CONOPS

Trucking Fleet Concept of Operations (CONOPS) for Managing Mixed Fleets

RESEARCH BRIEF

MAY 2021

Port Queuing Demonstration

BACKGROUND

There is a growing problem of increasing wait times at U.S. ports and other major shipping facilities. In the past decade, container ships have gotten considerably larger. The number of 20-foot containers that these mega container ships can carry has grown from 8,000 or so to more than 20,000 containers. Port improvements, and technologies, including reservation systems for trucks, have not been able to keep pace with the sheer number of shipping containers. As a result, wait times for loading and unloading containers on to trucks have increased considerably, in some cases a driver must wait more than 6 hours (Figure 1). Wait times can greatlyreduce driver and carrier productivity because it diminishes a driver's available hours of service (HOS). Typically, a commercial driver can drive a total of 11-hours in a 14-hour workday. Therefore, when paid by the mile, as most commercial drivers are paid, increased wait times can greatly reduce driver earnings.

Figure 1. Photo of Long Wait Times at U.S. Ports

Automated Driving Systems (ADS) offer the potential to allow the vehicle to drive itself in "Level 4" mode while queueing to be loaded or unloaded. With an ADS equipped truck, a driver could go off duty and rest in a sleeper berth or leave the ADS and obtain rest in a motel or port facility. Therefore, the waiting could be used for rest and not count against the driver's HOS, thereby increasing the driver's overall productivity, the carrier's bottom line (more distance could be covered in the day), and safety (drivers would be better rested and less pressured by time). Alternatively, for local delivery it could change the operations at port facilities where a driver could manually drive the truck in city traffic to the port waiting line, then switch the truck into autonomous mode and pick up an already loaded ADS equipped vehicle. This could greatly increase the number of turns that a driver could make in a workday.

OBJECTIVES

For this study effort, the Virginia Tech Transportation Institute (VTTI) study team will perform a series of demonstrations that display how various levels of ADS can be simultaneously deployed by fleets in a safe, repeatable, and commercially viable manner. This demonstration showed how ADS technology could be safely deployed in a Port Queuing Operational Design Domain (ODD).

METHODS

The study team conducted considerable outreach for this demonstration. The study team briefed principals within the Federal Motor Carrier Safety Administration (FMCSA) and Maritime Administration (MARAD) regarding the study effort and the Port Queuing demonstration. MARAD assisted VTTI with briefing the port facilities in Northern California, including project managers at the Port of Oakland. The study team also briefed the California Highway Patrol, California Department of Motor Vehicles, and California Department of Transportation Caltrans) on this demonstration project.

METHODS *continued*

For this study effort, VTTI has partnered with an ADS technology developer. Pronto is a safe-driving autonomy company led by an unrivaled pioneering team that has been at the forefront of the most important advances in the autonomous vehicle industry. Pronto was founded in 2018 and in that same year became the first, and still the only, company to successfully drive coast-to-coast in the United States without a single driver input. During 2020, Pronto conducted considerable testing at the Port of Oakland. They subsequently made refinements in their driving algorithms to account for cut-ins and aggressive driving behaviors To better understand how the SAE Level 4 ADS equipped vehicle would affect loading and unloading operations in port queuing settings, Pronto conducted a series of tests at the Oakland Ports to better understand the suitability of this technology in relieving major port congestion points in daily port operations. For 4 months, Pronto, developed and tuned their ADS platform to participate in daily port queueing activities at the Oakland ports. Initially, the ADS system was already proficient at traversing the routes of the different queues, but was unable to handle the speed and aggressive driving of other drivers. For example, as the queue progressed any significant gap between the ADS equipped vehicle and leading truck would be a target for another driver cutting the line. In addition, if the ADS equipped vehicle was driving too slow at restarting motion when the queue started moving, it would be a target of aggressive honking and yelling by human drivers.

In order for the ADS equipped vehicle to be successful at participating in queue operations, Pronto spent the majority of the testing time tuning the system to be an effective driver under those circumstances. Key modifications to Pronto's base algorithms included reducing the transition time between the ADS being stationary and reinitiating motion when the queue resumed; improving the finesse of the ADS's adaptive cruise control to keep tighter gaps between leading vehicles; and improve object detection tracking algorithms to prevent collisions during aggressive low speed cut-ins. (see Figure 2)

To showcase the capabilities developed during those months. VTTI and Pronto setup a week of Port Queueing Demonstrations where the ADS equipped vehicle delivered at least one container a day for an entire week (5 days). During the Demonstration 7 containers were delivered, 50-60 GB of data were generated (operating 2-3 hours each day), and each delivery was live streamed via Zoom to show case the ADS capabilities to a wider audience.

Figure 2. Live Streaming of Port Queuing Demonstration

CONCLUSIONS

The Pronto system operated flawlessly negotiating heavy traffic and intersections. Pronto provided a live streaming of in-cab and dashcam footage via Zoom for all interested stakeholders. Here is a link to a video describing the Port Queuing Demonstration:

https://drive.google.com/file/d/1m9Hel4ng6PiEek6I3ivMiglEnYdvhJ4V/view?usp=drivesdk

Scan to view the Port Queuing Demonstration Video →

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