	Winter
Produce 100% of additional volume during that season	6	12
Produce at least 75% of additional volume during that season	15	17
Produce at least 50% of additional volume during that season	36	47
Produce at least 25% of additional volume during that season	54	60

Table 57. Summary of percent of additional cordwood volume respondents could have produced in 2016 to operate at full capacity during summer and winter (n = 68).

Annual production (cords)	Number of respondents	Percent of additional cordwood volume to operate at full capacity in 2016 by season	
		Summer	Winter
100 - 1,000	18	31.7	68.3
1,001 - 5,000	20	48.5	51.5
5,001 - 10,000	9	55.2	44.8
10,001 - 15,000	9	52.2	47.8
> 15,000	12	56.7	43.3

Break-even volume (Question 31)

Breakeven sales volume is the amount of a product (i.e., harvest volume) that you will need to produce and sell to cover total costs of production. The average break-even volume was 10,579 cords (median = 4,000 cords, minimum = 100 cords, maximum = 150,000 cords) (n = 75). From Question 2, the average respondent produced 11,267 cords in 2016 (median = 4,000 cords). Dividing the break-even volume (Question 31) by the 2016 production volume (Question 2), the average respondent needed to produce 117 percent of their 2016 harvest volume to break-even (i.e., 17 percent more than they reported harvesting) (median = 100 percent, minimum 46 percent, maximum 1000 percent) (n = 73).

Respondents who reported producing as many as 5,000 cords in 2016 needed to produce at least 111.8 percent of their reported production level to break-even (Table 58). While 50.0 percent of respondents who produced up to 1,000 cords broke-even, 81.8 percent of the respondents who produced more than 15,000 cords broke-even.

Table 58. Summary of break-even volume (Question 31) as a percent of actual harvest volume reported (Question 2) (n = 73).

Annual production (cords)	Number of respondents	Break-even volume (Question 31) compared to actual volume reported (Question 2)	
		Average percent of actual volume harvested needed to reach break-even volume (percent) ¹	Percent whose break-even volume was less than their actual volume harvested (percent)
100 - 1,000	20	160.8	50.0
1,001 - 5,000	25	111.8	64.0
5,001 - 10,000	8	101.8	62.5
10,001 - 15,000	9	94.4	77.8
> 15,000	11	76.7	81.8

¹A value more than 100 percent means that to reach break-even production level, the average respondent in that category would need to increase their actual harvest volume reported in Question 2 by the percentage reported in the column. As an example, if the average reported volume harvested for a category was 500 cords and the percent reported in the column is 150, the break-even volume for that category would be 750 cords (i.e., 500 cords actually reported x 1.5 = 750 cords).

Number of years the company has been in operation (Question 32)

Minnesota’s logging businesses continue to be long-established, indicating a long-term commitment to the profession. The average logging business had been in operation for 30.5 years (median 30.0 years) in 2016 (Table 59). More than 70 percent (71.5 percent) of the responding businesses had been in business for more than 20 years.

Table 59. Summary of number of years the logging business has been in operation in 2016 by the number and percent of respondents in a category (n = 133) compared to the 2011 (Blinn et al. 2014) (n=217) and 2003 survey (Powers 2004). Percentages may not total 100 due to rounding error.

Number of years	2016 Survey		Percent of respondents (%)	
	Number of respondents	Percent of respondents (%)	2011 survey Blinn et al. 2014)	2003 survey (Powers 2004)
0 – 10	20	15.0	12.9	10.1
11 – 20	18	13.5	16.6	25.2
21 – 30	34	25.6	29.0	37.0
31+	61	45.9	41.5	27.7

The response to this question continues to show an aging of businesses over time. For the 2011 survey, the average business had been in operation for 28.1 years (median 29) (Blinn et al. 2014) (Table 59). In 1996, the average length of time in the logging business was 22.8 years and the average length of ownership of the business was 17.6 years (Puettmann et al. 1998). The average time spent in the profession was 25.3 years in 2003 (Powers 2004). The percentage of new logging businesses in Minnesota (up to 10 years) was higher in the 2016 survey than for the 2011 (Blinn et al. 2014) or 2003 (Powers 2004) surveys.

Some logging businesses pass ownership from one generation within a family to the next without changing the name of the business. Thus, a company could be in operation across multiple generations of a family without ever changing the name of the business. Unfortunately, it isn’t possible to know the extent to which these phenomena have occurred from the survey data.

Table 60 compares the number of years in operation with various factors. Businesses which had been in operation for 21 – 30 years reported the highest average production in cords by number of years in operation. Respondents reported that access to capital became easier with an increasing number of years in operation. The average profitability rating didn’t vary much by the number of years in operation. Respondents who had been in operation for 11 – 20 years reported the lowest average profitability rating in 2016 and percent of respondents who operated at full capacity in 2016. At least 70 percent of respondents who had been in business for more than 20 years reported breaking even in 2016.

Table 60. Summary of the relationship between the number of years in business in 2016 with average production in cords (n=133), access to capital (n=131), average profitability (n=128), operations at full capacity (n=130) and break-even (n=73). Numbers in parentheses represent the number of responses for each category.

Number of years in business	Average production (cords)	Average access to capital ¹	Average profitability rating ²	Percent of respondents who operated at full capacity in 2016 (%)	Percent of respondents who reported breaking even in 2016 (%)
0 – 10	9,087 (20)	2.7 (20)	3.2 (19)	35.0% (20)	40.0% (10)
11 – 20	3,158 (18)	2.4 (18)	3.2 (18)	22.2% (18)	50.0% (12)
21 – 30	20,180 (34)	2.3 (33)	3.1 (33)	31.3% (32)	76.2% (21)
31+	9,388 (61)	2.1 (60)	3.1 (58)	41.7% (60)	70.0% (30)

¹Response categories: Very easy = 1, Somewhat easy = 2, Neither easy nor hard = 3, Somewhat hard = 4, and Very hard = 5.

²Likert scale values for profitability of business in 2016: Very poor = 1, Poor = 2, Average (broke even) = 3, Good = 4, and Excellent = 5.

Expect to be in business in 5 years (Question 33)

A change in the number of businesses within any industry is inevitable over time due to changes in profit and loss, interest and ability of the business owners, difficulty in recruiting and retaining labor, family situation, competition, markets, etc. Within the logging industry, it is important to ensure that there are businesses that have the knowledge, skills/ability, equipment, and markets to profitably harvest the range of tract sizes (e.g., it may be economically inefficient for some businesses to harvest small tracts), silvicultural prescriptions (i.e., clearcutting, selection harvesting), and site conditions (e.g., steeper topography may require more manual systems) across the state.

Of the 130 businesses that responded to this question, 95 (73.1 percent) indicated that they expect to be in the logging business in five years (Table 61). Approximately 25 percent of the respondents stated they would not be in business in five years. Similar findings were reported for the 2011 survey (Blinn et al. 2014). Businesses which reported that they do not expect to be in the logging business in five years produced an average of 10,870 cords in 2016 while respondents who expect to be in business in five years produced an average of 11,851 cords.

Table 61. Summary of logging business’ assessment of whether they expect to be in business in five years for 2016 (n = 130) and 2011 (Blinn et al. 2014) (n = 199) surveys.

Expect to be in logging business in 5 years	Percent of respondents (%)	
	2016 survey	2011 survey (Blinn et al. 2014)
Yes	73.1	75.4
No	26.9	24.6

Businesses within the MnDNR’s central/southern Minnesota region were more likely to report that they would not be in business in five years (35.7%, n = 14) as compared to respondents from northwest (25.5%, n = 47) and northeast Minnesota (26.1%, n = 69).

Businesses who responded that they would not be in business in five years reported that the average age of their newest piece of felling machinery (feller-buncher or cut-to-length harvester) was older (15.5 years vs. 11.7 years) and their additional capacity was higher (5,883 cords vs. 5,197 cords) than businesses who reported that they would be in business in five years. For businesses which indicated that they would not be in businesses in 5 years, 29.4 percent indicated that they operated at full capacity. For businesses which indicated that they would be in businesses in 5 years, 37.2 percent indicated that they operated at full capacity.

While approximately 32 percent of the responding businesses that produced up to 5,000 cords reported that they won't be in business in five years, 13.6 percent of businesses which produced 5,001 – 10,000 cords reported similarly. Twenty-five percent of the businesses which reported producing 10,001 – 15,000 cords and 21.7 percent of the businesses which produced more than 15,000 cords reported that they don't plan to be in business in five years.

Why businesses won't be operating in 5 years (Question 34)

The most common response for the 35 respondents who provided reasons why they wouldn't be in business in 5 years was the owner's age or that the owner was already retired or planned to retire (Table 62).

Table 62. Summary of reasons why respondents don't expect to be in business in five years. Some respondents provided more than one reason.

Reason	Number (and percent) of responses
Age/Already retired/Plan to retire	25 (64.1%)
Can't make enough money / Costs too high	5 (12.8%)
Loss of or poor markets	5 (12.8%)
Too many regulations	3 (7.7%)
Other ¹	1 (2.6%)

¹Agency foresters are severely incompetent and lazy.

General plans for the business in the future (Question 35)

While the 2016 survey asked about the respondent's general plans for the future, the 2011 (Blinn et al. 2014) and 2003 (Powers 2004) surveys asked about their general plans for the next five years. In all three surveys, approximately 75 percent of respondents indicated that they plan to either maintain or increase their annual volume harvested (Table 63). Approximately 20 percent of respondents in each survey indicated that they plan to either retire or sell their business in the next 5 years.

Table 63. Summary of logging business general plans for the future (n = 129) and compared to the 2011 (n = 221) (Blinn et al. 2014) and 2003 surveys (n = 119) (Powers 2004) where the future was defined as the next five years. Percentages may not total 100 due to rounding error.

General plans for the business over the next 5 years	2016 Survey number of respondents	Percent of respondents (%)		
		2016 Survey	2011 survey (Blinn et al. 2014)	2003 survey (Powers 2004)
Increase annual volume harvested	46	35.7	29.4	26.9
Maintain annual volume harvested	52	40.3	43.4	47.9
Decrease annual volume harvested	5	3.9	8.6	6.7
Retire or sell business	26	20.2	18.6	18.5

Each response category was assigned a numeric value with Increase annual volume harvested = 1, Maintain annual volume harvested = 2, Decrease annual volume harvested = 3, and Retire or sell business = 4. Mean response values were calculated by annual production levels. Over all of the annual production levels, those producing 10,001 – 15,000 cords were slightly less likely than respondents who produced 5,001 – 10,000 cords or more than 15,000 cords to either increase or maintain annual harvest levels (Table 64).

Table 64. Summary of logging business owner perspectives about the general plans for their business in the future by annual production (cords) (n = 125). Percentages may not total 100 due to rounding error.

Annual production (cords)	Number of respondents	General plans for the business in the future ¹					
		Average	Median	1	2	3	4
100 - 1,000	32	2.1	2.0	34.4%	40.6%	3.1%	21.9%
1,001 - 5,000	38	2.3	2.0	28.9%	42.1%	2.6%	26.3%
5,001 - 10,000	22	1.9	2.0	40.9%	40.9%	9.1%	9.1%
10,001 - 15,000	12	2.1	2.0	41.7%	33.3%	0.0%	25.0%
> 15,000	21	2.0	2.0	38.1%	42.9%	4.8%	14.3%

¹Response categories: Increase annual volume harvested = 1, Maintain annual volume harvested = 2, Decrease annual volume harvested = 3, and Retire or sell business = 4.

Future ownership of the business (Question 36)

Logging businesses tend to be family run operations which are passed from one generation to another. The average business in this survey had been in operation for 30.5 years (Question 32). Approximately forty percent (42.2 percent) of the respondents indicated that it was most likely that a family member (e.g., son, daughter, niece, nephew, spouse, sibling) of the owner’s family would take over the business at some point in the future (Table 65). Respondents selected the “Don’t know” and “Nobody” options each 28.2 percent of the time.

Table 65. Summary of logging business owner perspectives about who is most likely to take over their business in the future (n = 131). Percentages may not total 100 due to rounding error.

Perspectives about future family involvement	Number of respondents	Percent of respondents (%)
Family member (son, daughter, niece, nephew, spouse, sibling)	54	41.2
Current employee or subcontractor	2	1.5
Other	1	0.8
Don't know	37	28.2
Nobody	37	28.2

Each response category was assigned a numeric value with Family member (son, daughter, niece, nephew, spouse, sibling) = 1, Current employee or subcontractor = 2, Other = 3, Don't know = 4, and Nobody = 5 (Table 66). Businesses which produced 5,001 – 10,000 cords and more than 15,000 cords selected the “Family member (son, daughter, niece, nephew, spouse, sibling) = 1” option at least 60 percent of the time. Over half of the respondents who produced 100 – 1,000 cords responded that “Nobody” likely will take over their business.

Table 66. Summary of logging business owner perspectives about who is most likely to take over their business in the future by annual production (cords) (n = 126). Percentages may not total 100 due to rounding error.

Annual production (cords)	Number of respondents	Who will most likely take over ownership of the business in the future ¹				
		1	2	3	4	5
100 - 1,000	32	18.8%	0.0%	0.0%	28.1%	53.1%
1,001 - 5,000	39	33.3%	0.0%	2.6%	43.6%	20.5%
5,001 - 10,000	21	71.4%	0.0%	0.0%	4.8%	23.8%
10,001 - 15,000	11	27.3%	9.1%	0.0%	36.4%	27.3%
> 15,000	23	60.9%	4.3%	0.0%	26.1%	8.7%

¹Response categories: Family member (son, daughter, niece, nephew, spouse, sibling) = 1, Current employee or subcontractor = 2, Other = 3, Don't know = 4, and Nobody = 5.

Importance of various factors in respondent's decision to enter logging business (Question 37)

Respondents were asked to rate the importance of nine factors which were thought to be related to why a logging business owner might decide to enter the logging business using a five-point Likert scale. Respondents could also select “Other” and write in a factor. The Likert scale response categories were Not at all = 1, A little = 2, Somewhat = 3, Very = 4, and Extremely = 5.

On average, three factors were rated 4.0 or better (i.e., at least Very important) (Table 67). Those factors were “I enjoy a sense of independence,” “I enjoy working outdoors” and “It gives me a sense of accomplishment”. The three lowest rated factors, each averaging below 3.0 (i.e., less than Somewhat important) were “It is in line with my career goals”, “It is a respected profession in my community” and “It pays well”. The six “Other” factors which were written in were a) physical work is good sideline work,

b) it is a way of life, c) I hate people, d) I enjoy being in the woods, e) being a steward of the forest, and f) not a lot of options.

Table 67. Summary of logging business owner perspectives about the importance of various factors in their decision to enter the logging business. Percentages may not total 100 due to rounding error.

Factor	Number of respondents	Importance ¹						
		Average	Median	1	2	3	4	5
I am from a logging family	130	3.2	4.0	22.3%	10.8%	15.4%	27.7%	23.8%
I enjoy working outdoors	134	4.1	4.0	2.2%	0.0%	12.7%	50.7%	34.3%
I enjoy a sense of independence	133	4.2	4.0	1.5%	1.5%	9.8%	51.9%	35.3%
It gives me a sense of accomplishment	133	4.0	4.0	2.3%	4.5%	15.8%	49.6%	27.8%
I like that it is challenging work	133	3.7	4.0	4.5%	3.0%	33.8%	36.1%	22.6%
It pays well	131	2.2	2.0	26.7%	31.3%	35.1%	6.9%	0.0%
It is a respected profession in my community	133	2.7	3.0	17.3%	24.1%	38.3%	16.5%	3.8%
It is in line with my career goals	131	2.8	3.0	22.1%	10.7%	38.9%	25.2%	3.1%
It gives me the flexibility to stay in the area	132	3.7	4.0	7.6%	3.0%	22.0%	50.8%	16.7%
Other ²	6	3.8	4.0	16.7%	0.0%	0.0%	50.0%	33.3%

¹Likert scale response categories were: Not at all = 1, A little = 2, Somewhat = 3, Very = 4, and Extremely = 5.

²“Other” factors identified were: Physical work is good sideline work, It is a way of life, I hate people, I enjoy being in the woods, Being a steward of the forest, and Not a lot of options

Encourage family member or close friend to become a logger (Question 38)

Nearly 20 percent of the respondents (19.7 percent) indicated that they would encourage a family member or close friend to become a logger, 39.4 percent indicated that they would not encourage a family member or close friend to enter the logging business and 40.9 percent indicated that they were not sure (Table 68).

Table 68. Summary of number and percent of respondents who would encourage members of their family or close friends to become a logger (n = 132).

Option	Number of responses	Percent of responses (%)
Yes	26	19.7
No	52	39.4
Not sure	54	40.9

Extent to which various factors encourage or discourage new individuals from entering into the logging business (Question 39)

Respondents were asked to rate the importance of eight factors which were thought to encourage or discourage the entry by new people into the logging business using a five-point Likert scale.

Respondents could also select “Other” and write in a factor. The Likert scale response categories were:

Greatly discourages = 1, Somewhat discourages = 2, Neither encourages or discourages = 3, Somewhat encourages = 4, and Greatly encourages = 5.

On average, none of the eight factors would encourage the entry of new people into the logging business. The highest rated factor was “Work environment” which had an average of 3.0 (i.e., Neither encourages nor discourages) (Table 69). The Benefits package was the lowest rated factor, averaging 1.6. All other factors averaged between 2.1 and 2.7. Fourteen respondents provided a total of 17 “Other” factors which were written in. Those Other factors, all of which were rated as Greatly discouraging entry, were a) It is too easy for people to sit home and collect welfare; b) Profit vs. investment, constant weather / market challenges; c) Good paying construction, mining, pipeline jobs; d) Cost to start logging; e) I just think it is fun; f) Start-up cost; g) Expensive to start, poor harvesting always fighting with the weather and mills; h) Lack of credit; i) Too expensive to enter; j) Year-round weather related schedule; k) Hard work “summer heat” old school logging balsam; l) Can’t compete with the mines & construction for pay and benefits package; m) No one understands how things really work – they all want to live off someone else’s productivity; n) Finding good employees; o) Investment; p) Cost of equipment; and q) MnDNR.

Table 69. Summary of logging business owners’ perspectives about the importance of various factors which may encourage or discourage the entry of new people into the logging business. Percentages may not total 100 due to rounding error.

Factor	Number of respondents	Importance ¹						
		Average	Median	1	2	3	4	5
Physical demands of the job	125	2.3	2.0	16.0%	40.8%	36.8%	6.4%	0.0%
Work environment	125	3.0	3.0	8.8%	27.2%	28.8%	30.4%	4.8%
Pay or wages	127	2.1	2.0	27.6%	43.3%	22.0%	7.1%	0.0%
Benefits package	126	1.6	1.0	54.0%	33.3%	12.7%	0.0%	0.0%
Prestige associated with work	122	2.7	3.0	10.7%	24.6%	50.8%	13.9%	0.0%
Availability of competing jobs in the area	125	2.7	3.0	14.4%	21.6%	42.4%	19.2%	2.4%
Skills necessary to perform logging operations	124	2.7	3.0	8.9%	33.9%	38.7%	16.9%	1.6%
Health of logging industry	125	2.3	1.0	20.8%	41.6%	24.0%	12.8%	0.8%
Other ²	14	1.0	1.0	100.0%	0.0%	0.0%	0.0%	0.0%

¹Likert scale response categories: Greatly discourages = 1, Somewhat discourages = 2, Neither encourages or discourages = 3, Somewhat encourages = 4, and Greatly encourages = 5.

²“Other” factors identified were: It is too easy for people to sit home and collect welfare; Profit vs. investment, constant weather / market challenges; Good paying construction, mining, pipeline jobs; Cost to start logging; I just think it is fun; Start-up cost; Expensive to start, poor harvesting always fighting with the weather and mills; Lack of credit; Too expensive to enter; Year-round weather related schedule; Hard work “summer heat” old school logging balsam; Can’t compete with the mines & construction for pay and benefits package; No one understands how things really work – they all want to live off someone else’s productivity; Finding good employees; Investment; Cost of equipment; and MnDNR.

Family members who have previously done logging (Question 40)

Parents were the most commonly reported family members who had previously done logging (Table 70). Grandparents and uncle(s) or aunt(s) were the second and third most reported family members. Nine respondents handwrote in “none” to indicate that none of their family members had ever previously done logging.

Table 70. Summary of number of and percent of respondents who indicated types of family members who had ever previously done logging. Respondents could select more than one type of family member (n = 122).

Family member	Number of respondents	Percent of respondents (%) ¹
Grandparent	70	55.6
Parent	94	74.6
Uncle or Aunt	59	46.8
Sibling	26	20.6
Cousin	35	27.8
Other relative	13	10.3
None (noted by respondent)	9	7.1

¹Percentages do not total 100 because respondents could select more than one family member.

Is company a family logging business? (Question 41)

Seventy-six percent of respondents reported that their company met the definition to be a family business. The definition used in the survey was “A family business is one in which the family plays a central role in the leadership and daily workings of the business and includes at least two family members, such as a father and son, or a husband and wife.” At least 80 percent of respondents reported that their company was a family logging business for all annual production levels except those who produced up to 1,000 cords in 2016 (Table 71).

Table 71. Summary of logging business owner perspectives about whether they believe that their company is a family business (n = 124).

Annual production (cords)	Number of respondents	Is the company a family logging business? (%)	
		Yes	No
100 - 1,000	29	48.3	51.7
1,001 - 5,000	38	81.6	18.4
5,001 - 10,000	22	86.4	13.6
10,001 - 15,000	12	83.3	16.7
> 15,000	23	95.7	4.3

Total number of owners (Question 42)

The average number of owners per business was 1.6. Over 50 percent of respondents (53.4 percent) indicated that there was one owner in their business (Table 72). The median number of owners was 1.0.

Table 72. Summary of the number of owners per business by number and percent of respondents (n = 133). Percentages do not total 100 due to rounding error.

Number of owners	Number of respondents	Percent of respondents (%)
1	71	53.4
2	49	36.8
3	9	6.8
4	1	0.8
5	2	1.5
6	0	0.0
7	1	0.8

Age and number of years in industry of owners (Question 43)

One-hundred thirty-one (131) respondents reported a total of 212 owners whose average age was 52.9 years (median 54.0 years, minimum 19 years and maximum 87 years). A summary of the number of respondents by age group is shown in Table 73. The average age of owners who don't expect their business to be in business in five years (Question 33) was 61.1 years (n = 35) as compared to 51.2 years for businesses which do expect to be in business in five years (n = 92).

Table 73. Summary of owner age (years) for 212 owners (n = 131).

Owner age (years)	Number of owners	Percent of owners (%)
< 20	1	0.5
20 – 29	13	6.1
30 – 39	20	9.4
40 – 49	44	20.8
50 – 59	63	29.7
60 – 69	47	22.2
70 – 79	22	10.4
80 - 89	2	0.9

The 212 owners identified through this question had been in the logging industry for an average of 30.1 years (median 32.0 years, minimum 1 year and maximum 70 years). A summary of the number of respondents by number of years in the logging business is shown in Table 74.

Table 74. Summary of number of years in business for 202 owners (n = 126).

Years in business	Number of owners	Percent of owners (%)
< 20	44	21.8
20 – 29	40	19.8
30 – 39	52	25.7
40 – 49	53	26.2
50 – 59	11	5.4
60 – 69	1	0.5
70 – 79	1	0.5

Use of technology (Question 44)

Eight technologies were identified as being possible tools that logging business owners might have available in their home or office for business use. For each technology, respondents were asked if it was available within their home or office (Yes or No) and then to rate their frequency with which they access or use each technology that is available. More than 70 percent of respondents indicated that high speed or broad band internet (82.3 percent of respondents), a smartphone (77.0 percent of respondents) and/or a laptop computer (74.6 percent of respondents) were available in their home or office (Table 75). Only 18.6 percent of respondents had access to dial-up internet.

Table 75. Summary of whether various technologies are available for use in the home or office for business use (n = 130).

Technology	Number of respondents	Available in home office			
		Number		Percent (%)	
		Yes	No	Yes	No
Dial-up internet	102	19	83	18.6	81.4
High speed or broad band internet	124	102	22	82.3	17.7
Smartphone	122	94	28	77.0	23.0
Desktop computer	120	86	34	71.7	28.3
Laptop computer	118	88	30	74.6	25.4
Tablet computer	105	47	58	44.8	55.2
Global positioning system (GPS)	113	71	42	62.8	37.2
Geographic information system (GIS)	104	32	72	30.8	69.2

Respondents were asked to rate their frequency of use for each technology that was available in their home or office using a six-point Likert scale. The Likert scale response categories were Never = 1, Once a year or less = 2, Once per month = 3, Once per week = 4, Once a day = 5, and Multiple daily uses = 6. For those who had the technology available in their home or office, all technologies were reported as being used at least once a month (Table 76). Both smartphones and high speed or broad band internet were reported to be used at least once a day.

Table 76. Summary of frequency of use for business purposes of various technologies within responding logging businesses (n = 120). Percentages may not total 100 due to rounding error.

Technology	Number of respondents	Frequency of use ¹							
		Average	Median	1	2	3	4	5	6
Dial-up internet	21	4.5	5.0	0.0%	4.8%	19.0%	23.8%	23.8%	28.6%
High speed or broad band internet	103	5.2	5.0	0.0%	1.0%	4.9%	20.4%	24.3%	49.5%
Smartphone	93	5.7	6.0	1.1%	0.0%	1.1%	4.3%	9.7%	83.9%
Desktop computer	85	4.6	5.0	2.4%	2.4%	5.9%	34.1%	28.2%	27.1%
Laptop computer	85	4.5	4.0	0.0%	1.2%	18.8%	31.8%	25.9%	22.4%
Tablet computer	48	4.5	5.0	2.1%	4.2%	12.5%	29.2%	29.2%	22.9%
Global positioning system (GPS)	74	3.7	3.5	0.0%	13.5%	36.5%	23.0%	17.6%	9.5%
Geographic information system (GIS)	36	3.7	3.0	0.0%	13.9%	41.7%	16.7%	19.4%	8.3%

¹Likert scale response categories: Never = 1, Once a year or less = 2, Once per month = 3, Once per week = 4, Once a day = 5, and Multiple daily uses = 6.

Open-ended comments (Question 45)

Forty-one respondents provided open-ended comments they thought would be helpful to the study. Some of the comments reinforced their opinions regarding other issues addressed earlier in the survey. Comments were arranged by the themes noted below. Similar issues were cited by Monte (2018) for Wisconsin.

- Entry into the business (2 comments)
- Labor availability and cost (5 comments)
- Purchasing and operating equipment (6 comments)
- Cost of insurance (4 comments)
- Stumpage availability and cost (18 comments)
- Markets/delivered prices (13 comments)
- Regulations (9 comments)
- Impact of weather conditions on operations (2 comments)
- Other/miscellaneous (15 comments)

Other than the “Other/miscellaneous” category, the theme which received the most comments was “Stumpage availability and cost”. There were also many comments for the “Markets/delivered prices” and “Regulations” themes. The breadth of and most common themes identified through the open-ended comments is similar to what was reported from the 2011 survey (Blinn et al. 2014) where “Difficulty maintaining profitability”, “Stumpage availability/timber sale policies”, “Issues associated with agencies and foresters” and “Issues associated with markets” received the most comments.

A listing of open-ended comments, arranged by theme, is reported in Appendix 9. Where a respondent’s input fit into multiple themes, the appropriate portion of their comment was placed with the corresponding theme. Some comments appear multiple times as the individual comment addressed more than one theme.

Statistical evaluation of how various factors are influenced by purchaser type, annual production level and in-woods transportation method

To better understand the effects of annual production level (Question 2), percentage of stumpage purchased by someone else (Question 4) and in-woods transportation method from the stump to the landing (Question 18) on various factors, various statistical tests were performed. The factors analyzed and statistical procedure performed are summarized in Table 77. The results of those analyses are presented below.

Table 77. Summary of factors assessed in the purchaser type, annual production level and in-woods transportation method analyses, the question number from the 2016 survey, and whether the same analysis was conducted for the 2011 survey and reported in Blinn et al. (2014).

Factor	Survey question number	Statistical analysis performed	Was similar analysis conducted for 2011 survey data (Y/N)
Volume produced (cords)	2	ANOVA ^a	Y ¹
Years in business	32	ANOVA	Y
Average tract size harvested (acres)	6	ANOVA	Y
Percent of total stumpage from family forest lands	10	ANOVA	Y
Percent of total stumpage from county forest lands	10	ANOVA	Y
Percent of total stumpage from state forest lands	10	ANOVA	Y
Percent of volume produced during the summer	8	ANOVA	Y
In-woods fuel consumed/cord (gallons/cord)	22	ANOVA	Y
Percent reporting profitability was slightly/much better in 2016 vs. 2013	27	Chi-square ^b	Y ²
Percent reporting their profitability was average (broke even), good, or excellent in 2016	26	Chi-square	N
Percent operating at full capacity	28	Chi-square	Y ³
Percent who expect to be in business in 5 years	33	Chi-square	Y
Percent who plan to increase or maintain volume in the future	35	Chi-square	Y ⁴
Percent who harvested wood from one or more salvage sales in 2015 or 2016	11	Chi-square	N

^aOne-way analysis of variance. Post-hoc tests were conducted using Tukey's multiple comparison procedures.

^bPearson's Chi-squared contingency table tests. Post-hoc tests were conducted using Tukey's multiple comparison procedures.

¹For the analysis of annual production level on the various factors, volume production data is presented for descriptive purposes only. No statistical analyses were performed.

²In the 2011 survey, the comparison was 2011 vs. 2008.

³In the 2011 survey, the question asked about percent of total capability.

⁴In the 2011 survey, the question asked about plans in the next 5 years.

Influence of Annual Production Level (Question 2) on Various Factors

Based on the reported 2016 production (Question 5), five annual production categories were defined: 1) 100 to 1,000 cords, 2) 1,001 to 5,000 cords, 3) 5,001 to 10,000 cords, 4) 10,001 to 15,000 cords and 5) more than 15,000 cords. Those categories were selected because they are similar to the groupings used in previous surveys (Puettmann et al. 1998, Powers 2004, Rickenbach et al. 2005, Blinn et al 2014).

Most of the factors don't vary by level of production. State and county stumpage were important sources of stumpage for every size of business in 2016 (Table 78). Where significant differences existed ($p \leq 0.05$), respondents in one level were different from the other level in the following ways.

- The average tract size for businesses which reported harvesting more than 15,000 cords in 2016 was significantly higher than businesses which reported harvesting 1,001 – 5,000 cords,
- Businesses which reported harvesting 100 – 1,000 cords in 2016 purchased a significantly higher percent of their stumpage from family forest lands as compared to businesses which harvested 5,001 – 10,000 cords, 10,001 – 15,000 cords and more than 15,000 cords, and
- A significantly lower percent of businesses which produced 1,001 – 5,000 cords in 2016 harvested one or more salvage sales in 2015 or 2016 as compared to businesses which harvested 5,001 – 10,000 and more than 15,000 cords.

Table 78. Summary of influence of 2016 annual production level (Question 2) on various factors.

Factor	Overall mean (<i>n</i>)	2016 Production level (cords) ¹				
		100–1,000	1,001–5,000	5,001–10,000	10,000–15,000	> 15,000
Volume produced (cords) ²	11,267 (131)	475 (32)	2,709 (41)	8,139 (22)	13,318 (13)	43,369 (23)
Years in business	30.7 (134)	28.5	31.7	28.9	26.7	35.3
Average tract size harvested (acres)	37.6 (124)	33.8 ^{ab}	29.2 ^b	35.2 ^{ab}	36.9 ^{ab}	60.6 ^a
Percent of total stumpage from family forest lands	31.7% (108)	46.7% ^a	35.6% ^{ab}	22.1% ^b	14.2% ^b	19.3% ^b
Percent of total stumpage from county forest lands	26.7% (82)	22.8%	35.3%	28.0%	24.1%	19.5%
Percent of total stumpage from state forest lands	26.5% (85)	28.1%	26.8%	18.5%	27.0%	29.9%
Percent of volume produced during the summer	17.2% (99)	15.3%	15.2%	18.0%	17.3%	22.3%
In-woods fuel consumed/cord (gallons/cord)	1.5 (96)	1.5	1.5	1.5	1.8	1.6
Percent reporting profitability was slightly/much better in 2016 vs. 2013	18.9% (122)	11.8%	14.6%	27.3%	14.3%	20.0%
Percent reporting their profitability was average (broke even), good, or excellent in 2016	72.9% (129)	78.1%	61.0%	90.9%	61.5%	69.6%
Percent operating at full capacity	34.8% (132)	29.4%	29.3%	45.5%	21.4%	44.0%
Percent who expect to be in business in 5 years	70.8% (130)	64.7%	58.5%	86.4%	64.3%	72.0%
Percent who plan to increase or maintain volume in the future	76.0% (129)	75.0%	65.8%	81.8%	69.2%	73.9%
Percent who harvested wood from one or more salvage sales in 2015 or 2016	41.9% (129)	36.7 % ^{ab}	18.9% ^a	65.0% ^b	38.5% ^{ab}	69.6% ^b

¹Means within a given factor followed by the same letter are not significantly different ($P \leq 0.05$).

²Volume production data is presented for descriptive purposes only. No statistical analyses were performed.

In comparison, in the 2011 survey (Blinn et al. 2014), significant differences ($P \leq 0.05$) between production levels were reported for a) percent of total stumpage from family forest lands, b) percent of total stumpage from county forest lands, c) percent of volume produced during the summer, and d) percent operating at total capability. As in the 2011 survey, the smallest firms are the ones that rely on family forest landowner stumpage the most. That raises questions such as if there is a trend towards larger, consolidated logging businesses over time, will there be interest / ability to log small family forest tracts in the future? And/or, if family forest landowners can't be enticed to do more harvesting, what is the future of these small logging businesses?

While not statistically significant, general trends found that (Table 78):

- Respondents who reported producing 100 – 1,000 or 1,001 – 5,000 cords in 2016 reported producing the two lowest average percentages of their volume during the summer, below average percent of respondents who reported that their profitability was slightly or much better in 2016 than in 2013, below average percent of respondents who expect to be in business in 5 years, and below average percent of respondents who plan to increase or maintain their production volume in the future.
- Respondents who reported producing 5,001 – 10,000 or > 15,000 cords in 2016 reported producing the two highest average percentages of their volume during the summer, the two highest average percent of respondents who reported that their profitability was slightly or much better in 2016 than in 2013, the two highest average percent of respondents who reported that they operated at full capacity in 2016, and the two highest average percent of respondents who expect to be in business in 5 years.

“Small” (100 – 5,000 cords) producers were compared to “large” (more than 15,000 cords) producers for a number of factors (Table 79). As compared to small producers, large producers tended to harvest one additional season per year, their newest piece of mechanized equipment was younger by approximately 12 years, they harvested more than seven times as much of the reported volume, their percentage of family members who will most likely take over ownership of the business is more than double that of small businesses, their access to capital is better, their additional capacity tends to be in summer as compared to winter for small businesses and there was a higher percentage of businesses who reported breaking even and who thought that 2016 was better than 2013. Thus, large producers tended to have a more positive outlook about the health and longer-term future of their business.

Several factors were evaluated to assess statistical differences between small (i.e., up to 5,000 cords of production reported in 2016) and large (i.e., more than 15,000 cords of production reported in 2016) responding businesses (Table 79). The larger businesses operated in significantly more seasons per year, generally reported a significantly younger age for their newest piece of mechanized felling and in-woods transport equipment, and a significantly higher percentage of businesses with a family member who will take over the business ($P \leq 0.05$). Only two large respondents reported the age of their youngest cable skidder.

Table 79. Summary of how various factors influence “small” (100 – 5,000 cords) and “large” (more than 15,000 cords) producers.

Factor ¹	100 – 5,000 cords	> 15,000 cords
Number of seasons	2.7 ^a	3.7 ^b
Age of newest mechanized equipment-feller buncher (years)	18.8 ^a	5.7 ^b
Age of newest mechanized equipment-CTL harvester (years)	13.8 ^a	3.4 ^b
Age of newest mechanized equipment-grapple skidder (years)	23.6 ^a	5.7 ^b
Age of newest mechanized equipment-cable skidder (years)	36.5 ^a	45.5 ^b
Age of newest mechanized equipment-forwarder (years)	20.9 ^a	6.5 ^b
% of 2016 reported volume	9%	68%
In-woods transport	Cable and grapple skidders	Grapple skidders and/or forwarders
% with family members to take over business	26.7% ^a	60.9% ^b
% who had easy access to capital	78.6% ^a	95.7% ^a
% operating at full capacity	31.4% ^a	47.8% ^a
Timing of additional capacity	Winter	Summer
% who broke even or did better	73.5% ^a	69.5% ^a
% where 2016 was better than 2013	29.9% ^a	52.4% ^a
% who had easy access to capital	78.6% ^a	95.7% ^a

¹Means within a given factor followed by the same letter are not significantly different ($P \leq 0.05$).

Influence of Percentage of Stumpage Purchased by Someone Else (Question 4) on Various Factors

In Question 4, respondents indicated the percent of stumpage that was purchased by someone else (e.g., a mill, a broker) and by the logging business itself. The following two levels of stumpage that were purchased by someone else (e.g., a mill, a broker) were defined based on the survey responses: 1) at least 75 percent provided by someone else and 2) more than 50 percent provided by someone else. Separate analyses were performed for each level. Those levels were defined because they compare responses from businesses which are highly dependent on stumpage provided by someone else (at least 75 percent) and more than 50 percent dependent as compared to other respondents.

Few analyses showed significant differences ($p > 0.05$) (Table 80). While not significant, county and state stumpage are an important source of stumpage for every in-woods transport method regardless of the percent of stumpage provided by someone else. Where significant differences existed, respondents in one level were different from the other level in the following ways.

- Businesses which have at least 75 percent of their stumpage provided by someone else purchase a significantly smaller percent of their stumpage from family forest landowners as compared to businesses which purchase less than 25 percent of their own stumpage,
- Businesses which have more than 50 percent of their stumpage provided by someone else purchase a significantly smaller percent of their stumpage from family forest landowners as compared to businesses which purchase up to 50 percent of their stumpage, and
- Businesses which have more than 50 percent of their stumpage provided by someone else have a significantly lower expectation of being in business in 5 years as compared to businesses which purchase up to 50 percent of their stumpage.

Table 80. Summary of influence of 2016 percent of stumps provided by someone else (Question 4) on various factors.

Factor	Overall mean (n)	Percent of stumps provided by someone else ^{1,2}			
		≥75%	<75%	>50%	≤50%
Volume produced (cords) ²	11,345 (134)	9,783 (27)	11,754 (107)	11,951 (37)	11,103 (97)
Years in business	30.5 (130)	30.0	30.6	31.7	30.1
Average tract size harvested (acres)	37.6 (124)	56.2	32.4	51.6	31.6
Percent of total stumps from family forest lands	31.2% (107)	15.9% ^a	35.1% ^b	18.6% ^a	36.0% ^b
Percent of total stumps from county forest lands	26.9% (82)	21.0%	28.4%	22.4%	28.6%
Percent of total stumps from state forest lands	26.6% (84)	22.4%	27.7%	23.7%	27.8%
Percent of volume produced during the summer	17.3% (98)	20.1%	16.6%	20.5%	16.1%
In-woods fuel consumed/cord (gallons/cord)	1.5 (96)	1.7	1.5	1.7	1.5
Percent reporting profitability was slightly/much better in 2016 vs. 2013	22.3% (121)	11.1%	22.4%	10.8%	23.7%
Percent reporting their profitability was average (broke even), good, or excellent in 2016	74.2% (128)	63.0%	72.9%	64.9%	73.2%
Percent operating at full capacity	35.4% (130)	44.4%	31.8%	35.1%	34.0%
Percent who expect to be in business in 5 years	73.4% (128)	55.6%	73.8%	54.1% ^a	76.3% ^b
Percent who plan to increase or maintain volume in the future	76.4% (127)	63.0%	74.8%	67.6%	74.2%
Percent who harvested wood from one or more salvage sales in 2015 or 2016	41.1% (123)	44.0%	41.8%	39.2%	40.5%

¹Means within a given factor followed by the same letter are not significantly different ($P \leq 0.05$).

²Separate analyses were conducted for stumps levels at 75% and 50% thresholds. Letters denoting significant differences are only comparable within a single stumps level.

While the 2011 survey (Blinn et al. 2014) didn't show significant differences ($P \leq 0.05$) for the percent of stumps from family forest lands for the split at 75 percent, it did show significant differences for the percent of volume harvested during the summer for the split at 50 percent, differences for both splits for the percent of total capability the businesses operated at in 2011, and for the percent of percent of businesses who expect to be in business in 5 years for the split at 75 percent.

Some general (nonstatistical) trends associated with respondents who had the higher percentage of stumps provided in each comparison (i.e., at least 75 percent and more than 50 percent) are noted below.

- They harvest larger tracts.
- They are less dependent on family forest, state and county stumps.
- They produce a higher percentage of their wood during the summer.

- A smaller percentage reported being better in 2016 than 2013.
- A smaller percentage reported that their profitability was average (broke even), good or excellent in 2016.
- A higher percentage reported operating at their full capacity.
- A lower percentage reported that they expect to be in business in 5 years.
- A lower percentage plan to increase or maintain volume produced in the future.

Influence of In-woods Transportation Method (Question 18) on Various Factors

Decisions about how to organize a business's in-woods operations can impact a variety of factors. For example, a cut-to-length system with a forwarder carries short wood pieces from the stump to the landing while cable and grapple skidders generally drag their material either in tree-length (top and branches have been removed from the tree bole) or full-tree (includes the tree bole, top and branches) form. One way to assess their in-woods operations is to categorize businesses according to how they move harvested material from the stump to the landing. In Minnesota, the three primary ways in which harvested material is transported to the landing is through the use of cable skidders, grapple skidders, and forwarders (Table 30). For the purpose of this analysis, the following six equipment configurations were defined:

- Cable skid – Businesses used a cable skidder for 100% of their volume
- Grapple skid
 - a) $\leq 5,000$ cords – Businesses used a grapple skidder for 100% of their volume and produced up to 5,000 cords
 - b) 5,001 to 15,000 cords – Businesses used a grapple skidder for 100% of their volume and produced 5,001 to 15,000 cords
 - c) 15,000 cords – Businesses used a grapple skidder for 100% of their volume and produced more than 15,000 cords
- Forwarder – Businesses used a forwarder for 100% of their volume
- Mixed – Businesses used two in-woods transport methods and produced at least 5,000 cords.

An overview of the 13 mixed businesses included in this analysis is presented below.

- Production range: 6,000 to 216,000 cords (Average: 41,686, Median: 22,174)
- Number of businesses by combination of the three methods
 - 5 businesses grapple skid (primarily) and forward
 - 4 businesses forward (primarily) and grapple skid
 - 2 businesses have an equal split between grapple skidding and forwarding
 - 1 business grapple skids (primarily) and cable skids
 - 1 business forwards (primarily) and cable and grapple skids
- Percentage of volume within the two methods range from 98/2 to 50/50

The in-woods transportation categories were not significantly different from each other ($p > 0.05$) for most of the factors examined (Table 81). Other than significant differences in volume produced ($p > 0.05$), the only other significant difference is noted below (Table 81).

- As compared to respondents from the mixed category, the lowest grapple skidder production category (harvested $\leq 5,000$ cords) had a significantly lower percentage of respondents who had harvested wood from one or more salvage sales in 2015 or 2016.

Table 81. Summary of average values for various factors by in-woods transport method (Question 18).

Factor	Overall mean ¹ (n)	Cable skid	Grapple skid			CTL	Mixed ≥ 5,000 cords
			≤ 5,000 cords	5,001–15,000 cords	> 15,000 cords		
Volume produced (cords)	11,310 (129)	793 ^b (11)	1,912 ^b (37)	10,742 ^b (20)	38,934 ^a (12)	7,400 ^b (19)	41,686 ^a (13)
Years in business	30.7 (129)	29.9	27.9	33.1	37.6	23.4	32.9
Average tract size harvested (acres)	37.9 (121)	27.5	32.2	37.8	67.9	36.5	46.1
Percent of total stumpage from family forest lands	31.7% (105)	50.0%	33.2%	18.4%	20.2%	24.8%	23.0%
Percent of total stumpage from county forest lands	27.0% (80)	36.8%	36.4%	30.5%	17.4%	21.5%	26.3%
Percent of total stumpage from state forest lands	26.0% (82)	13.2%	27.8%	27.0%	30.1%	19.7%	23.6%
Percent of volume produced during the summer	17.2% (96)	20.9%	14.1%	14.3%	21.5%	23.0%	21.8%
In-woods fuel/cord (gallons/cord)	1.5 (96)	1.5	1.5	1.7	1.6	1.6	1.5
Percent reporting profitability was slightly/much better in 2016 vs. 2013	19.2% (120)	0.0%	10.8%	15.0%	8.3%	31.6%	30.8%
Percent reporting their profitability was average (broke even), good, or excellent in 2016	74.8% (127)	72.7%	62.6%	80.0%	75.0%	78.9%	69.2%
Percent operating at full capacity	36.4% (129)	27.2%	32.4%	25.0%	58.3%	57.9%	30.8%
Percent who expect to be in business in 5 years	73.8% (126)	72.7%	56.8%	75.0%	66.7%	78.9%	92.3%
Percent who plan to increase or maintain volume in the future	76.4% (127)	81.8%	64.9%	80.0%	66.7%	84.2%	76.9%
Percent who harvested wood from one or more salvage sales in 2015 or 2016	40.3% (123)	50.0% ^{ab}	17.6% ^a	38.9% ^{ab}	58.3% ^{ab}	55.5% ^{ab}	92.3% ^b

¹Means within a given factor followed by the same letter are not significantly different ($p \leq 0.05$).

In the 2011 survey, the following statistically significant differences were reported (Blinn et al., 2014).

- Grapple skidder businesses which produce more than 15,000 cords and mixed operations produce significantly more volume than all other in-woods transport methods ($p < 0.001$),
- Cable skidder businesses and grapple skidder businesses which produce $\leq 5,000$ cords obtain a significantly higher percentage of their stumpage from family forest lands than do grapple skidder businesses which produce 5,001 to 15,000 cords ($p < 0.001$),
- Grapple skidder businesses which produce $\leq 5,000$ cords produce a significantly smaller percent of their volume during the summer than the largest grapple skidder businesses, forwarder businesses, and mixed system businesses ($p < 0.001$),
- Grapple skidder businesses which produce $\leq 5,000$ cords operate at a significantly lower percent of their total operating capability than businesses which forward ($p = 0.006$), and
- Cable skidding businesses, grapple skidding businesses which produce more than 15,000 cords and forwarding businesses have a significantly higher expectation that they will be in business in five years than grapple skidder businesses which produce $\leq 5,000$ cords ($p = 0.005$).

Some general (non-statistical) statements about some of the in-woods equipment configurations from the 2016 survey are noted below (Table 81).

- Cable skidding businesses obtain half of their stumpage from family forest lands and about one-eighth of their stumpage from state forest lands, and none of the businesses reported that their profitability was slightly or much better in 2016 than in 2013.
- The smallest volume grapple skidder producers (5,000 cords) are nearly equally dependent on family forest, county and state lands for their stumpage, do not tend to operate on a year-round basis, less than two-thirds felt that their profitability was average (broke even) or good or excellent in 2016, have a relatively low expectation of being in business in 5 years or similarly to increase or maintain their volume produced in the future, and did not tend to harvest wood from salvage sales in 2015 or 2016
- The largest grapple skidding businesses (produce more than 15,000 cords) have been in business the longest, harvest the largest tracts, have the highest percent who reported operating at their total capability in 2016, and were the most likely group to report harvesting wood from one or more salvage sales in 2015 or 2016.
- CTL businesses are the youngest, have the highest percentage of volume produced during the summer, have the highest percentage who reported being better in 2016 than 2013, and have the highest percentage who plan to increase or maintain their production in the future.
- Mixed businesses have the highest percentage of businesses who expect to be in business in 5 years.

Summary

This analysis adds to the growing longitudinal assessment of Minnesota's logging business sector and provides important insights. As in the 2011 survey (Blinn et al. 2014), Minnesota's logging business sector continues to be characterized by a large percentage of firms which produce relatively small volumes annually and a small percentage of firms with high levels of production. The average Minnesota logging business in 2016 harvested 11,267 cords. The median harvest volume per respondent was 4,000 cords, which is identical to the volume in the 2011 and 2003 surveys of Minnesota logging businesses (Powers 2004; Blinn et al. 2014). Compared to results from the 2003 survey, it appears that the relative contribution and dominance of the large volume firms is increasing. Implications of this trend are myriad and include concerns about who will harvest smaller tracts in the future as larger businesses may not be able to cover their fixed costs where there is little volume removed, a hardship faced by one large logging business could have a big impact on procurement for a mill, procuring mills don't want to end up in a situation where they have few suppliers (an oligopoly) as they might lose control of the supply chain, and competition for stumpage could change as there might be little interest in some timber sales (e.g., low quality timber) and high interest in other sales (e.g., high quality timber, summer stumpage).

The largest reported harvest volume in 2016 was generated from state and county lands, contributing approximately 50% of harvest volume. These two land types were also the largest contributors in 2011, but in that year provided 61% of the harvest volume. Thus, there have been slight increases in some of the other land types, such as Forest Service land, in the intervening five years. Smaller-volume producers derive a higher percentage of their harvest volume from family forest lands than larger producers. Specifically, producers of less than 1,000 cords derived 47% of their volume from family forest lands versus 19% by producers of greater than 15,000 cords. Thus, if interest in commercial harvests by family forest landowners declines and/or is made more difficult by small tract size, the impact is going to have a greater impact on the smallest-volume producers.

Logging businesses in the state tend to be highly experienced and have been in business, on average, 30.5 years. The average business tenure has increased as compared to earlier surveys where the average tenure was 17.6, 25.3, and 29.1 years in the 1996, 2003, and 2011 surveys, respectively. This trend suggests that businesses have tended to stay in business over this time frame, although we aren't able to discern from the data whether a business has continued operations under new ownership, but under the same company name. This would be a topic to explore in future research. The trend of MN logging businesses continuing to age may reverse or decline if long-tenured businesses begin to close. This scenario could become a reality in the near future for businesses with aging owners who do not have business succession plans in place. Given that a much lower percentage of small-volume companies have identified someone who may take over their business in the future, this segment of the logging business sector may be more vulnerable. While the average age of Minnesota's logging business owner was 54 years old, approximately one-third of our respondents are 60 years or older, suggesting succession planning will be a factor of importance in the coming decade.

Also of note is the percentage of respondents who are less than 30 is quite small (6%). Thus, efforts are needed to help attract and maintain a younger cohort of loggers and logging business owners. Efforts that reinforce factors which current loggers value about their jobs and business (e.g., being independent, working outdoors, and having a sense of accomplishment in their work) would be important to emphasize in recruiting new individuals into the profession. At the same time,

respondents also indicated that the logging business is physically demanding, is not a respected profession, has low pay, and no benefits. Further, only around 20% of respondents would encourage family members or friends to enter the profession. Respondents see few factors associated with logging that would encourage the entry of new people into the profession. Thus, challenges exist for workforce development in Minnesota's logging business sector.

In terms of equipment, the average Minnesota logging business relies upon feller-bunchers and grapple-skidders. The majority of harvested timber in the state is felled via feller-bunchers (74%). Compared to the 2011 survey, however, there has been a slight decrease in the percent volume harvested via feller-bunchers (82% versus 74%) with an associated increase in volume via cut-to-length (16% versus 24%). Increased use of CTL might be related to difficulties in securing labor where fewer people are needed to operate a cut-to-length operation as compared to a conventional system that uses feller-bunchers and skidders. Future research should continue to track harvest volume by felling method to determine whether there is an emerging trend of increased reliance on cut-to-length harvesting. The smallest volume producers (100-1,000 cords) have the oldest equipment among producers. The average age of their newest piece of mechanized felling equipment is 15 years older than for businesses producing more than 15,000 cords (20.8 years old versus 5.7 years old). Respondents mentioned the impact of high equipment costs to their operations in open-ended comments. About 75 percent of equipment purchases will be to replace existing equipment, generally by purchasing used equipment.

Winter is the most common time for Minnesota logging businesses to harvest timber, with just over half (53%) of the reported volume harvested in this season during 2016. Since 1991, there has been a trend towards a greater percentage of harvest volume occurring in winter, with 43% of total volume in 1991 harvested in that season. The relative contribution of summer harvests has remained fairly constant at approximately 21% of the total harvest volume since 1991. The average Minnesota logging business harvested during three seasons in 2016. However, small-volume producers (up to 5,000 cords) operated in fewer seasons than companies producing at least 15,000 cords (2.7 vs. 3.7 seasons). Mild winters and frozen-ground logging restrictions create additional challenges and stresses for loggers, as mentioned in open-ended comments. Moreover, respondents lament limited supply and high prices for summer stumpage, which creates challenges in trying to operate year-round. Thus, if mild winter conditions become more common with shorter periods of frozen ground and/or the frozen ground only restrictions become more common in timber sale design, the impacts under current regulations are likely to be significant.

When examining data from a number of the survey questions broken out into annual harvest volume categories, the businesses producing 10,001 to 15,000 cords have some different characteristics than the volume categories directly above and below this business size cohort (e.g., 5,001-10,000 and more than 15,000 cords). For example, 25% of businesses in the 10,001-15,000 cord group rated their 2016 profitability as good to excellent versus at least 43 percent of respondents in the volume size classes directly above and below this cohort rating their profitability as good to excellent. In terms of succession planning, 27 percent of the 10,001-15,000 group say they have a family relative likely to take over the business in the future, versus 71 percent of the 5,001-10,000 group and 61 percent of the greater than 15,000 cords group.

For some factors, the 10,001-15,000 cord businesses are different than all of the other volume size classes. In one example, the 10,001-15,000 business size class derived the smallest percentage of its timber volume from family forest lands as compared to all of the other timber volume size classes. In another example, the 10,001-15,000 cord cohort had the smallest percentage of respondents operating

at full capacity (18 percent) among all volume size class groups. One possible explanation that may explain why the 10,001-15,000 cord businesses seem to be performing differently is that they could be in a transitional phase. That is, they may have invested in additional equipment in an effort to expand operations and thus aren't producing enough to be profitable due to additional costs. As opposed to smaller companies which have older equipment, but have fulfilled their outside financial obligations for that equipment. Table 23 provides some support for this hypothesis in that the average of the newest piece of mechanized felling machinery for the 5,001-10,000 cord group is 11.5 years, while it is 6.2 years for the 10,001-15,000 cord group and 5.7 years for the more than 15,000 cord group. The 5,001-10,000 cord producers also have the highest percentage of their stumpage provided by someone else (Table 6). Thus, they have less flexibility to cut their own stumpage as it might jeopardize their ability to cut on wood provided by someone else.

There are some optimistic signs about Minnesota's logging business sector. For example, on average, respondents expect to be in business in five years and are more optimistic about their business now than when they were in 2011. Additionally, respondents produced more volume in 2016 than 2011, intend to maintain or increase their annual harvest volume in the future, and report that access to capital isn't difficult. Further, 40% reported their business profitability to be good or excellent in 2016, and 21% plan to purchase additional equipment to expand their business.

However, there are some indicators signifying challenges, particularly for the smaller-volume producers. Our survey results provide several indications that small-volume producers (e.g., those 1,000 cords or less) may be facing more challenges than larger-volume producers. For example, they harvest in fewer seasons, have a much higher reliance on wood from family forest lands, have the oldest equipment, are less likely to have operated at full capacity, are the farthest-away from their break-even volume, and are the least likely to have a family member likely to take over the business in the future. Open-ended comments cite additional challenges for small-volume producers, including a trend towards larger-volume sales being offered by the DNR for which small producers can't compete. Future research should continue to track the condition, evolution and fate of small-volume producers. The impact of a decline in the number of small-volume producers in the state is uncertain, but important to understand. For example, if the number of small-volume producers did significantly decline, will larger-volume companies simply absorb the sales that small-volume companies typically purchase? If so, would this result in reduced cost-efficiency of operations given that harvesting costs are typically larger on smaller tracts? Alternatively, would family forest landowners and/or small-tract owners experience greater difficulty in having their lands harvested? Could this cause businesses to travel longer distances to timber harvest sites? Challenges that all businesses may face, regardless of their timber volume size class, is an increasing difficulty in finding enough timber to buy and rising stumpage prices. Open-ended comments in the survey underscore this point, as well as challenges faced by mill closures and pricing practices.

Potential improvements for future surveys

A listing of potential ways to improve the mail survey are noted in Appendix 10.

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Appendices

Appendix 1. Minnesota logging business owners survey for the 2016 calendar year.

Appendix 2. Survey pre-mailing letter printed on Minnesota Logger Education Program (MLEP) letterhead and sent to all logging business owners.

Appendix 3. Correspondence printed on University of Minnesota letterhead for the initial mailing of the survey.

Appendix 4. Follow-up postcard sent to all logging business owners one week after the initial mailing of the survey.

Appendix 5. Correspondence printed on University of Minnesota letterhead for the second mailing of the survey to non-respondents.

Appendix 6. Final letter printed on Minnesota Logger Education Program letterhead sent to all logging business owners.

Appendix 7. Expenses for the MLEP pre-survey postcard and final letter.

Appendix 8. Mailing invoices from JS Print Group for the two survey mailings.

Appendix 9. Listing of open-ended comments (Question 45), arranged by theme. Where a respondent provided multiple thoughts in their comments, each portion of their insight is reported in the appropriate theme.

Appendix 10. Potential improvements for future surveys.

Appendix 1. Minnesota logging business owners survey for the 2016 calendar year.

Minnesota 2017 Logging Business Owner Survey



Minnesota 2017 Logging Business Owner Survey

1. In what county is your business based?

2. We would like to begin with some questions about timber you produce. In answering these questions please provide your best estimates. Remember, all your answers will remain strictly confidential.

In 2016, what was the total volume of timber you harvested? Please use the units that best fit your recollection. For example, "10,000 cords and 20,000 board feet."

	Volume	
a.		Cords
b.		Thousand board feet (MBF)
c.		Cunits
d.		Green tons (biomass)
e.		Green tons (clean chips)
f.		Other unit (please specify below):

3. In 2016, of the timber you harvested, what percent was hardwoods and softwoods? These should total 100%.

	Percent of volume
a. Aspen	
b. Other hardwoods	
c. Pine	
d. Spruce	
e. Other softwoods	
Total	100%

4. In 2016, of the timber you harvested, what percentage of your stumpage was purchased by others, such as a mill, and what percentage was purchased by you? These should total 100%.

	Percent
Stumpage purchased by others	
Stumpage purchased by you	
Total	100%

5. What is your target/goal in percent for controlling wood under your purchased contracts in each of the following time periods? If none, please write in "0." These should total 100%.

	Target percent of volume
a. Control in the current year	
b. Control one year out	
c. Control two years out	
d. Control three years out	
e. Control four years out	
Total	100%

6. In 2016, what was the approximate average tract size that your business harvested? If there were multiple cutting blocks within a timber sale, consider each block separately.

Acres

Please continue to Question 4 above. ↗

7. In 2016, how many of your timber sales were in each of the following acreage categories? If none, please write in "0"		
	Number of sales completed	Number of sales partially completed
a. 0-5 acres		
b. 6-10 acres		
c. 11-20 acres		
d. 21-40 acres		
e. 41-80 acres		
f. 81-160 acres		
g. 161 acres or more		

8. In 2016, what percentage of your total harvest volume did you harvest in each season? If none, please write in "0." These should total 100%.	
	Percent of volume
Winter (December – February)	
Spring (March – May)	
Summer (June – August)	
Fall (September – November)	
Total	100%

Please continue to Question 9 above. ➔

9. For those seasons noted in Question 8 when you did not harvest any timber, indicate what else you did during that period of time. Place a check (✓) in each appropriate box.				
	Winter (Dec – Feb)	Spring (Mar – May)	Summer (Jun - Aug)	Fall (Sep – Nov)
a. Recovered from injury or illness				
b. Farmed crops				
c. Livestock production				
d. Installed septic systems				
e. Construction				
f. Road building				
g. Nothing				
h. Harvested timber in every season				
i. Other (please specify):				

10. For this question, think about the landowner, not the permit holder. In 2016, what percentage of your harvest volume came from the following ownership categories? If none, please write in "0." These should total 100%.	
	Percent of volume
a. Private woodlands	
b. Industrial or corporate owned forests	
c. National forests	
d. State forests	
e. County forests	
f. Municipal forests	
g. Tribal forests	
h. Other (please specify)	
Total	100%

11. In 2016 or 2015, did you harvest wood from one or more salvage sales?

- Yes → Go to question 12
 No → Go to question 14

12. For each of the following issues, please indicate whether it is a concern for your logging business when operating on salvage sales. Place a check (✓) in the column for each issue that is a concern when operating on salvage sales.



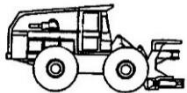


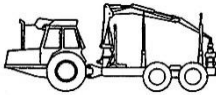

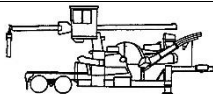

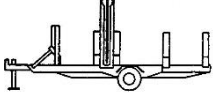




Issue	Yes
a. Higher level of safety concerns	
b. Higher level of impacts to equipment	
c. Higher level of impacts to site	
d. Reduced in-woods productivity	
e. Reduced wood quality	
f. Reduced value of delivered wood	
g. Higher stumpage prices for salvage timber	
h. Fewer markets for salvage timber	
i. Other (list below):	


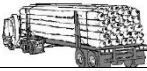


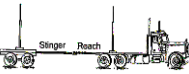

13. For each of the following scenarios, does harvesting salvage timber take a longer, shorter or the same amount of time as compared to what it would take you to harvest the same tract under non-salvage conditions? For each scenario, place a check (✓) in the appropriate box to indicate the impact on your business. Check only one response for each scenario.

Scenario	Longer compared to non-salvage sale	Same amount of time compared to non-salvage sale	Shorter compared to non-salvage sale
a. Sale affected by a severe windstorm (snapped trees and downed trees)			
b. Sale affected by an insect or disease outbreak (standing dead trees)			
c. Sale affected by a recent fire (standing dead trees)			

Please continue to Question 13 above. ↗

14. As of December 2016, not including older pieces of machinery that were non-operational or used only for spare parts, how many of the following pieces of in-woods equipment did you own and actively use? If none, write “0” in the “Number of pieces” column. Also, please indicate the age in years of the newest piece of equipment for each category.

		Number of pieces	Age of newest piece
a. Chainsaws / hand delimiting			
b. Cut-to-length (CTL) harvesters			
c. Feller-bunchers			
d. Cable skidders			
e. Grapple skidders			
f. Forwarders			
g. Mechanical delimiters			
h. Chippers			
i. Grinders			
j. Slashers			
k. Hahn harvesters			
l. Flail debarkers			
m. Loaders			
n. Bulldozers			
o. Other (please specify):			

15. In 2016, not including older pieces of machinery that were non-operational or used only for spare parts, how many of the following pieces of over the road equipment did your logging business own and actively use? If none, please write "0." These should total 100%.			
		No. of pieces	Age of newest piece
a.	Tractor (semi)		
b.	Pulp/sawtimber trailer		
c.	Self-loading truck/trailer		
d.	Lowboy		
e.	Pole trailer		
f.	Van/walking floor trailer		
g.	Other (please specify below)		

16. Which of the following pieces of equipment will you replace within your existing equipment configuration or purchase to help you expand your operations in the next three years? Use a check (✓) to indicate if the replacement equipment will be new or used.					
		Replace existing equipment		Purchase to expand business	
		New	Used	New	Used
a.	Cut-to-length (CTL) harvesters				
b.	Feller-bunchers				
c.	Cable skidders				
d.	Grapple skidders				
e.	Forwarders				
f.	Delimbers				
g.	Chippers				
h.	Grinders				
i.	Slashers				
j.	Hahn harvesters				
k.	Flail debarkers				
l.	Loaders				
m.	Bulldozer				
n.	Tractor (semi)				
o.	Pulp/sawtimber trailer				
p.	Self-loading truck/trailer				
q.	Lowboy				
r.	Pole trailer				
s.	Van/walking floor trailer				
t.	Other (please specify below)				
u.	○ Do not plan to replace or purchase any equipment				

17. In 2016, what percentage of your harvest volume was felled by each of the following felling methods? If none, please write "0." These should total 100%.

	Percent of volume
a. Chainsaw	
b. Cut-to-length (CTL) harvester	
c. Drive-to-tree feller-buncher	
d. Reach-to-tree feller-buncher	
e. Other (please specify)	
Total	100%
<input type="radio"/> Did not fell timber	

18. In 2016, what percentage of your harvest volume was transported to the landing by each of the following methods? If none, please write "0." These should total 100%.

	Percent of volume
a. Cable skidder	
b. Grapple skidder	
c. Forwarder	
d. Other (please specify)	
Total	100%
e. <input type="radio"/> Did not transport timber	

19. In 2016, what was your average one-way travel distance, in miles, from your primary business location to the timber harvest site?

30 miles or less
 31 to 60 miles
 61 to 90 miles
 91 to 120 miles
 121 to 150 miles
 More than 150 miles

20. In 2016, what was your average one-way travel distance, in miles, from the timber harvest site to the mill?

30 miles or less
 31 to 60 miles
 61 to 90 miles
 91 to 120 miles
 121 to 150 miles
 More than 150 miles

21. In 2016, what percentage of your harvest volume was transported to mills by trucks you own, and what percentage by trucks you contracted? If none, please write "0." These should total 100%.

	Percent of volume
Owned	
Contracted	
Total	100%

22. In 2016, about how many gallons of fuel did your logging business use...

	No. of gallons
a. ...in off-road activities?	
b. ...in over-the-road activities?	

23. In 2016, in total, how much capital was invested in your logging business? Check only one response.

Less than \$100,000
 \$100,000 to \$249,999
 \$250,000 to \$499,999
 \$500,000 to \$749,999
 \$750,000 to \$999,999
 \$1,000,000 to \$1,249,999
 \$1,250,000 to \$1,499,999
 \$1,500,000 to \$1,749,999
 \$1,750,000 to \$1,999,999
 \$2,000,000 to \$2,249,999
 \$2,250,000 to \$2,499,999
 \$2,500,000 to \$2,749,999
 \$2,750,000 to \$2,999,999
 \$3,000,000 or more

Please continue to Question 20 above. ↗

24. What percentage of that capital reported in Question 23 was invested in each of the following categories? If none, please write "0." These should total 100%.

	Percent of capital
a. Harvesting equipment	
b. Off-road transport equipment	
c. Over-the-road hauling equipment	
d. Stumpage	
e. Other	
Total	100%

25. In general, how difficult is it for your business to access capital, such as loans and letters of credit?

Very easy
 Somewhat easy
 Neither easy nor hard
 Somewhat hard
 Very hard

26. How would you rate the profitability of your business in 2016?

Very poor
 Poor
 Average (broke even)
 Good
 Excellent

27. Compared to 2013, how would you rate your logging businesses' profitability in 2016?

Much worse in 2016 than in 2013
 Slightly worse in 2016 than in 2013
 Same in 2016 as in 2013
 Slightly better in 2016 than in 2013
 Much better in 2016 than in 2013
 Wasn't in business in 2013

28. Operating at full capacity means that no additional volume can be produced. In 2016, did your logging business operate at full capacity?

Yes → Go to question 31
 No

29. In 2016, if you had operated at full capacity, how much more could you have harvested? Please use the units that best fit your operation.

Volume	
a.	Cords
b.	Thousand board feet (MBF)
c.	Cunits
d.	Green tons (biomass)
e.	Green tons (clean chips)
f.	Other unit (please specify measurement unit below)

30. Of the additional volume that you could have produced in 2016 to operate at full capacity, what percent could your business have produced in summer versus winter? Please use the units that best fit your operation.

	Summer (percent)	Winter (percent)	
a.			Cords
b.			Thousand board feet (MBF)
c.			Cunits
d.			Green tons (biomass)
e.			Green tons (clean chips)
f.			Other unit (please specify measurement unit below)

Please continue to Question 28 above. ↗

31. Including paying yourself, what volume of wood do you need to harvest annually to break even financially? Please use the units that best fit your operation.

Volume

a.		Cords
b.		Thousand board feet (MBF)
c.		Cunits
d.		Green tons (biomass)
e.		Green tons (clean chips)
f.		Other unit (please specify measurement unit below)

32. How many years has this company been in operation?

Years

33. Do you expect to be in the logging business 5 years from now?

- Yes → Go to question 35
 No

34. Why do you expect you will not be in the logging business 5 years from now?

35. Looking into the future, what are the general plans for your business? Check only one response.

- Increase annual volume harvested
- Maintain annual volume harvested
- Decrease annual volume harvested
- Retire or sell business

36. Looking into the future, who will most likely take over ownership of your business? Check only one response.

- Family member (son, daughter, niece, nephew, spouse, sibling)
- Current employee or sub-contractor
- Other
- Don't know
- Nobody

Please continue to Question 37 on the next page ↗

Please continue to Question 35 above. ↗

37. In making your decision to enter the logging business, how important were the following?

	Not at all	A little	Somewhat	Very	Extremely
a. I am from a logging family	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. I enjoy working outdoors	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c. I enjoy the sense of independence	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d. It gives me a sense of accomplishment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e. I like that it is challenging work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
f. It pays well	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
g. It is a respected profession in my community	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
h. It is in line with my career goals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
i. It gives me the flexibility to stay in the area	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
j. Other, please specify: <input type="text"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

38. Would you encourage members of your family or your close friends to become a logger?

- Yes
- No
- Not sure

39. Listed below are aspects of the logging business that may affect a decision to become a logger. In general, how much do you think each of the following encourages or discourages the entry by new people into the logging business?

	Greatly discourages	Somewhat discourages	Neither encourages or discourages	Somewhat encourages	Greatly encourages
a. Physical demands of the job	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. Work environment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c. Pay or wages	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d. Benefits package	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e. Prestige associated with work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
f. Availability of competing jobs in the area	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
g. Skills necessary to perform logging operations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
h. Health of logging industry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
i. Other, please specify: <input type="text"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please continue to Question 40 on the next page ➔

40. Before you started in the logging business, which of your family members had ever previously done logging? Check all that apply.

- Grandparent
- Parent
- Uncle or Aunt
- Sibling
- Cousin
- Other relative

41. A family business is one in which the family plays a central role in the leadership and daily workings of the business and includes at least two family members, such as a father and son, or a husband and wife. Based on this definition, is your company a family business?

- Yes
- No

42. How many owners does your business have in total?

Number of owners

43. For each owner of this business, what is the owner's age in years? Also, not necessarily only as the owner, how many years in total has each owner worked in the logging industry?

	Age of owner in years	Total number of years in logging industry
a. Owner A (You)		
b. Owner B (if applicable)		
c. Owner C (if applicable)		
d. Owner D (if applicable)		
e. Owner E (if applicable)		

(Write in additional owners below if necessary)

Please continue to Question 44 on the next page ➔

44. For each of the following technologies, please indicate whether you have it available in your home or office for business use. For each technology available, please indicate how often you or someone else within your business uses it for business purposes by placing a check (✓) in the appropriate box.

<u>Technology</u>	<u>Available in home or office</u>		<u>Frequency with which you access or use technology</u>					
	Yes	No	Never	Once a year or less	Once per month	Once per week	Once a day	Multiple daily uses
a. Dial-up internet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. High speed or broad band internet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c. Smartphone	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d. Desktop computer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e. Laptop computer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
f. Tablet computer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
g. Global positioning system (GPS)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
h. Geographic information system (GIS)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

45. If you have additional comments on the logging industry, please tell us.

Thank you for your help with this study!

Please return your completed questionnaire in the postage-paid envelope provided to:

**Charlie Blinn
 Department of Forest Resources
 University of Minnesota
 1530 Cleveland Avenue North
 St. Paul, MN 55108-1027**

Appendix 2. Survey pre-mailing letter printed on Minnesota Logger Education Program (MLEP) letterhead and sent to all logging business owners.

March 28, 2017

Dear MLEP Member:

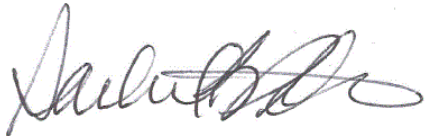
In a couple of weeks, you will receive a survey that is being conducted in an effort to better understand the current status of the logging industry in Minnesota. Your input is vital and will be used to help ensure a strong future for the logging industry in Minnesota. I strongly encourage you to complete and return the survey.

Please be assured that all survey information will be kept confidential, and no information will be released that can be linked to you. The survey is being conducted by the University of Minnesota in conjunction with MLEP and the Minnesota Timber Producers Association. A “double-blind” process will be used to ensure respondents are only known by survey code.

Your participation in this survey is highly encouraged. When complete, a report summarizing the results of the study will be available at www.mlep.org.

If you have any questions about this study, please don't hesitate to contact me.

Sincerely,

A handwritten signature in black ink, appearing to read 'Rachel Peterson', written in a cursive style.

Rachel Peterson
Executive Director

Appendix 3. Correspondence printed on University of Minnesota letterhead for the initial mailing of the survey.

May 12, 2017

Dear Logging Business Owner:

A healthy logging industry is critical to Minnesota's forestry sector. Without a healthy logging industry, it is impossible to sustain our forests. Many of our Minnesota communities and businesses are also dependent on the health of the forest products industry. For that reason, we would like your help to understand the current status of your logging business so that we can compile an assessment of Minnesota's logging industry.

As a logging business owner who is a member of the Minnesota Logger Education Program (MLEP), you have been chosen to participate in a research study being conducted by the University of Minnesota in conjunction with MLEP and the Minnesota Timber Producers Association. In the enclosed survey, we ask you a variety of questions about the background of your business, the operations you perform, your equipment, and your thoughts about the future of your business and the industry as a whole. The survey should take about 20 minutes to complete.

Please be assured that all survey information will be kept confidential, and no information will be released that can be linked to you. The code number on your survey will only be used to make sure that you don't receive reminders once you have returned your completed questionnaire to us. Your participation in this survey is voluntary and you do not have to answer all the questions. However, your input is important. When complete, a report summarizing the results of the study will be available on the internet at MLEP.org.

If you have any questions about this study, please do not hesitate to contact me at (612) 624-3788 or cblinn@umn.edu

Thank you very much for helping with this important study!

Sincerely,



Charlie Blinn
Professor and Extension Specialist

Enc.

Appendix 4. Follow-up postcard sent to all logging business owners one week after the initial mailing of the survey.

May 24, 2017

Dear Logging Business Owner:

Last week, I mailed you a survey asking for information about your logging business. If you have already completed and returned it – thank you! Your response is appreciated and will provide a better understanding of the logging industry in Minnesota.

If you have not yet completed the survey, I encourage you to do so as soon as you are able. Your response is crucial to helping build an accurate understanding of Minnesota’s logging industry. If you have any questions, please do not hesitate to contact me at (612) 624-3788 or cblinn@umn.edu.

Thank you for your help!

A handwritten signature in black ink that reads "Charlie Blinn". The signature is written in a cursive, slightly slanted style.

Charlie Blinn

Appendix 5. Correspondence printed on University of Minnesota letterhead for the second mailing of the survey to nonrespondents.

June 9, 2017

Dear Logging Business Owner:

About three weeks ago, a survey was sent to you asking for information about your logging business. As of today, we have not received your questionnaire. If you have already completed the survey, please let us know so that we can double-check our records.


The University of Minnesota is conducting this survey in conjunction with the Minnesota Logger Education Program and the Minnesota Timber Producers Association to understand the current status of Minnesota's logging industry. In order for the results to truly reflect the status of the industry, it is very important that we receive your completed questionnaire. The survey should take about 20 minutes to complete.

All responses will be kept confidential. The code number on your survey is used only to make sure that you don't receive reminders once you have returned your completed questionnaire to us. Your participation in this survey is voluntary and you do not have to answer all the questions. However, your input is important. When complete, a report summarizing the results of the study will be available on the internet at MLEP.org.

If you have any questions about this study, please do not hesitate to contact me at (612) 624-3788 or cblinn@umn.edu.

Your participation is greatly appreciated!

Sincerely,

A handwritten signature in cursive script that reads "Charlie Blinn".

Charlie Blinn
Professor and Extension Specialist

Enc.

Appendix 6. Final letter printed on Minnesota Logger Education Program letterhead sent to all logging business owners.

June 26, 2017

First Name Last Name
Address 1
Address 2
City, MN ZipCode

Dear Logging Business Owner's Name:

I am writing to you about the survey on Minnesota's logging industry which you should have received several weeks ago. If you have already returned your questionnaire – **thank you!** If you have not yet completed the survey, please do so today. Your response is crucial to helping build an accurate understanding of Minnesota's logging industry.

If you need a replacement questionnaire, please contact me at (218) 879-5633 or rachel.peterson@mlep.org.

Although we have received a large number of completed questionnaires, our understanding of the logging industry in Minnesota improves with each response. Therefore, your completed questionnaire is very important to the success of this survey.

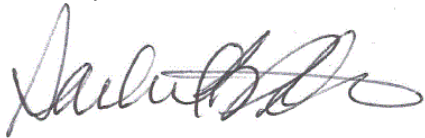
The survey is being conducted by the University of Minnesota in conjunction with the Minnesota Logger Education Program and the Minnesota Timber Producers Association to understand the current status of Minnesota's logging industry. The survey should take about 20 minutes to complete.

All responses will be kept confidential. Your participation in this survey is voluntary and you do not have to answer all the questions. However, your input is important. When complete, a report summarizing the results of the study will be available on the internet at MLEP.org.

If you have any questions about this study, please contact me.

Your participation is greatly appreciated!

Sincerely,



Rachel Peterson
Executive Director

Appendix 7. Expenses for the MLEP pre-survey postcard and final letter.

**Minnesota Logger Education Program
Transaction Detail By Account
January through December 2017**

Name	Memo	Class	Clr	Split	Amount	Balance
US Bank- Credit Card	Logger survey postcard paper	MLEP		US Bank Chec...	40.69	40.6
US Bank- Credit Card	Logger survey postcard postage	MLEP		US Bank Chec...	130.56	171.2
US Bank- Credit Card	Logger Survey Reminder Mailing	MLEP		US Bank Chec...	187.67	358.9
					358.92	358.9
					358.92	358.9

Appendix 8. Mailing invoices from JS Print Group for the two survey mailings.



JS Print Group
 4918 Pitt Street #201
 Duluth, MN 55804
 Phone: 218.464.5576
 e-mail: billing@jsprintgroup.com

Invoice

ESTIM 2 9 2007

Bill To: Minnesota Logger Educational Program 1111 Cloquet Ave., Suite 7 Cloquet, MN 55720

Date	Invoice No.	P.O. Number	Terms
06/05/17	4008		Net 30

Item	Description	Quantity	Rate	Amount
Layout & Design	Layout & Design per client direction	4	75.00	300.00
Printing	Logging Business Owner Survey - 12 page plus cover, ink 1/1 cover 4 process all guts BW, 60# offset text, print variable data and address on cover and guts, trim, fold, saddlestitch, stitch in return envelope to codes keep in order	383	1.16188	445.00
Printing	6 x 9 Envelopes - ink 1/0 24# open side	390	0.11538	45.00
inkjet label	Apply 1st class stamp to return envelopes	390	0.09615	37.50
address				
Postage	1st class 2 oz stamps (to be applied to the return envelope)	390	0.71974	280.70
Postage	Postage paid by JS Print Group		161.42	161.42
			<i>Alien 6-20-17</i>	
				<i>MEL 300</i>
			Total	\$1,269.62



JS Print Group
 4918 Pitt Street #201
 Duluth, MN 55804
 Phone: 218.464.5578
 e-mail: billing@jsprintgroup.com

Invoice

62001 2 9 2017

Bill To:
 Minnesota Logger Educational Program
 1111 Cloquet Ave., Suite 7
 Cloquet, MN 55720

Date	Invoice No.	P.O. Number	Terms
06/27/17	4158		Net 30

Item	Description	Quantity	Rate	Amount
Layout & Design	Layout & Design per client direction sort code and setup mailing and direct impression	4	75.00	300.00
Printing	Logging Business Owner Survey (second run) - 12 page plus cover, ink 1/1 cover 4 process all guts BW , 60# offset text, print variable data and address on cover and guts, trim, fold, saddlestitch, stitch in return envelopes to codes keep in order	338	1.16188	392.72
Printing	6 x 9 Envelopes - ink 1/0 24# open side	390	0.11538	45.00
inkjet label address	Apply 1st class stamp to return envelopes	338	0.09615	32.50
Postage	1st class 2 oz stamps (to be applied to the return envelope)	338	0.71974	243.27
Postage	Postage paid by JS Print Group		142.45	142.45
			Total	\$1,155.94

*pk
 WSN
 6-30-17*

*MEL 1000
 300*

Appendix 9. Listing of open-ended comments (Question 45), arranged by theme. Where a respondent provided multiple thoughts in their comments, each portion of their insight is reported in the appropriate theme.

Entry into the business

- Part of the problem with owners selling or retiring is that the mills are not always willing to take on the person or company you sell your equipment to.
- I feel the logging industry is going to have a tough time in the future with the age of the business owners now to the cost of younger business owners in the future because of the costs involved with starting a new company today. I feel the cost of the starting a new company today, to be somewhat competitive would take over a million dollars plus which is going to be very challenging to younger business owners.

Labor availability and cost

- Employees need higher wages to live.
- To find qualified people and being able to afford to pay them what they are worth.
- To get good workers into logging the wages have to come up. I've enjoyed being in the logging business but not much to show for the years being in it. Can't survive on social security. Health issues and age make it hard to continue.
- Finding good employees is my biggest challenge. School often portray us as evil and a dead end job. Not many farm kids to hire. Most young people can't even run a lawn mower. Not trying to be hurtful, but true.
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Entry into the business

- Part of the problem with owners selling or retiring is that the mills are not always willing to take on the person or company you sell your equipment to.
- I feel the logging industry is going to have a tough time in the future with the age of the business owners now to the cost of younger business owners in the future because of the costs involved with starting a new company today. I feel the cost of the starting a new company today, to be somewhat competitive would take over a million dollars plus which is going to be very challenging to younger business owners.

Labor availability and cost

- Employees need higher wages to live.
- To find qualified people and being able to afford to pay them what they are worth.
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Appendix 10. Potential improvements for future surveys.

Mail the survey out earlier in the calendar year. While the first postcard was mailed to logging business owners in late March to announce that they would soon receive the survey, delays made it such that the survey wasn't actually received until the middle or end of May in a year when Spring breakup came early.

Question 5. Some respondents didn't know what we were asking for through this question. Reword it.

Question 9. Consider routing respondents around the question if they harvested timber in every season. Further clarify "Road building" to exclude roads built to their timber harvest sites.

Consider asking one or more questions about training/skills needs and who should be responsible for leading those efforts. Responses may identify needs and providers who could better address needs within the industry.

While the 2016 survey asked for the number of gallons of fuel consumed for over-the-road activities (Question 22), it is unknown whether a respondent expended any of that fuel hauling for one or more other logging businesses. Thus, consider adding a question to clarify if all of their over-the-road fuel consumption was for hauling wood that their business harvested (e.g., what percent of your over the road fuel consumption was for hauling wood harvested by your business?).

Perhaps add a question about challenges or concerns their business or logging industry in general is facing. Or, a question about training/information needs, their work with the good neighbor authority work program, efforts they have made to attract new logging employees, or the average age or range of ages of their in-woods employees.

Avoid surveying the entire MLEP membership too often as that could have a negative impact on response rates for this survey.