Utilization of Phone Application Technology to Record Log Truck Movements in the Southeastern U.S.

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Abstract:
Delays incurred by loggers hauling wood from the landing to the mill affect profitability and have the potential to make harvesting some areas unfeasible. Minimal research has been conducted to analyze driver's delays for round trip turn times. In order to accurately gather information concerning delay times at the mill, the landing, and during travel to and from each location, a phone app was created that recorded driver location using GPS. This app also allowed the driver to input the reason for their delays, record their fuel stops, delivery scale tickets, load sheet numbers, starting mileage and ending mileage. The ability to choose from multiple delay reasons created a user-friendly program which required a minimal amount of time for the driver, enabling him to focus on his job. By directly asking the driver the reason for the delay at the exact moment it occurred, we were able to gather accurate information in real time regarding delays and therefore better able to understand driver dilemmas. Initial research was conducted in various states to ensure its ability to work in various environments. Results indicated that turnaround times for all drivers from all states averaged approximately 36 minutes both in the mill and on the landing. Maximum turn times ranged from 1:16 to 2:29 at landings and 1:18 to 3:39 at mills. Although average turn times were determined to be reasonable, the maximum turn times cause issues of concern with driver time, haul costs, and overall costs which need to be addressed.

Keywords: delays, android phone, google technology, GPS, turn times

Introduction:

Delays incurred by loggers hauling wood from the landing to the mill affect profitability and have the potential to make harvesting some areas unfeasible. Studies have been conducted to determine single direction turn times for logging trucks from the landing to the mill, however, these studies failed to portray real life situations such as the traffic accidents, road conditions, lunch breaks, admin delays and when the driver is forced to wait in order to load his truck. These previously mentioned reasons can potentially cause delays and influence overall harvest cost negatively if they occur too often or for an extended duration of time (Deckard, Newbold, and Vidrine 2003, Holzleitner et al. 2011, Barrett 2001, Sankaran & Wood 2007).

Past studies collected delay response data by using fleet management equipment that connected to the drivers' tractor but, unless there was someone monitoring the computer screen observing all of these delays for the duration of the driver's work day, delay reasons were not recorded. Logging companies are looking for ways to reduce their haul costs in addition to their overall costs. If a company is forced to hire an additional person to observe truck locations and inquire about delays, they will not be reducing their costs significantly enough and could, in fact, increase their overall expenditures. By directly asking the driver the reason for the delay at the exact moment it occurred from a piece of equipment he has on him, accurate information in real time can be recorded.

Potential harvest sites are often times discarded after an economic analysis is conducted because of the haul costs associated with the sale. Mathews 1942 originally found that haul costs produce one of the biggest expenses to the logger a majority of the time due to increased fuel prices and frequent maintenance costs required to maintain the equipment that travels in a wide variety of road conditions. While this research may have been conducted decades ago, it is still found to be true and applicable today. Even the best drivers and businesses inevitably incur delays, and although trucks that are idling due to a delay use less fuel than those that are driving on the road, they are losing production time and therefore losing money (Fluck 2012). Delays are considered to be maintenance on the machine, breakdowns on either the tractor trailer or another piece of equipment which inadvertently pauses the entire logging system process, waiting in line at the mill to unload because of a mill regulated quota, lunch breaks, administrative delays, or even dealing with traffic during travel (Baumgras 1978). Although it is understood that delays will occur, the types of delay, the duration of the delay and where the delay is occurring represent information that if communicated quickly could be used to diminish delay times or at least analyze them more accurately when determining haul costs.

Overall Objectives for Study:

1) Create a phone app that collects drivers start and ending time, location, duration at each location, the number of stops made, and allows the driver to input a reason for being delayed.
2) Provide drivers the option of inputting starting and ending mileage, fuel stops made, gallons of fuel consumed, delivery and scale ticket numbers.
3) Analyze delay locations, driver durations at each location, and reasons for being delayed.
4) Provide results for both industry and loggers to view and utilize to reduce delays.
5) Provide turnaround times for various mills grouped by type, state, and/or region.
6) Provide cycle times for participating loggers.
7) Compare set-out trucking versus hot-loading.
8) Compare the tradeoff of in-woods utilization versus truck utilization.
9) Provide a productivity analysis during quota versus non-quota times.
10) Provide a haul cost analysis guideline for truckers.

Justification:

The study was conducted using a cell phone app because cell phones now play such an immense part of everyone’s lives regardless of age or gender. A recent survey indicated that 92% of adults in the United States own a cell phone and that 68% of these adults own a smartphone (Monica Anderson 2015). This number has increased 33% from 2011. Due to this fact, our belief was that more accurate results could be collected in real time from loggers using their cell phone as the medium rather than if you would try and inquire at the end of the week or even the end of every day on paper. Initially, there was a thought to have loggers record delays manually in a delay record book since truck drivers are required by law to keep log books recording their drive miles and hours, however, these books are not always kept up to date, therefore, it was assumed without significant incentive, ours may not be kept properly either. Bird et al. (2003) found that delays are not significant to the truck driver because they occur so frequently, therefore, the individuals incur a mentality of why should they remember exact details.

The study chose to record round trip delays from the landing to the mill rather than one-way delays for two reasons. First, one-way trips have already been covered in previous studies (Holzleitner et al. 2011, Barrett 2001, Sankaran & Wood 2007). These studies did a good job of portraying delays as they occurred one way, but in order to be able to truly fix the delay issue, it needs to be understood exactly where, when, and why the delays are occurring. This project intended to inquire about delays throughout the entire day and therefore every segment of the trip the driver covers to determine why the delay is occurring. The second reason for the round trip study was based on the fact that if the phone app was downloaded onto the drivers' phone, it was not able to differentiate between the drivers' routes to the mill or to the landing. Rather than create more confusion and potential errors by having the driver turn the app on and off for each trip, it was better to simply leave the app running and gather data the entire day.

Approach

Development of the phone application was initiated in the spring of 2015. The app was a Google-based application which only ran through Android-based phones; I-phones were not programmable for this project due to their high clearance security settings. The trucking app was programmed using Java. The phone application was shared to designated participants through a Gmail/Google Drive account that was created specifically for each driver for this project. All collected data was received and stored in the drivers google drive account and was then shared through Google drive to a designated website that was created specifically so that it could analyze the data. This website provided the viewer with information concerning the driving date, the time the driver began and ended their day, the number of stops made, the total stopped time, mileage, the state they traveled in, the latitude and longitude of the stops made, the exact time the stop was made, the duration of each stops, user-defined stops (delays), the reason for the delay, and time associated with the delay. The website also provided a KML download of the file so the viewer could view the day in google earth.

Initial data collection began in the spring of 2016 and has intentions of continuing through the fall of 2017. Logging companies from the states of Alabama, Ohio and South Carolina were used for the initial research. These states were chosen based on accessibility of companies and their willingness to participate in research studies. Further state inclusion will depend on initial analysis findings but has the potential to expand throughout the eastern half of the United States.

Data collection for each participant officially began once the phone application was downloaded onto the driver's phone. A GPS (global positioning system) recorded location for the duration the driver ran the app. The app possessed a menu button with four tab options for the driver to choose from. The About tab, Stop Location Service tab, Archive Data tab and Set Driver Number tab. These tabs provided the user with licensing information, allowed the driver to close the program at the end of the day, send data to Google drive, and ensure their identity was kept confidential. The main page for the app provided the driver with four additional tabs to choose from, an Add Fuel Stop tab, Add Delivery, Add Delay, and Add Load Stop. The Add Fuel Stop allowed the driver to indicate when they had a fuel stop. The Add Delivery and Add Load Stop gave the driver the option of including ticket numbers for each load. The Add Delay tab gave the driver the option of recording when they had been delayed by choosing from one of nine reasons for the delay in movement. The nine reasons provided were: in woods loading, in-woods delay, waiting at the mill, maintenance/repair, traffic, DOT stop, fueling, personal/meal time, and other.

Stops would accumulate on the main page throughout the day until the driver archived the data at the end of their working shift. Once the data had been collected from the server, they were viewed in google earth for verification purposes. The routes the drivers took were compared with their delay responses. Polygons/geofences were established around the mill and landing areas and all turn times which fell within the polygon zone were recorded from the time the driver entered the geofence until the time they departed. All data were recorded in Microsoft Excel where initial description statistics were calculated. T-tests and linear regression models will be determined after all data has been collected.

Results

Initial results from the data collected were broken down by state as well as the location the event occurred at focusing on either the mill or at the landing (See figure 1 & 2). All turn time data was collected from the time the driver entered the geofence (polygon) until he left the geofence area. These geofences were determined based on property boundaries and entrances. Mill event data showed that Alabama had the highest average turn time at 42 minutes. The average turn time at the mill for South Carolina was 36 minutes and 30 minutes for Ohio. Average landing turn time data for the three states were as follows: Alabama at approximately 28 minutes, South Carolina was 44 minutes, and Ohio was 38 minutes.

Minimum turn times were recorded for all states at each location. These turns were designated as the shortest amount of time a driver spent at the particular location. Minimum mill turn times indicated that Alabama was the highest at 21 minutes for their minimum turn time, South Carolina was next at 17 minutes, and Ohio had the shortest mill turn time at 10 minutes. Minimum landing turn times found South Carolina to have the highest minimum at 22 minutes, Ohio followed at 11 minutes, and Alabama has the lowest minimum at 10 minutes.

Maximum turn times for each state at each location were designated as the longest time period a driver was stationed or delayed within the polygon boundary. Maximum mill turn time depicted Alabama to be the highest at 3 hours and 39 minutes, Ohio to follow at 2 hours and 10 minutes, finishing with South Carolina at 1 hour and 18 minutes. Maximum landing turn time once again indicated that Alabama had the highest turn time at 2 hours and 29 minutes, South Carolina was next at 1 hour and 39 minutes, and Ohio had the lowest at 1 hour and 16 minutes.

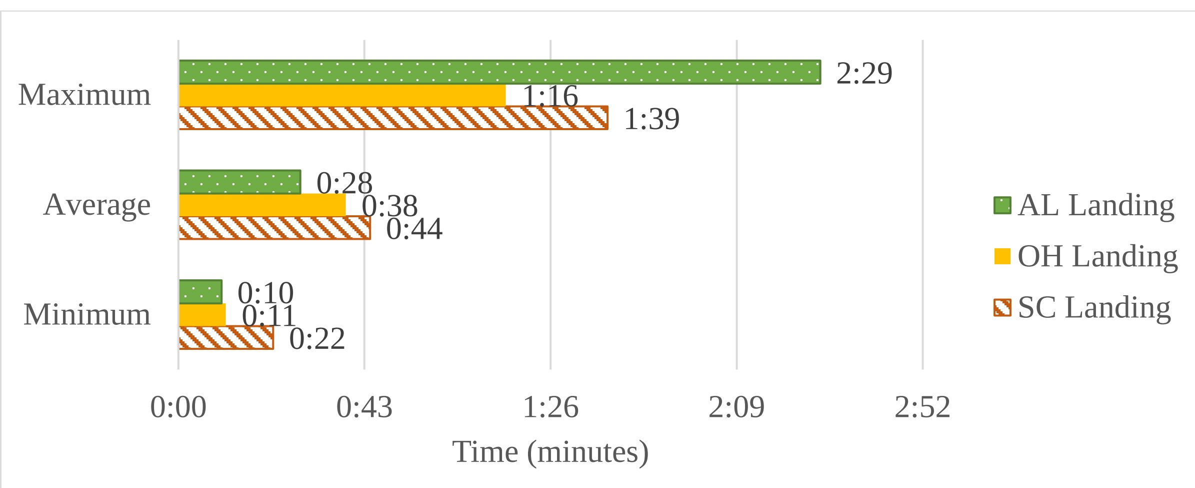

Figure 1. A state comparison of landing turn times.

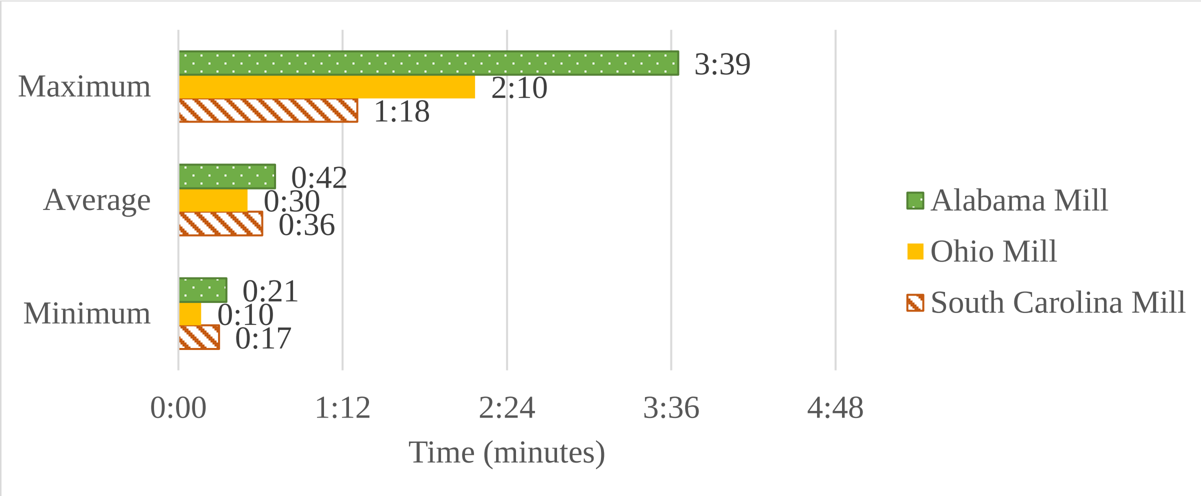

Figure 2. A state comparison of mill-turn times,

Discussion

One of the first points to be noted is that this study chose to record turn times from the property line boundaries. Many mills record turn times from the time the truck enter the scale to the moment he leaves the scale, however, we felt this provided a biased representation of the driver's actual wait time. We used the same method for recorded turn times at the landing to eliminate potential bias that could be created otherwise.

It is important to recognize the difference in loading methods at the landing when comparing the differences in the average turn time at the landing between the states. All Alabama drivers who participated in the study worked for loggers who utilized set-out trucking solely. The South Carolina drivers all worked for loggers who hot-loaded and the Ohio drivers all used a cold-decking method for loading their trailers. Set-out trucking requires loggers to have multiple trailers and an area where they can set the loaded trailer off the main highway. Often times the truck driver is able to hook up to the loaded trailer without ever having to go to the landing site saving them drive time as well as wait time on the loader if they were hot-loading. Hot loading requires the driver to back their truck next to the loader and wait while the truck is being loaded. If there is not enough wood on the landing, the driver must wait until the wood has been skidded to the landing and processed before it can be loaded onto his truck. Cold decking occurs in the areas where the wood can be harvested and skidded to the side of the road or landing in the winter when the ground is frozen and then hauled in the spring after the roads have cleared out again. Although the driver still has to load the wood onto their trailer with the cold-deck method, they are not required to wait on wood, which in some cases can speed up turn times.

Minimum, average, and maximum loading times correspond to the duration of time a driver will have to wait, either at the landing or the mill before they can get loaded or unloaded. Minimum times depict a situation where the driver's wait time is zero. Average wait times correlate to a driver having a few trucks ahead in line if at the mill or waiting for a short duration at the landing for various reasons. Maximum turn times are significant in both locations because they affect the drivers time allotted as well as haul costs and overall costs. New federal regulations mandate that a driver is only allowed to drive for 11 hours a day if they are spending over an hour of that time waiting in line to unload or load they are drastically reducing the number of loads they can haul in the day. Fewer loads equal less money but with the same costs incurred which inadvertently creates a higher hauling and overall cost.

Conclusion

Our study chose to calculate turn times based on pre-determined geofences to ensure each truck was measured accurately. In general, this explains the difference in our findings from mill produced data or other studies conducted. Our findings indicated that on average, for all three states, turn times were approximately 36 minutes for both the landing and the mills. Differences between states turn times ranged 12 minutes at the mill for the average turn time and 16 minutes at the landing for the average turn times. A majority of the differences in the landing turn time averages can be explained by the loading system choice.

Although they happen less frequently, the maximum turn times pose the greatest concern to both loggers and mill owners. These extended turn times pose the highest risk for delays that will decrease productivity, increase costs, and increase the amount of time required to haul wood to the mills.

Overall accurate truck turn time information at the mill as well as the landing may allow the owner to minimize delays seen by their drivers by choosing alternate routes or mills, repairing any tractors which are causing them significant delays due to breakdowns or DOT (Department of Transportation) stops, providing more accurate haul cost analysis for determining if a tract is economically feasible or even alter their trucking operation more drastically.

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