

Title: Tracking Truck Flows with Programmable Mobile Devices for Drayage Efficiency Analysis

PI: Shui Lam

Department of Computer Engineering & Computer Science

California State University Long Beach

Long Beach, CA 90840

Email: shui.lam@csulb.edu

Project Objective

The purpose of this project is to design and experiment on a technology to track, organize, extract and analyze data on port drayage activities from which a clear understanding of drayage efficiency can be gained. Drayage efficiency may point to different measures for different stakeholders. However, they can all be linked to a number of quantifiable measures that include turn times at the port terminals, speed of travel on the road, as well as percentage of travel that drivers make in vehicle repositioning. We show how these and other relevant measures can be obtained using this technology.

Problem Statement

Inefficient use of drayage trucks results in negative externalities in the form of pollution and congestion. A clear awareness of the current state of drayage efficiency is especially important in Southern California since the cargo volume in the Ports of Los Angeles and Long Beach has just about recovered to its previous peak since the 2007-2008 financial crisis. A full measure of efficiency can only be obtained through detailed tracking of drayage activities. GPS tracking has been used for fleet and asset management, and can certainly be adopted for tracking truck movements. Data obtained through GPS tracking, however, can provide detailed information on where and when a truck has been but not what a truck is doing at a particular location. Such information would require driver inputs. Tablet computers provide an ideal platform for the design of an electronic on-board recorder that supports both GPS tracking and touch screen input, therefore has been adopted in our design for the tracking.

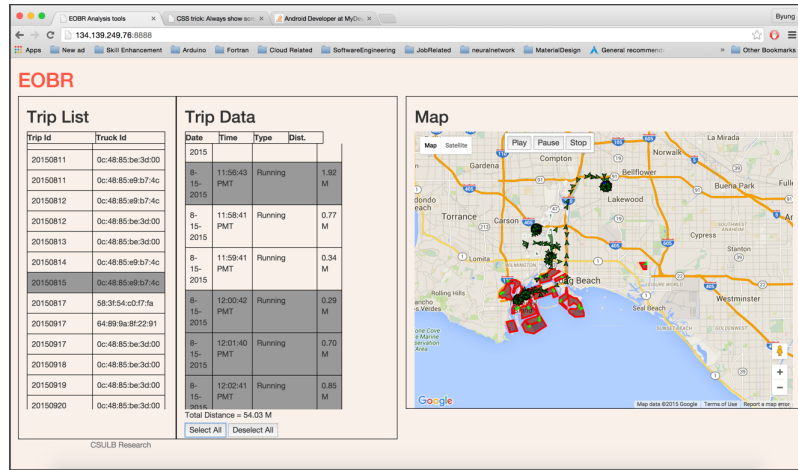
A thorough understanding of drayage inefficiencies and their causes, and the freight flow pattern in a given area will not only provide useful data for the truck industry to devise strategies for productivity improvement, but also help stakeholders in supply chain management to identify the sources of inefficiency in drayage and develop solutions. Such understanding would be especially important in the Southern California area where the largest port complex in the United States is located and where a large and growing population resides.

Research Methodology

Following a set of detailed functional specifications we selected the hardware and designed the software for the tracking, and deployed the tracking device to 5 drivers from a drayage company for 9 weeks from June 8th, 2015 to Aug 12th, 2015. The device logs the GPS location of the truck in one-minute intervals and event data upon driver input. Each GPS location sent to the server is first interpreted according to predefined geofences. Such interpretation enables us to construct each drayage trip with points of origin and destination. The collected data are saved in a database, and are retrieved and organized into a total of 2405 transactions via a web application. A

transaction can be a cycle in a port terminal or a warehouse, or a trip from one location to another. These transactions are then analyzed for a variety of statistical measures including turn time, truck travel speed, and percentage of travel on truck repositioning.

Fig. 1: User Interface for Web Application



Results

From the tracked data we are able to obtain a number of measures that can be useful indicators of efficiency for all stakeholders in supply chain management. Major measures include: average turn time, turn time by transaction type, turn time by time of arrival at the terminal, travel paths the drivers make, truck travel speed, travel speed by work type and its comparison with ideal speed, percentage of travel spent on truck repositioning, and cumulative distance traveled within a terminal. From our 9-week tracking of the 5 drivers that perform 4 types of drayage (heavy containers, to/from rail ramps, Target warehouses, and general store delivery), we found an average of 88 minutes turn time, and vastly different turn times by transaction type (see graph). Other findings include: (i) drayage trucks are traveling between 26-39% below ideal speed (see table), with the slowdown on the heavy container corridor the most significant; (ii) the drivers spent a substantial percentage of travel on truck repositioning; and (iii) “picking up load” is the dominant type of work that drivers go to port terminals for. Through our experiment we also

observed that counting on accurate and timely inputs by all drivers all the time is unrealistic. Hence, logging of the task performed in a drayage operation must be fully automated for the tracking technology to be widely adopted.

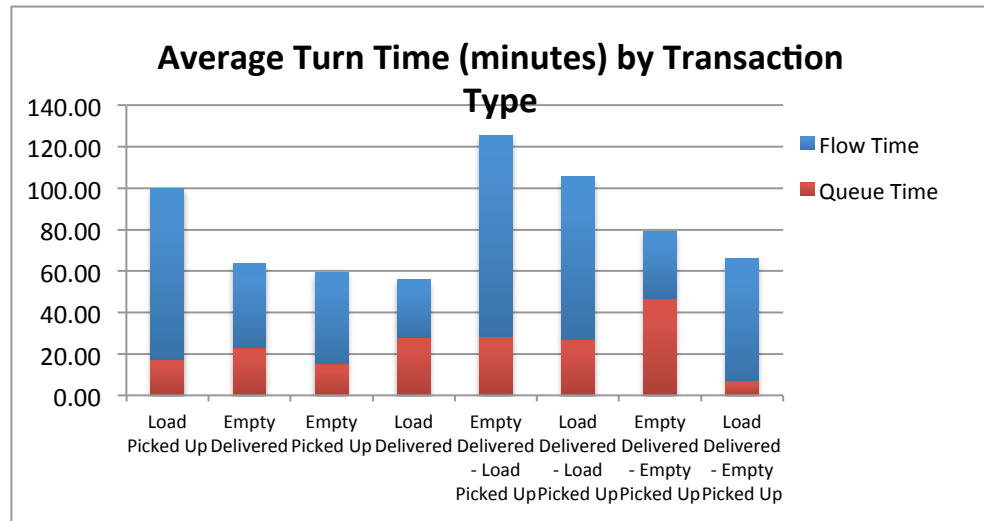


Table 1: Travel Speed by Work Type

Work Type	From Tracked Data					Google Estimation with No Traffic		% Actual Speed Below Google Estimation
	Average Time (min)	Average Distance (miles)	Average Speed (mph)	Min Speed (mph)	Max Speed (mph)	Average Time (min)	Average Speed (mph)	
Heavy	23	7	19	3	33	15	31	39%
Rail	18	6	22	4	43	14	30	28%
Target Warehouses	21	8	23	7	40	15	32	29%
General Store Delivery	58	34	35	12	55	39	47	26%