



U.S. Department of Transportation

Federal Motor Carrier Safety Administration

Small Business Innovation Research: Fatigue Monitoring and Blockchain

**2020 Transportation Research Board 99th Annual Meeting
Federal Motor Carrier Safety Administration
Analysis, Research, and Technology Forum
January 14, 2020**

Small Business Innovation Research (SBIR) Program

- Congress established the SBIR program to stimulate innovation and to utilize small businesses to meet Federal Research and Development (R&D) needs.
- Administered for the Department by the Volpe Center.
- Best suited for safety challenges in need of innovation.
- Intended for commercial solutions.
- FMCSA is leveraging the SBIR program in various areas to assist with our Safety mission.
- FMCSA is required to use ~3% of the research budget for SBIR projects.

Three Phase Program

- Phase I - Establish the technical merit, feasibility, and commercial potential of the proposed R&D efforts.
- Phase II - Continue the R&D efforts initiated in Phase I.
- Phase III – The small business pursues commercialization objectives resulting from the Phase I and II R&D activities. The SBIR program does not fund Phase III.

Phase 1 Project: Secure Motor Carrier Safety Data Information Exchange Using Blockchain

Phase I Project

- Phase I project with Physical Optics
- FMCSA and its State partners record inspections, crashes, and insurance status (for hire carriers). FMCSA electronically collects and exchanges safety performance and credentials information with States, Federal agencies, and motor carriers.
- FMCSA is interested in determining the feasibility of a system that uses blockchain technology to create a secure transaction platform with a distributed ledger.

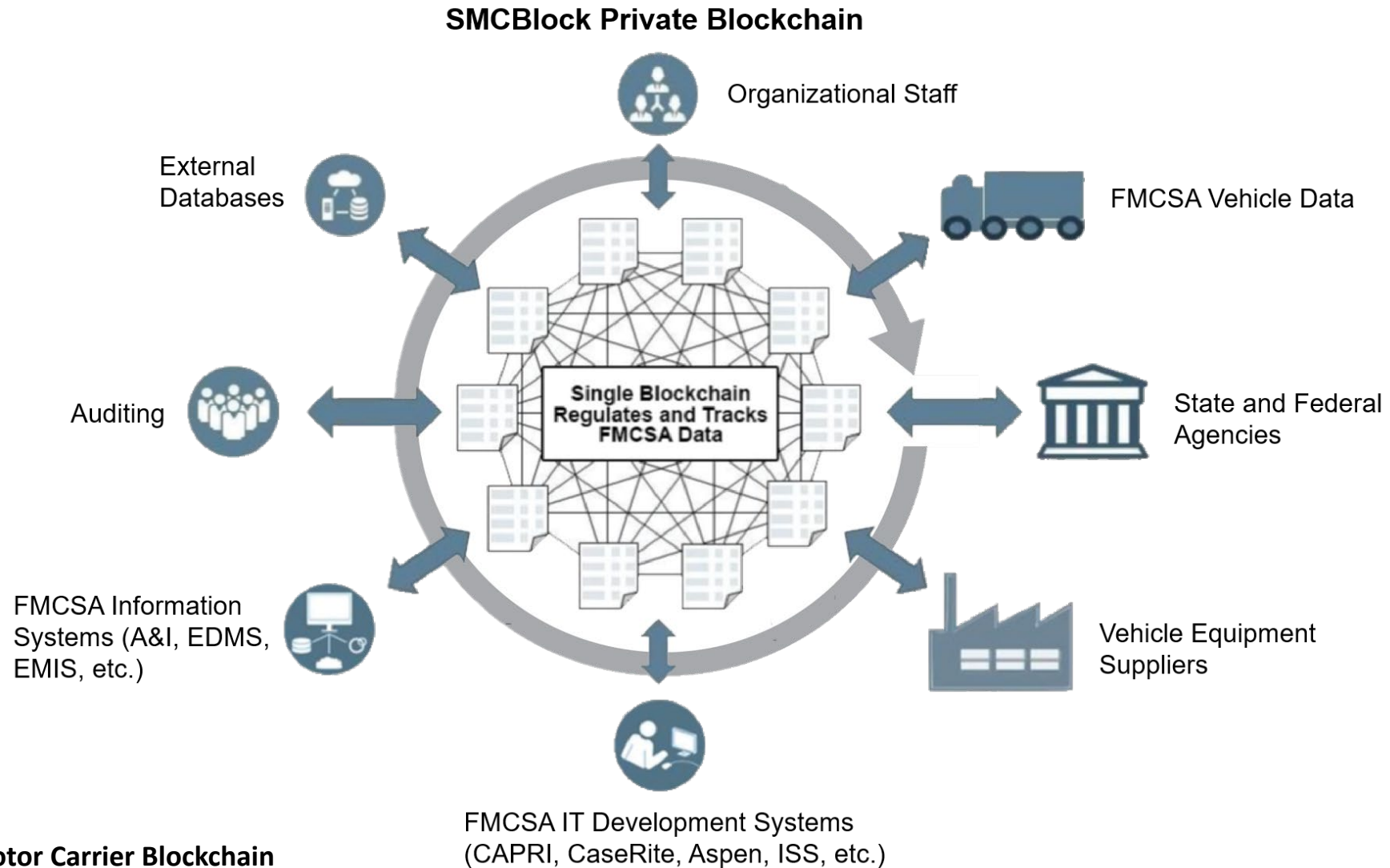
Blockchain Basics



- A blockchain is a growing list of records, called blocks, that are linked using cryptography. Each block contains a cryptographic hash of the previous block, a timestamp, and transaction data.
- Blockchain technology works on the concept of a distributed ledger— a database that is synchronized, replicated and shared among members of a network. The ledger records all transactions among members of the network.

Blockchain Characteristic	Strength
Decentralized	All nodes have entire blockchain providing redundancy
Consensus	New transactions are added only after participant nodes agree that they are valid
Authentication	Cryptography and digital signatures prove participants identity
Immutability	Data that exists earlier in a blockchain cannot be altered
Uniqueness	Transactions are time-stamped, making it possible to audit and verify information
Programmable	Smart contract instructions embedded within blocks allow actions to be carried out when conditions are met

Phase I Project



Phase 2 Project: Multi-Modal Driver Distraction and Fatigue Detection/Warning System (MDF)

Phase 2 Project

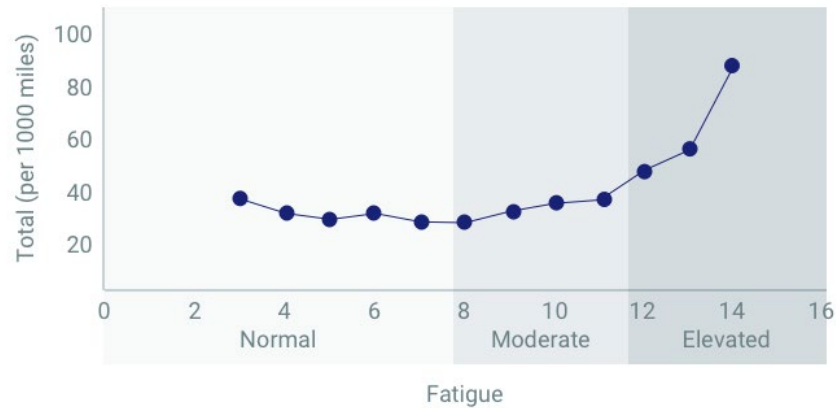
- Phase II project with Intelligent Automation to develop the Multi-Modal Driver Distraction and Fatigue Detection/Warning System (MDF).
- The key concept is that since there is no single silver bullet to solve this difficult problem in a wide variety of driving conditions, we use a fusion based approach that intelligently combines multiple sensing modalities:
 1. Driver behavioral based measurements: such as measuring driver pose and psychophysiological measures of alertness (e.g. percentage of eye closure-PERCLOS, average eye closure speed-AECS), detecting yawning and gestures.
 2. Driving style based measurements: detecting erratic inter/intra-lane driving, and erratic speed variations based on yaw rate sensor and/or controller area network (CAN) bus signals.
 3. Physiological sensing: leveraging recent advances in physiological sensing (like heart rate, sleep and activity monitoring) using wearable devices.

Phase 3 Project: Trucking Fatigue Meter

Phase 3 Project

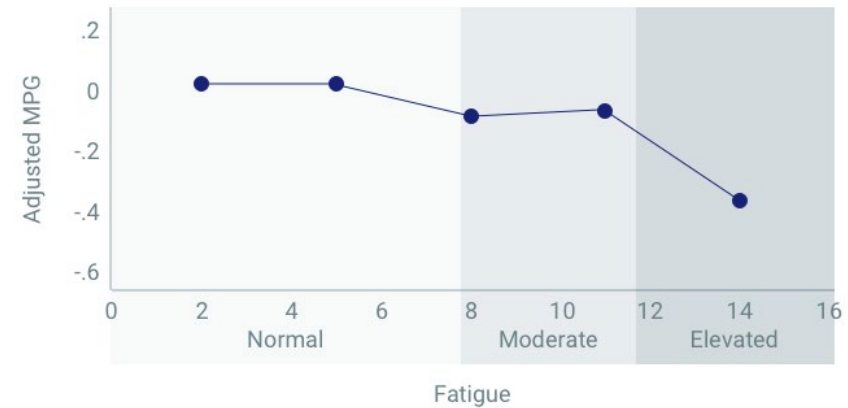
- Phase III Small Business Innovation Research project with Pulsar Informatics.
- Trucking Fatigue Meter provides accurate assessments of fatigue in trucking operations.
- Assessments can be quantitatively linked to operational metrics related to safety and cost.
- CMV operators can use fatigue data in their workflow to impact driver fatigue, safety, and cost.

Fatigue and Return on Investment



Hard braking incidents increases as fatigue increases.

Incidents = safety + wear and tear \$



Fuel efficiency degrades when drivers are fatigued.

MPG = \$

How Trucking Fatigue Meter Works

1

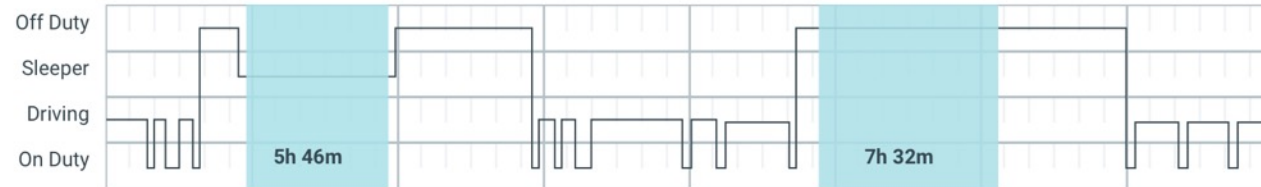
Receive HOS data



2

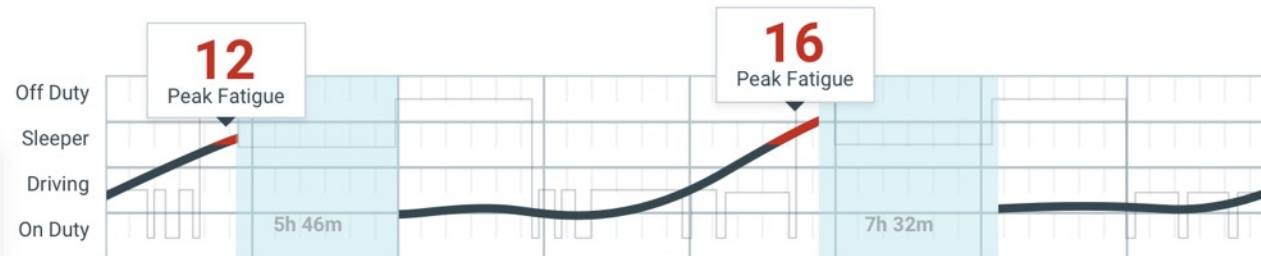
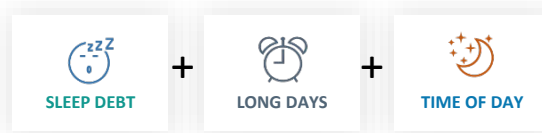
Estimate sleep

Off-Duty Behavior Model accuracy
between 85% to 95%



3

Predict fatigue

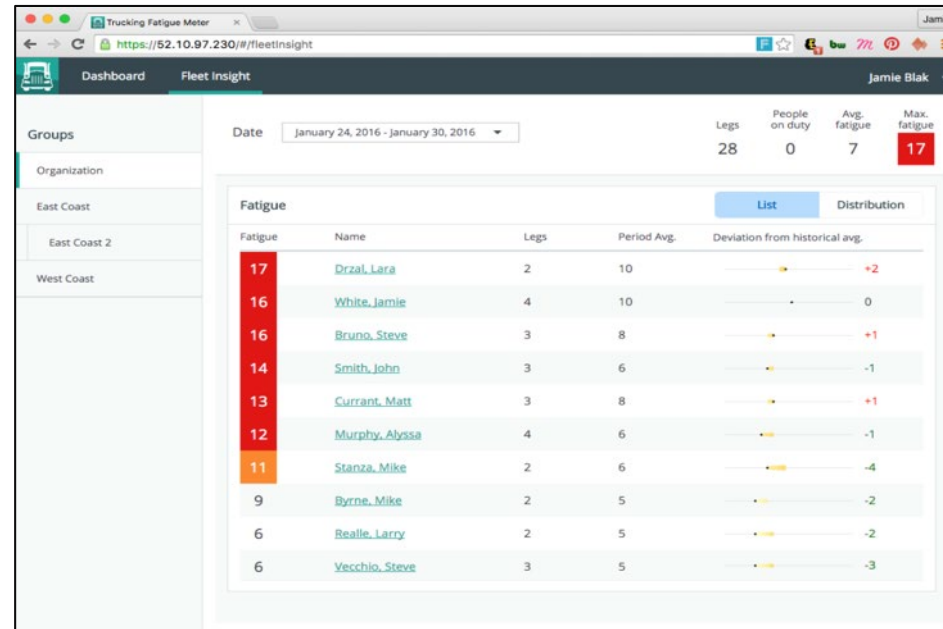


Fatigue score quantified using the "PVT"
scale: a measure of lapses in vigilant
attention

It Starts with ELD, Enabling Insight Across the Operation



HOS logs
from ELD



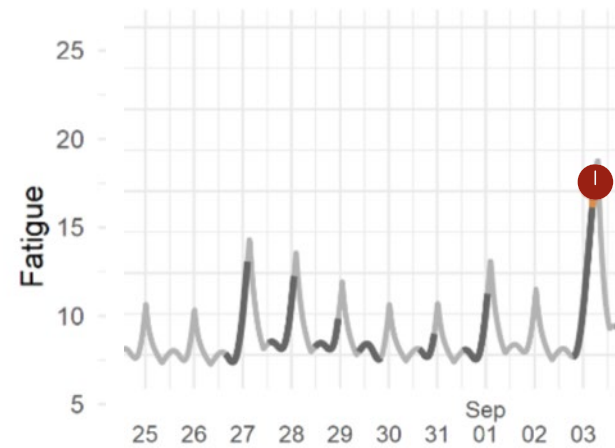
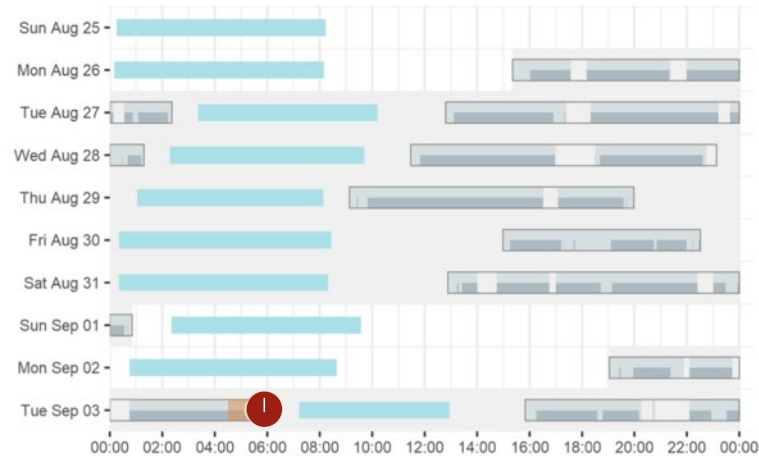
Identify high risk drivers from
fatigue scores

Send High Fatigue Alerts

Automated coaching tips and alerts to managers and drivers

John Doe

Saturday December 07 2019 at 07:37 (ET)



Later End

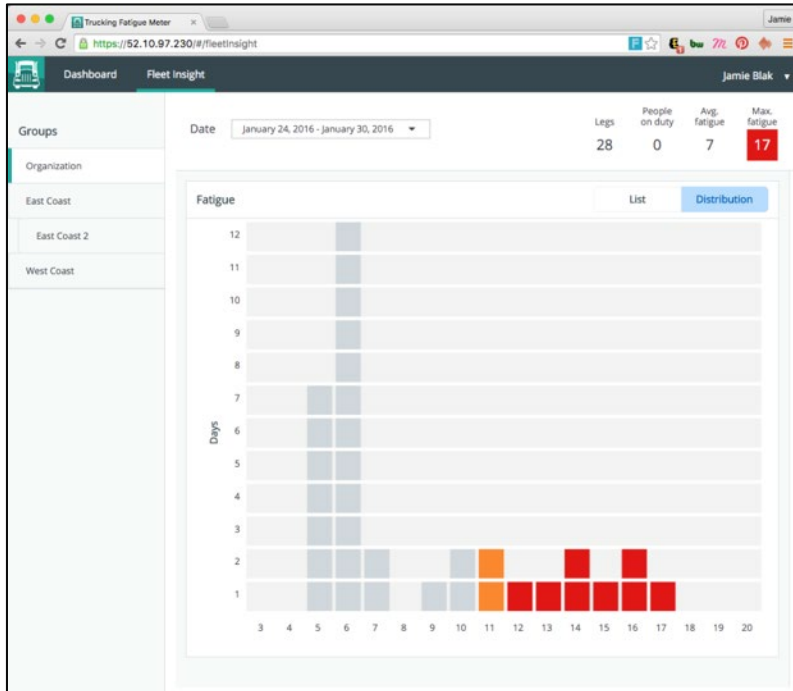
5h 11m later than normal end at 00:26



Irregular Schedule

Moderately variable work start times

Analyze fatigue profiles



Monitor fatigue profile
of groups



Create fatigue reports
for incidents

Integrated with Fleet Management Software



Trucking Fatigue Meter powers fatigue analytics in
Trimble Safety Analytics Dashboard

Commercialization Successes

- All Customer Advisory Board Customers have had successful pilot programs and are planning wider roll-outs with additional system integrations:
 - JB Hunt intermodal terminals showed significant accident reductions. Next phase roll-out to wider fleet planned with integration to dispatching system and in-cab notifications.
 - Maverick planning to build fatigue scores into their dispatching terminals
 - Schneider working fatigue into their new generation of fleet management systems in conjunction with Platform Science.
- Trimble built custom fatigue dashboard into their Safety Analytics Portal and are offering fatigue as an add-on service.
- Business partnerships with insurance carriers offering Trucking Fatigue Meter to their insured driving operations.
- Safety Critical Event data partnership with Lytx established.
- Integrations to Peoplenet, Omnitrac, Telogis, Geotab, Rand McNally, and Bigroad are operational to be able to support carriers from broad cross section of the ELD market.

Contact Information

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