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Benefits of Individual Log Identification to Sawmills in New Zealand

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EXECUTIVE SUMMARY

The commercialisation of individual log tagging in New Zealand could provide sawmills with the opportunity to increase profitability by increasing mill yields as more is known about the logs supplied before they are delivered. Also, there may be an opportunity to reduce environmental footprint, by reducing waste as logs that do not meet specifications will not be delivered to mills.

Development of an individual log (Log ID) tagging and tag reading system (Murphy and Raymond, 2019) is being jointly funded by government and the forestry industry through a Primary Growth Partnership forestry automation programme. Assessing the potential benefits of a Log ID system for participants along the forest to customer supply chain is an important element of the development.

A survey of sawmills was conducted by a summer intern working for Forest Growers Research Ltd. (FGR) during 2021-2022. A total of 13 mills participated in the survey which was undertaken between 13th December 2021 and 28th January 2022, excluding the Christmas and New Year holiday period. The survey had three parts; background information, the current situation on the use of data, and the potential use of Individual LogID data.

Mills all over New Zealand participated in the survey, however the majority of participants were in the North Island. Mills from the following areas were surveyed; Upper North Island (2), Central North Island (5), Lower North Island (3) and South Island (3). The participating mills processed approximately 50% of the domestic sawlog volume supplied to New Zealand mills and could therefore be considered to be representative of the sector.

Results from the Log ID survey were mostly positive which indicated that the majority of mill managers surveyed believed that individual log tagging will provide benefits to their mill. However, two mills out of the 13 surveyed did have impartial or negative views towards individual log tagging.

Mills were particularly interested in receiving individual log data on log sweep, stand wood density, felling date and silvicultural history.

The survey highlighted the benefits mills believe individual log tagging would provide. These included such benefits as:

- it would be very beneficial for mill operations, giving the ability to validate logs received and compare to data from the log scanner in the mill
- access to accurate location and time of harvest would be important because logs can stain or rot with extended time since felling
- log data received beforehand or on arrival at the mill provided the opportunity to reject logs if they were not within specification or were damaged.

The survey also showed some mills believed that individual LogID would result in improvements to the mill operation. Positive comments included; “Batch cut and sort logs before milling”, “possibly leading to segregation of logs from different forests for different batches and cut-plans”, and the “ability to align quad mill and head rig better”.

The survey highlighted not only the benefits of individual log tagging, but it also shed light on what mills would not find beneficial or useful. There were some mill managers, for example, who were not convinced that tagging would result in improvements to the mill operation.

INTRODUCTION

Interest in individual log identification and tracking is at least three decades old and is international in scope; e.g., reviews and developments have been undertaken in North America (Simonson 1992), Asia and Pacific region (Dykstra *et al.* 2002), Europe (Uusijarvi 2010), and Australasia (Murphy 2018). Individual log tagging and tracking has the potential to improve production efficiencies in the log supply chain from stump to mill. Other benefits include helping to reduce illegal logging and log theft, and providing information for chain of custody requirements for forest certification programs. Individual log tagging, as opposed to load level information, could provide benefits to mill owners, wood product suppliers, and ultimately to forest owners. In the case of New Zealand saw mills, the benefit of individual log tracking and traceability in the supply chain is likely to be measured through improvements to the mill's economic outcome.

Tracking allows mills to know where a log or wood product is located at any time within the supply chain. Traceability provides information about where each individual log has been throughout the whole supply chain, including what forest, or stand, or harvest area the log has come from. This knowledge can lead to improvements in mill volume and grade yields (thereby increasing mill profitability), to reductions in waste, and to lowering of environmental impacts.

Log yields could increase due to the difference between suitable and non-suitable logs for a particular end use reaching the mill. This is possible because logs can be individually selected based on wood properties which guarantee the best suited timber is used for each end wood product. Waste is reduced by the reduction in overconsumption, as logs would be selected based on their characteristics: logs that do not meet specifications would not reach the mill.

Logs destined for export markets are manually tagged when the logs arrive at New Zealand ports. Currently logs destined for New Zealand domestic mills are not individually tagged. In 2018, the New Zealand forest industry approved funding for a project to examine the utility of individual log ID tagging using an in-forest, grapple-processor-based log tagger. This would remove the manual aspect of log tagging for improved safety and expand the application to include both domestic and export markets. Additional reasons for the development of this technology are to link individual log identification with source information, provide added log security, lead to automation of load displays, and improved log tracking through the supply chain (Murphy and Raymond 2019).

Currently, three log tagging technology options would be suitable for application to logs using a harvester or processor head. These include punch code tags, ink-jet printing of matrix codes and RFID (Radio Frequency) tags. Punch code tags have no consumables and are low cost but readability can be limited by dirt and dust. Ink-jet codes require ink which can be affected by rain. RFID tags are made out of plastic and metal which are unacceptable if they get into wood chips used for pulp. RFID reading accuracy can also be negatively affected by moisture in fresh logs as well as rain.

Benefits from individual log identification are likely to accrue to New Zealand forest owners and forest managers, as well as to New Zealand mills. However, the purpose of the survey was to gather New Zealand mill managers' thoughts on individual log tagging and what benefits they believe the technology will provide.

OBJECTIVES

The objectives of this study were to determine

- what use is currently made of data provided by the load delivery docket and other sources (e.g., forest managers) to New Zealand sawmill managers,
- how mills might use data attached to uniquely identified logs, and
- if the information provided by individual logs tags would be beneficial to mill managers.

Mill managers would also be asked whether individual log tags would make any differences to their current operations and whether receiving information on logs before delivery would be useful or not.

SURVEY PARAMETERS

The individual log tagging survey for sawmills was focused on mill or operations managers, to get feedback from the people who are involved in the everyday operations of the mill or plant.

The survey had three parts and included both tick-box and open-answer questions (Appendix 1):

1. Background Information

The first section of the survey collected information on the mills and their operations. This individual mill information is not published and was recorded solely for the purposes of this study.

Information from load delivery docket and other sources

- Ownership/location data
- Log grade attribute data
- Harvesting crew data
- Time data
- Other information received from forest managers and other sources
- Other history data
- Log processing data

2. Current Situation with Data Usage

The second section of the survey asked mill managers various questions surrounding what data they currently receive via the load delivery docket, and whether the data is useful or not.

3. Individual Log Tagging (LogID)

The third section of the survey contained the same tick-box questions on data usage that were asked in the second section, but the mill managers were asked to assume that the information would be provided at the individual log level instead of at the load level. Three open-answer questions were also asked on what would be the biggest benefits to the mill, what differences LogID would make to the mill, and would there be benefits from receiving the information prior to log delivery.

The majority of the surveys were conducted over the phone or video conferencing facilities such as Zoom or Microsoft Teams, while a few were sent out to mills by email and returned filled out. There was little opportunity to survey the mills in the area by visiting the mill due to the Covid19 situation and trying to organise dates before and after the Christmas holiday period was extremely difficult.

The survey was undertaken between mid-December 2021 and mid-January 2022, which is a very busy time for mills. This caused issues around finding time for the survey to be conducted. Dates and times for the survey were organised around the mill managers' availability or alternatively a copy of the survey to fill in was sent out if requested.

WOOD PROCESSORS SURVEYED

Mills from both the North and South Island were contacted. A total of 13 mills participated in the survey, 10 in the North Island and 3 in the South Island. Mills who undertook the survey ranged from Upper North Island (2), Central North Island (5), Lower North Island (3) and South Island (3).

A list of sawmills which participated in the survey is given below:

- Northpine, Waipu, Northland
- Taranakipine, New Plymouth, Taranaki
- Carter Holt Harvey Wood Products, Kawerau
- Tenon Clearwood Limited Partnership, Taupō
- McAlpines Rotorua Ltd, Rotorua
- Pan Pac Forest Products Ltd, Hawkes Bay
- Red Stag Timber, Rotorua
- Kiwi Lumber, Dannevirke
- Donelley Sawmillers Ltd, Reporoa
- Westco Lumber Ltd, Ruatapu, West Coast
- One Forty One Kaituna Sawmill, Kaituna, Marlborough
- Pan Pac Forest Products (Otago) Ltd, Milburn, Otago

Size of Mill

The 13 mills who participated in the survey are graphed below by volume classes to maintain confidentiality of the results from each mill. Volume classes are 25,000 – 49,999m³, 50,000 – 99,000m³, 100,000 – 249,999m³ and >250,000m³.



Figure 1: Distribution of mills participating in the survey by annual lumber output volume (m³) class.

The most common size of mill surveyed had an annual lumber output volume that was between 50,000 and 99,999 m³; 5 out of the 13 mills (38.5%) belonged to this class. Volume classes 25,000 – 49,000 m³ and >250,000 m³ were both equal with 3 mills each (23.1% each). Finally, the remaining 2 mills belong to volume class 100,000 – 249,999 m³ and making up 15.4% of the mills participating in the survey.

Percentage of survey participants out of the number of sawmills in New Zealand:

According to the Australia and New Zealand Forestry Products Industry Map 2020, there are 38 sawmills in New Zealand (FIEA 2020), with 26 sawmills in the North Island and 12 in the South Island. A total of 13 sawmills participated in the survey, therefore, just over a third of New Zealand sawmills participated in the LogID survey (approximately 34%).

Mill participants volume as percentage of total volume of domestic lumber output:

For this comparison, data was gathered from the most recent (2018) wood processing statistics provided by the Ministry for Primary Industries (<https://www.mpi.govt.nz/forestry/new-zealand-forests-forest-industry/forestry/wood-processing/>).

In 2018, the total volume of sawn timber produced in New Zealand (domestically) was 4,452,000 m³ exclusively from plantations and 4,462,000 m³ including indigenous.

Although only 13 mills were surveyed the volume production of these mills is approximately 2,200,000 m³. Therefore, these mills represent almost half of total mill volume production (m³) in NZ (49.4%).

RESULTS – RESPONSES TO THE SURVEY

Responses to the survey were analysed according to: Ownership/location data, log grade attribute data, harvesting crew data, time data, other history data and log processing data.

Ownership and Location Data

Mills were asked about ownership and location data they receive from the log docket and if these data are useful or not. Ownership and location data consist of forest manager, forest name/source, harvest area/compartments or other if the survey participant would like to add any different ownership and location data they use.

In the next section of the survey, they were asked if they would use any of the ownership and location data if it was provided by individually tagged logs, rather than by load level. Results of usage of ownership and location data between load level (current situation) and LogID are given in Table 1.

Table 1: Mills' use of forest manager, forest name/source and harvest area/compartments data- currently and individual LogID

Data	Current Situation	LogID
Forest Manager	No – 31%	No – 23%
	Yes – 69%	Yes – 77%
Forest Name/Source	No – 8%	No – 8%
	Yes – 92%	Yes – 92%
Harvest Area/Compartment	No – 46%	No – 23%
	Yes – 54%	Yes – 77%

Forest manager usage by mills increased by 8% from 69% currently to 77% for individual LogID, whereas forest name/source data use remained the same for both current situation and individual LogID. Harvest area/compartments data usage of the mills surveyed was 54% with their current situation but this increased to 77% with individual LogID.

Log Grade Attribute Data

Log grade attribute data includes log grade, (average) log length, log diameter range, log sweep, stand wood density, log position in stem and reject rates. Three of these attributes are displayed in Table 2 rather than by graph because they have less significant changes compared to other log attribute data recorded.

Table 2: Mills use of log grades, log lengths and log position in stem data- currently and individual LogID.

Data	Current Situation	LogID
Log Grades	No – 10%	No – 0%
	Yes – 90%	Yes – 100%
Log Lengths	No – 46%	No – 38%
	Yes – 54%	Yes – 62%
Log Position in Stem	No – 100%	No – 69%
	Yes – 0%	Yes – 31%

Log grade and log length are the only log grade attribute data received currently via the load delivery docket. Log grade is currently received and used by 90% of the mills surveyed and increased by 10% to 100% usage with individual log ID. Log length data use by the mills increased slightly from 54% in current situation to 62% with individual log ID. Log position in stem data usage increased by 31% from 0% in current situation to 31% with individual LogID.

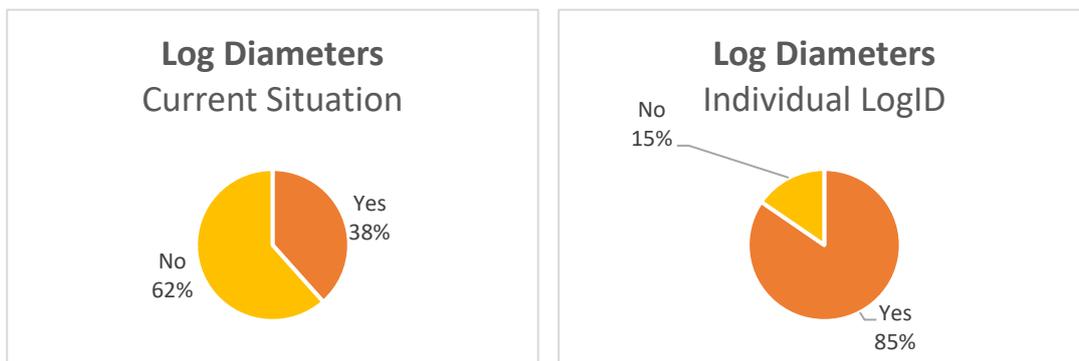


Figure 2: Percentage of mills receiving and using log diameter data currently (left) and potentially with individual LogID (right).

Log diameter data used by the mills surveyed increased from 62% for the current situation to 85% with individual LogID. Mills highlighted that it would be extremely beneficial for their operation to receive individual log diameters, it would also aid comparison between suppliers or forest areas. Some mills would find it beneficial to receive the both the small end diameter (SED) and large end diameter (LED) of each individual log.

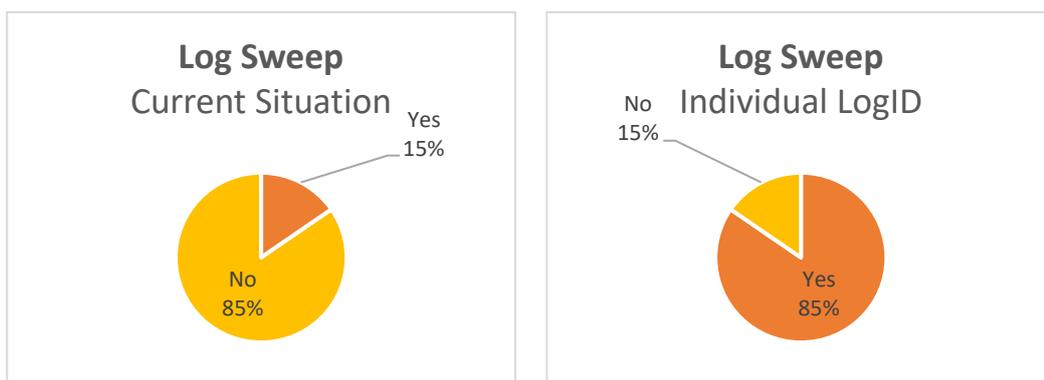


Figure 3: Percentage of mills receiving and using log sweep data currently (left) and potentially with individual LogID (right).

Log sweep is one of the most significant data changes from the current situation compared with an individual LogID system; the majority of mills surveyed want to know the sweep of individual log entering their mill. Currently 85% of the mills do not receive or use log sweep data, but 85% of the mills would use sweep data if it was provided at an individual log level with a LogID system.

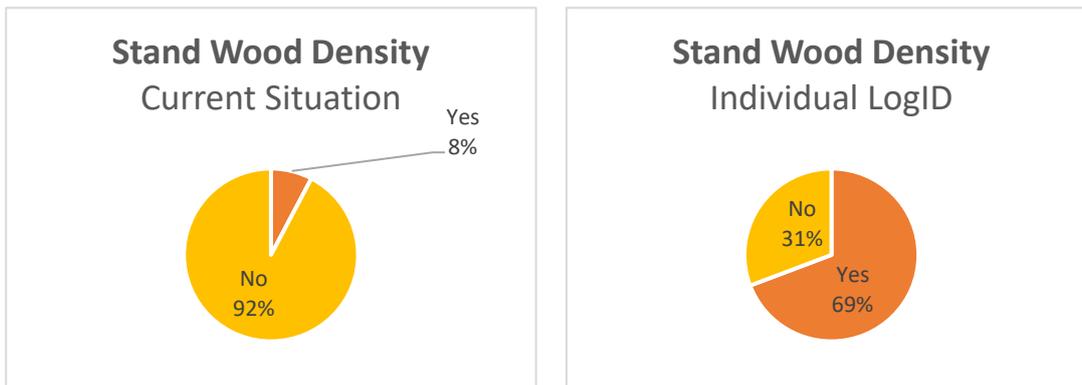


Figure 4: Percentage of mills receiving and using stand wood density data currently (left) and potentially with individual LogID (right).

Stand wood density is also one of the most significant data changes from the current situation compared with the individual log ID system. The majority of mills surveyed wanted to know the stand wood density of individual logs entering their mill. 92% of mills do not currently receive or use stand wood density data, but 69% would use this data if it was provided at an individual log level. Mills are interested in the density of the logs because the higher the density the greater the quality of the log for structural uses.

Harvesting Crew Data

Mills were questioned on harvesting data including logging contractor, loading contractor, harvest system type and other e.g., damage. These are displayed in Table 3 rather than by graph because they have less significant changes compared to the other log attributes recorded.

Table 3: Mills' use of logging contractor, loading contractor and harvest system type data- currently and individual LogID.

Data	Current Situation	LogID
Logging Contractor	No – 69%	No – 46%
	Yes – 31%	Yes – 54%
Loading Contractor	No – 77%	No – 69%
	Yes – 23%	Yes – 31%
Harvest Type System	No – 92%	No – 85%
	Yes – 8%	Yes – 15%

Time Data

Time data includes felling date and delivery date. These are displayed in Table 4 rather than in a graph because they have less significant changes compared to the other log attribute data recorded.

Table 4: Mills use of felling date and delivery date - currently and individual LogID.

Data	Current Situation	LogID
Felling Date	No – 23%	No – 0%
	Yes – 77%	Yes – 100%
Delivery Date	No – 8%	No – 8%
	Yes – 92%	Yes – 92%

Currently, 77% of mills surveyed use felling date but this would increase to 100% if felling date was received by individual LogID. Felling date is particularly important to mills in summer months as logs can be more prone to sap stain then. Delivery date data usage remained the same for both the current situation and individual LogID (92%).

Other History Data

Other history data looks at information mills may receive from forest managers or other sources including stand information (e.g., age), silvicultural history (e.g., pruning), site type and other.

Table 5: Mills' use of stand information and site type data - currently and individual LogID.

Data	Current Situation	LogID
Stand Information	No – 69%	No – 54%
	Yes – 31%	Yes – 46%
Site Type Data	No – 85%	No – 31%
	Yes – 15%	Yes – 69%

These are displayed in Table 5 rather than by graph because they have less significant changes compared to the other log attribute data recorded, such as silvicultural history.

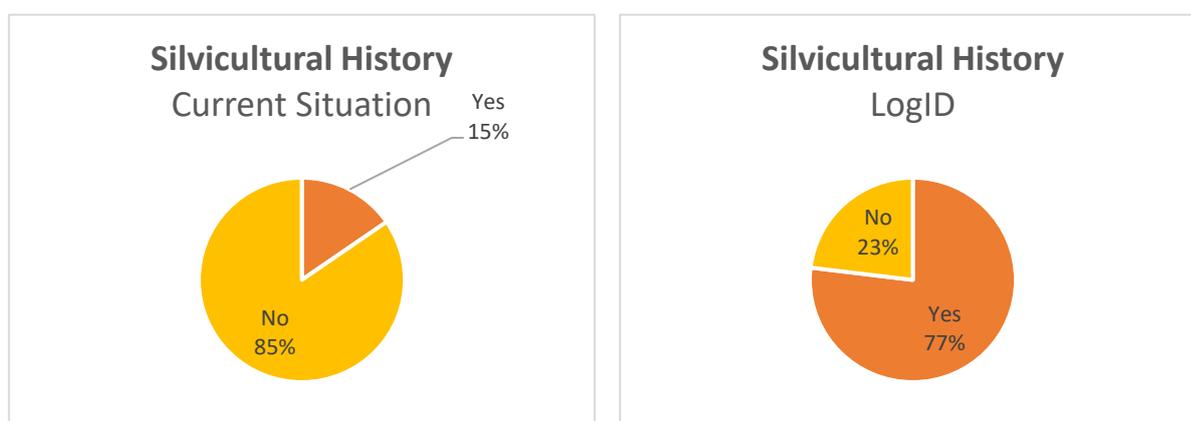


Figure 5: Percentage of mills receiving and using silvicultural history data currently (left) and potentially with individual LogID (right).

Silviculture is the practice of controlling the growth, composition, health, and quality of a forest plantation, for example pruning of Radiata pine stands is undertaken to produce clear wood (wood with no knots).

Silvicultural history is also one of the most significant data changes from the current situation to individual log tags. 85% do not currently receive or use silvicultural history. However over three-quarters of the mills surveyed (77%) wanted to know the silvicultural history of individual logs entering their mill and would use the information if it was provided by individual log tagging. Mills which exclusively process pruned logs were particularly interested in the pruning history of logs and believed this information will benefit their mill greatly.

Log Processing Data

Log processing data includes information on manual or mechanised processing, log processing head brand (if mechanised) and other data which mills may receive from forest managers or other sources. This data is displayed in Table 6 below rather than via graph because they have less significant changes compared to the other log attribute data recorded.

Table 6: Mills' use of manual or mechanised felling and log processing head brand - currently and individual LogID.

Data	Current Situation	LogID
Manual or Mechanised	No – 85%	No – 62%
	Yes – 15%	Yes – 38%
Log Processing Head Brand	No – 92%	No – 77%
	Yes – 8%	Yes – 23%

The majority of the mills who participated in the survey did not declare a need for log processing data. Currently 85% and 92% of mills do not receive or use log processing type data and log processing brand data, respectively. With individual LogID, the usage of log processing type data would increase by 23% and processor brand data would increase by 15%.

Benefits that individual LogID could provide the mill

One open-ended question was also asked on whether the mills would find LogID beneficial. Out of the 13 mills surveyed there was 10 completely positive responses about individual LogID. Most of the positive responses are listed below.

- “More information so it is easier to separate logs and log characteristics, ability to cut out differences in logs”
- “Able to identify density provided and separate high versus low density logs”
- “Access to accurate location and time of harvest is important, date and time are significant because logs can rot/stain”
- “By knowing what is being received from supplier, provides the ability to focus on what may need to be improved by supplier”
- “The potential to reject logs if they are not up to specification or damaged on arrival to mill or if data is received beforehand”
- “Identify exactly where logs have come from and who harvested them”
- “Access to crew and forest specific data provides the ability to trace”
- “More direct line to management company”
- “Felling date would be useful managing and understanding the risk of sap-stain over the warmer months”
- “Very beneficial for mill operations, ability to validate logs received and compare to data from scanner”
- “Receive extra information e.g., Crew ID, terrain and altitude - site type, which is currently not received”
- “Save manual data input time”
- “Help sawmill to gain a better understanding of the different relative values of logs coming from different log-suppliers and forests, by segregating logs in different batches”
- “Biggest benefit would be receiving critical information e.g., SED, sweep, pruning history and location data”
- “Ability to undergo out-turn assessments on particular stands”
- “Start matching up silvicultural data to out-turn data”
- “Reduce delivery of oversized logs to the site”

Responses listed below are impartial or do not find LogID beneficial. These are included to show the range of views mills have on individual LogID.

- “Debatable as it depends on whether the information would lead the mill to do anything differently”
- “Not practical for this mill of this scale and number of logs processed”
- “The number of crews will provide too much data, no way of keeping data separate when cutting a large number of logs a day”

Differences that individual LogID would make to mills

One open-ended question was also asked on what the mills would do differently if individual LogID were available. Approximately three-quarters of mills surveyed responded to this question and believed that LogID would make a difference. These responses are listed below (some that were repeated are listed only once):

- “Separate logs before milling by characteristics
- “Eliminate Hitman which measures acoustic velocity, replaced by scanner for tags”
- “Batch cut and sort logs before milling”

- “As pre-sorting is challenging, individual LogID may make sorting easier”
- “Possibly lead to segregation of logs from different forests for different batches and cut-plans”
- “Ability to align quad mill and head rig better”
- “Focus on capacity and pull in more logs, ability to pay on out-turn assessments”

Responses listed below are impartial or negative and do not find LogID will make any differences to their mill or mill operations.

- “Do not want logs to be tagged especially with consumables e.g., plastic could contaminate chip”
- “LogID will not make any differences for a mill of this size and processing speed”

Whether log information received before delivery is useful or not

One open-ended question was also asked on whether information on logs provided to the mill before delivery would be beneficial. Mills were divided on whether receiving information on logs before delivery is useful, two mills had no comment, and those who had positive responses are listed below:

- “Would be useful, allows operators to plan days”
- “Be able to know exactly when and what load is arriving at the mill”
- “Ability to reject low density logs before delivery”
- “Having information on logs prior allows operators to prepare mill”
- “Very useful to reject logs which are below spec or damaged beforehand”
- “Useful for predicting production amounts”
- “Could be useful especially for data modelling and planning”
- “Would be valuable to confirm if delivery is not from a forest block within a threatened environment for FSC certification”

Responses that were impartial or negative and do not find receiving information on logs prior to delivery is useful, are listed below:

- Not particularly, still have to receive the logs one way or another”
- “Probably not useful, as the supply chain does not allow much flexibility – have to commit to customers in order to cut certain volumes of certain logs”
- No, already purchased trees to be cut in advance so knowing information beforehand has no use”
- “Not for this mill, it would be if this mill had someone to collect and read/process the data before logs arrival”

DISCUSSION

In the opinion of the author, the results from this survey show that New Zealand sawmill managers believe that individual log tagging will provide benefits to their mill operations. Although only 13 out of 38 saw mills in NZ were surveyed, these mills total approximately half of the total volume (m³) produced by NZ sawmills in 2018. Therefore, although the sample size is on the small side, the percentage of total volume calculated allows for clear interpretation of survey results.

The survey asked mills what benefits individual LogID will provide, if individual LogID would cause the mills to do anything different and if receiving information on logs before arrival is useful or not. Some of the benefits the mills provided were often repeated, indicating some commonality of results. Some mills also said individual LogID would provide completely different benefits. There were comments about the potential to reject logs if they are not up to specification or damaged on arrival to the mill. Also, if data is received beforehand, many mill managers spoke about the ability to reject logs. Another benefit that was repeated by different managers was the importance of accurate felling date data, allowing segregation of logs by moisture content (by date of log manufacture) which could affect drying schedules and reduce log rot/sap stain in summer months.

In contrast however, there were two mills with impartial or negative thoughts on individual log tagging and information provided by tags. Their differences in views from other mills was due to the throughput volume of their mill. For example, the mill volume processed was too small and there was no staff to process LogID data, or the mill volume processed was too large and it would not be practical to receive large amounts of information on every log. Other respondents said receiving information on logs before delivery has no use due to log sales and purchase agreements.

There was some discussion from mills on future changes focused on the storing and analysis of data provided by individual log tagging. Since mills would be receiving an increased amount of data, it creates the potential for mills to develop data specific roles e.g., data analysts. Data analysts would turn the data into management information and reporting which would allow mills to make more informed decisions on log purchases.

The technology review by Murphy (2018) stated that individual log tagging has the potential to improve production efficiencies in the log supply chain ensuring that the correct timber is used for the best suited end product. This aligns with many of the mills' responses on benefits, the ability to reject unsuitable logs and ensure mills are receiving the best timber for their production.

CONCLUSIONS

Individual log tagging has the potential to improve production efficiencies in the log supply chain from stump to mill, by providing track and trace capabilities for each individual log. One of the goals of individual LogID is providing benefits to New Zealand mills. For example, increasing profitability of mills by ensuring the best suited log is supplied for a particular end use and reducing the delivery of logs that do not meet specifications.

In conclusion, 11 out of the 13 mills who took part in the individual log tagging survey had a positive response to this technology. These mills displayed their interest and need for individual LogID to benefit and improve mill operations. However, there was one mill who gave a mixed response and one with a negative response to individual LogID.

For many of the log attributes, providing information at an individual log level would result in greater usage of the attribute information. There would be some attributes, however, where there would be no change. The most significant data usage increases reported by the mills surveyed were log sweep, stand wood density, felling date and silvicultural history.

Mills would like to receive log sweep data so they know whether a log meets specification before arrival or entering the mill. Stand wood density is important to some mills because the higher the density means the greater the quality of the log. Felling date is particularly important in summer months because logs are prone to experience sap stain and rot, also this information allows mills to segregate logs based on moisture content. Finally, silvicultural history is particularly beneficial for mills to receive who process solely pruned logs.

The purpose of the survey was to determine what use is currently made of site-specific and crew-specific data by New Zealand mill managers. While, also determining how mills would benefit from the data attached to uniquely identified logs. The survey highlighted the benefits mills believe individual log tagging would provide but it also shed light on what mills would not find beneficial or useful.

Mills responded with many benefits they believe individual LogID would provide with some responding with the same benefits. These repeated benefits included; "Ability to reject logs which are not up to specification or are damaged", "Receiving accurate time data to minimise log rot and sap stain over summer months" and "Know exactly where a log has come from ensuring direct line with the forest management company".

Tagging of individual logs will allow for better communication between the mills and the forest e.g., forest owners and managers, this communication is essential to ensure a smooth process when introducing log tags. Mills are not the only party to benefit from individual log tagging as it will also provide intangible benefits for forest owners and managers, for example increased competition and interested buyers if logs supplied to mills are high quality and meet specification.

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- McAlpines Rotorua Ltd, Rotorua
- Pan Pac Forest Products Ltd, Hawkes Bay
- Red Stag Timber, Rotorua
- Kiwi Lumber, Dannevirke
- Donelley Sawmillers Ltd, Reporoa
- Westco Lumber Ltd, Ruatapu, West Coast
- One Forty One Kaituna Sawmill, Kaituna, Marlborough
- Pan Pac Forest Products (Otago) Ltd, Milburn, Otago

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APPENDIX 1: SURVEY

Background Information

1. Mill Name & Location _____
2. Contact Name and Phone Number _____
- 3.a. Annual Log Volume Throughput (m³) # _____
- 3.b. What species are you cutting?
 - Radiata pine
 - Douglas fir
 - Eucalyptus
 - Other: _____
4. What is your primary production product?
 - Appearance Grade Lumber
 - Structural Lumber
 - Fibre Mill
 - Pulp Mill
 - Other: _____

Many of the respondents could not provide data on log volume throughput. They could, however, provide lumber output volume data. Lumber output was used to determine how representative the respondents were of the sawmilling industry.

Current Situation

I would now like to now take a look at your mill's current situation and what information you receive that is of use?

For example, what use do currently make of the load delivery docket information?

- 5.a. Do you use tonnage on the load delivery docket?
 - Net weight of the load
- 5.b. What ownership/location data do you use?
 - Forest manager
 - Forest name/source
 - Harvest area/compartament
 - Other: _____

- 5.c. What log grade attribute data do you receive and use?
- Log grades
 - Log lengths
 - Log diameters
 - Log sweep
 - Wood density
 - Average stand acoustic velocity
 - Reject rates (Do you ask for crew details?)
 - Other: _____
-

- 5.d. What harvesting crew data do you use?
- Logging contractor
 - Loading contractor
 - Harvest system type (e.g., ground-based, cable yarding)
 - Other (e.g., damage)
-

- 5.e. What time data do you use?
- Delivery date
 - Felling date
 - Other: _____
-

Other Information – received from forest managers and other sources

6. What other history data do you use from other sources?
- Stand information (e.g., age)
 - Silvicultural history (e.g., pruning)
 - Site type; e.g., ex-pasture, prior-plantation, etc.
-
- Other: _____
-

7. What log processing data do you receive and use?
- Manual or mechanised processing
 - Log processing head brand (if mechanised)

Other: _____

8. Is there any information you would like to add about the current use of data?

What information would you use if logs could be individually tagged and identified?

For this project we are looking at changing from load data to individual logs, by marking individual logs using the harvester head and methods that limit consumables.

Let's turn to talking about what interest you would have in individual LogID e.g., using RFID, ink jet codes and punch codes, instead of information by Load Docket?

9. What log attribute data would you use? Data would be measured rather than estimated.

Log grades

Log lengths

Log diameters and why?

Log sweep and why?

Log density

Log position in stem (related to density)

Reject rates

Other; (e.g., Knot distribution or range)

10. If logs could be individually identified, what do you believe would be the biggest benefits to your mill? Would you benefit from knowing individual log attributes?

11. What would you do differently in you mill?
For example: Would you sort the logs before milling? Would you batch cut logs? Would you data management methods change?

12. If you knew more information about logs before they were delivered would it be useful to you? Would it be valuable to have more knowledge of individual logs? Would you do anything else with this information?

13. If there was individual ownership/location data would you use the data?

Forest manager	<input type="checkbox"/>
Forest name/source	<input type="checkbox"/>
Harvest area/compartments	<input type="checkbox"/>
Other: _____	<input type="checkbox"/>

14. What harvesting crew data would you use?

Logging Contractor	<input type="checkbox"/>
Loading Contactor	<input type="checkbox"/>
Harvest system type (e.g., ground-based, cable yarding)	<input type="checkbox"/>
Other (e.g., damage)	<input type="checkbox"/>

15. What time data would you use?
- Delivery date
 - Felling date
 - Processing date
 - Other: _____
 - _____

16. What log processing data would you use?
- Manual or mechanised processing
 - Log processing head brand (if mechanised)
 - Other: _____
 - _____

17. What other data would you use, if not currently received?
- Stand age
 - Pruning history
 - Site type; e.g., ex-pasture, prior-plantation, etc.
 - _____
 - Other: _____
 - _____

18. Do you have any concerns about individual log tagging?
- Costs: e.g., changes in data management
 - Readers on loader in the mill and at head ring
 - Internet connection for access to data
 - Do you have a scanner for diameters?
 - Changes in revenue
 - Changes in production time
 - Environmental Impact
 - Other:
 - _____

20. Do you have any further questions about individual log tagging and identification?
- _____
- _____
- _____