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*“Tactical Wheeled Vehicle Integrated Diagnostics –
The Past, Potential, Politics, and Path Forward”*

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Corporate Overview

DRIVE Developments, Inc. is a high quality engineering solution provider. Our experience is strongly rooted in vehicular diagnostics and prognostics. This is evidenced in our **DIME (Diagnostic Information Management Environment)** product line which combines over 50 years of staff experience with hardware and software development within test facilities, **remote diagnostics and fleet management.**

The breadth of our capabilities also extend into other areas of vehicular engineering to include scientific test cell development, internet applications and plant monitoring systems.

We truly believe in the philosophy of "Lead, Follow or Get Out of the Way"



Business Highlights

- Michigan Small Business incorporated in July 2007
- Focused on Military and Commercial vehicle work
- Featured on The Economic Report with Greg Gumbel in Fall 08'
- Selected as one of "Michigan's 50 Businesses To Watch for 2009"
- Selected as Prime on \$500M / 5 year TARDEC OMNIBUS



***“Tactical Wheeled Vehicle Integrated Diagnostics –
The Past, Potential, Politics, and Path Forward”***
Overview

- **PAST** – Research to CRM
 - Commercial, Government, & Military
- **POTENTIAL** – *Do we really need Prognostics Day One?*
 - Overview of Benefits from Diagnostics to Prognostics
- **POLITICS** – *Do we need another stimulus package?*
 - Funding for development that inhibits deployment
- **PATH FORWARD** – A bird in the hand?
 - Success Stories

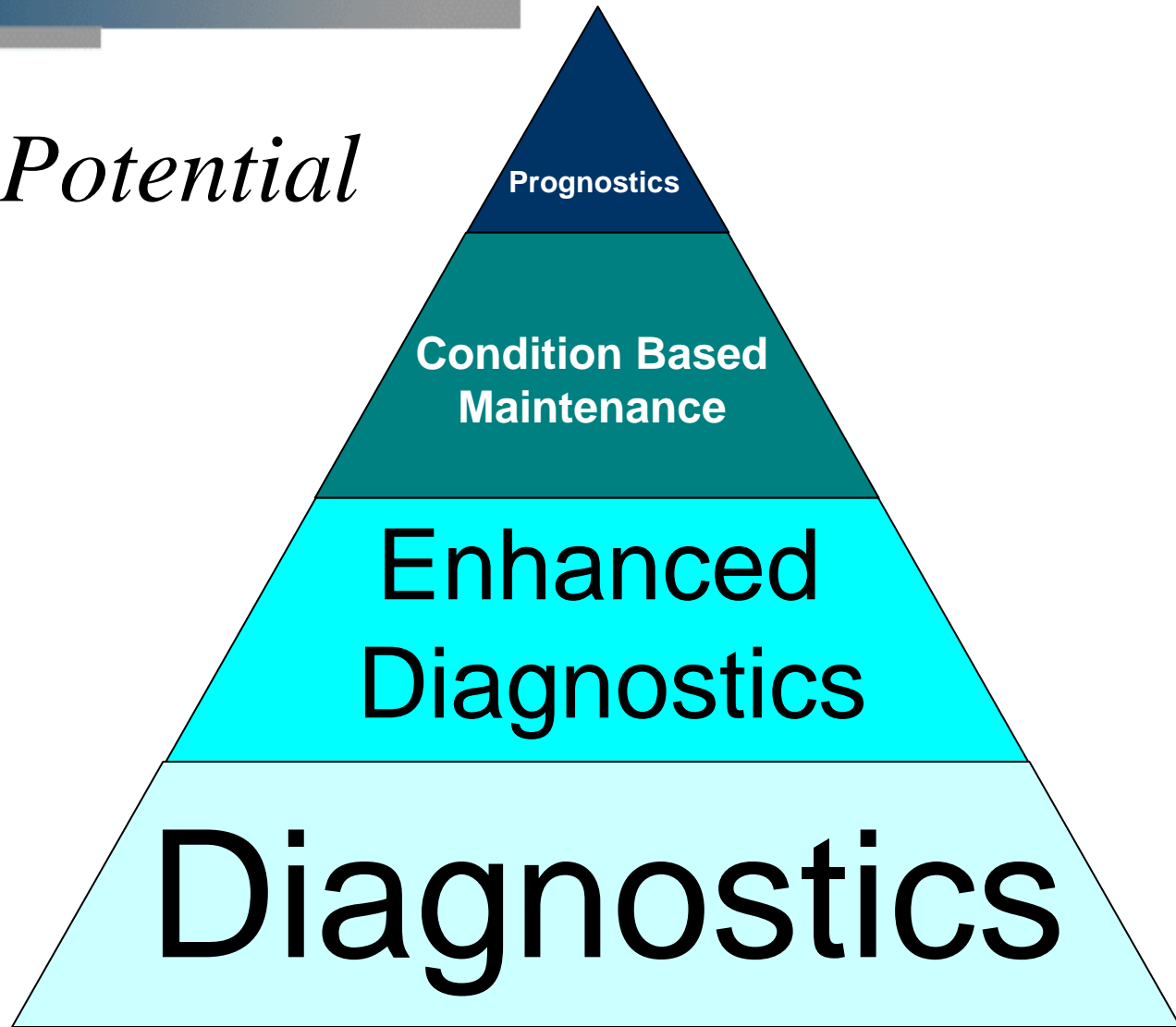


The Past

- Commercial Diagnostic Deployments
 - Automotive OEMS (Product development, CRM, Onstar)
 - Fleet Managers (dispatch, geofencing, employee monitoring)
 - Insurance Carriers (Tracking, use, and validation)
- Government Research Pilots
 - Dept of Transportation (MDOT DUAP)
 - I-95 Corridor activities (cell phone data for freeway congestion monitoring)
- Military Research
 - Congressional plus ups only, no requirement defined in most cases!
 - Diagnostics always listed as objective requirement, never a threshold requirement in vehicle OEM contracts



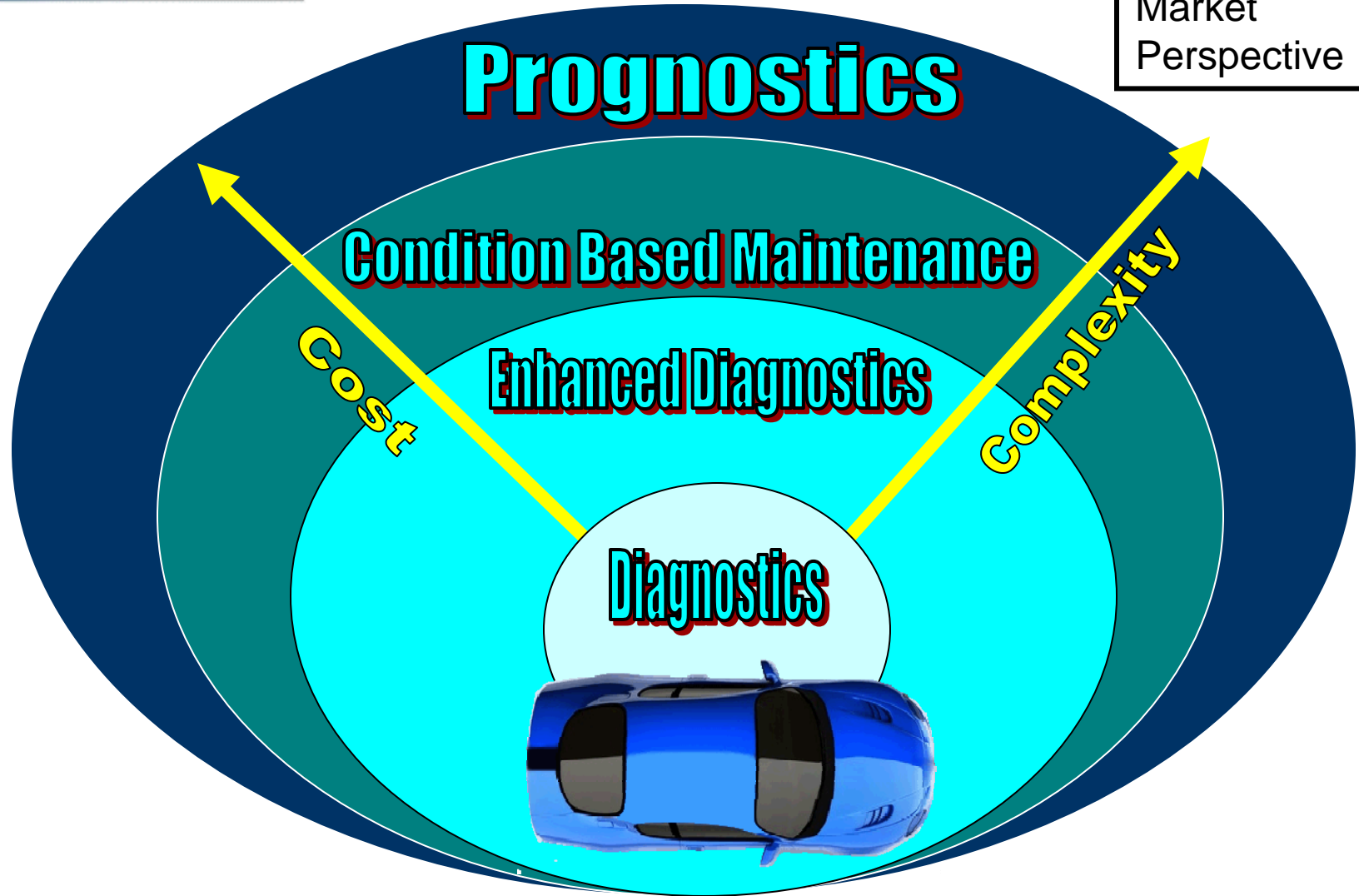
The Potential



The Potential (Commercial Mindset)

- Commercial market starts with diagnostics on the vehicle platform to diagnose failures as low hanging fruit for warranty and repair
- OEMs gather data to form baseline for Enhanced Diagnostics that along the way can provide CRM (Customer Relationship Management) benefit
- Seeks to develop prognostic concepts that support business objectives rather than for the challenge or academic aspects

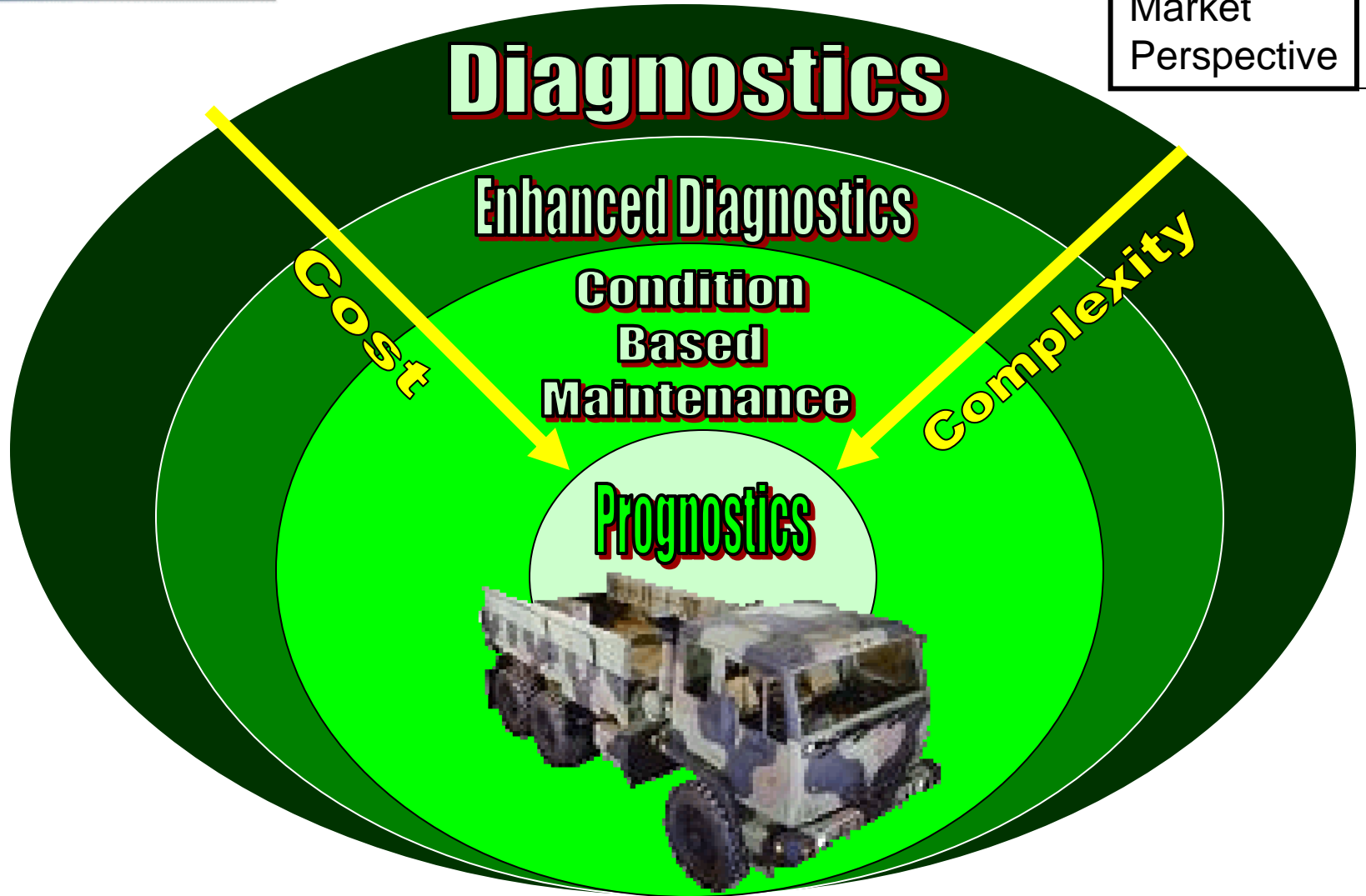




The Potential (Military Mindset)

- Seeks prognostics to predict impending component failure as first objective, heavy academic influence.
- Focuses on research to identify the perfect prognostic solution as opposed to collecting and analyzing data on existing fleets and providing immediate value.
- Disparate systems have political barriers to interoperability, not technical limitations.
- Retrofit more sensors onto vehicles to get more data.





Diagnostics

After the failure has occurred a diagnostic scan tool can be used to identify existing issues...

- Assists in diagnosis of vehicle failures
- Enhances Maintenance History



Enhanced Diagnostics

Immediately After the failure has occurred a resident recording device can gather data evidence.

- Circular Incident Buffers
- Situational Awareness
- Location History
- Incident Reporting
- Application development :
 - Fuel efficiency
 - Payload calculation
 - Weather Conditions
- Fleet Monitoring Interpolation



Condition Based Maintenance

Immediately After the failure the resident recording device forwards actionable data to depot

- *Real Time**
 - Situational Awareness
 - Location Tracking
 - Incident Reporting
- Application development :
 - Accident Detection / Reporting
 - Route Guidance
 - Integration with LOGSA
- Reduced MTTR due to CBM
- Increased MTBF due to CBM, not too early or too late based on expected component life and actual use.



Prognostics

Before the failure occurs the vehicle warns the entire chain of command from operator upstream.

Application development :

- Save lives through prediction of failures
- Maximize Asset Utilization through use management
- Advanced LOGSA inventory management to reduce logistics tail by providing repair parts Just In Time



The Politics

- Military vs. Commercial Requirements (OnStar like technology, you can have it as a convenience. Soldiers can't get it to save their life.)
- Congressional earmarks dictate direction of diagnostics and prognostics for last decade! Mostly 6.1- 6.3 funding which is only research funding. Rewarding research instead of rewarding of implementation working with the customers in the PM Shops to fulfill operational requirements.
- Fancy program names create atmosphere of false prophecy in diagnostics space. Past failures taint the diagnostics industry. "Stenographic, multifunctional , polymer, language communications system" – Rep Jeff Flake (AZ) describing how a common ink pen would be described if included in the Defense Appropriations Bill. <http://www.youtube.com/watch?v=McEz211EvDs&feature=channel>
- PM Shops starting to fund their own diagnostics recorder because research labs have been researching diagnostics in vehicles for over a decade and have not even developed or discovered the recorder that should be used, much less the application of it. Some areas are great for research to handle, some are not. Contractors have more data than the US Army on their vehicles. Why?



The Politics, continued...

- Not leveraging past experience of commercial markets because of need for continued research for technology that already exists in a form that can be utilized TODAY.
- Presently politics funding same work over and over (Groundhog day effect) Same projects going to same government agencies with same contractors. Only change is leadership on government side enabling this game to continue. e.g. Three year rotation cycle for 05's and 06's.
- Sexy language game sells in congressional plus up world and nowhere else. e.g. Rep Jeff Flake (AZ) quote regarding pen description.



The Path Forward

- Success Stories
 - PM MTV : Development of Militarized version of DIME (Diagnostic Information Management Environment)
 - FUEL : 2.6 mpg savings on a Medium Tactical Vehicle TODAY! (6.6 vs. 4mpg)

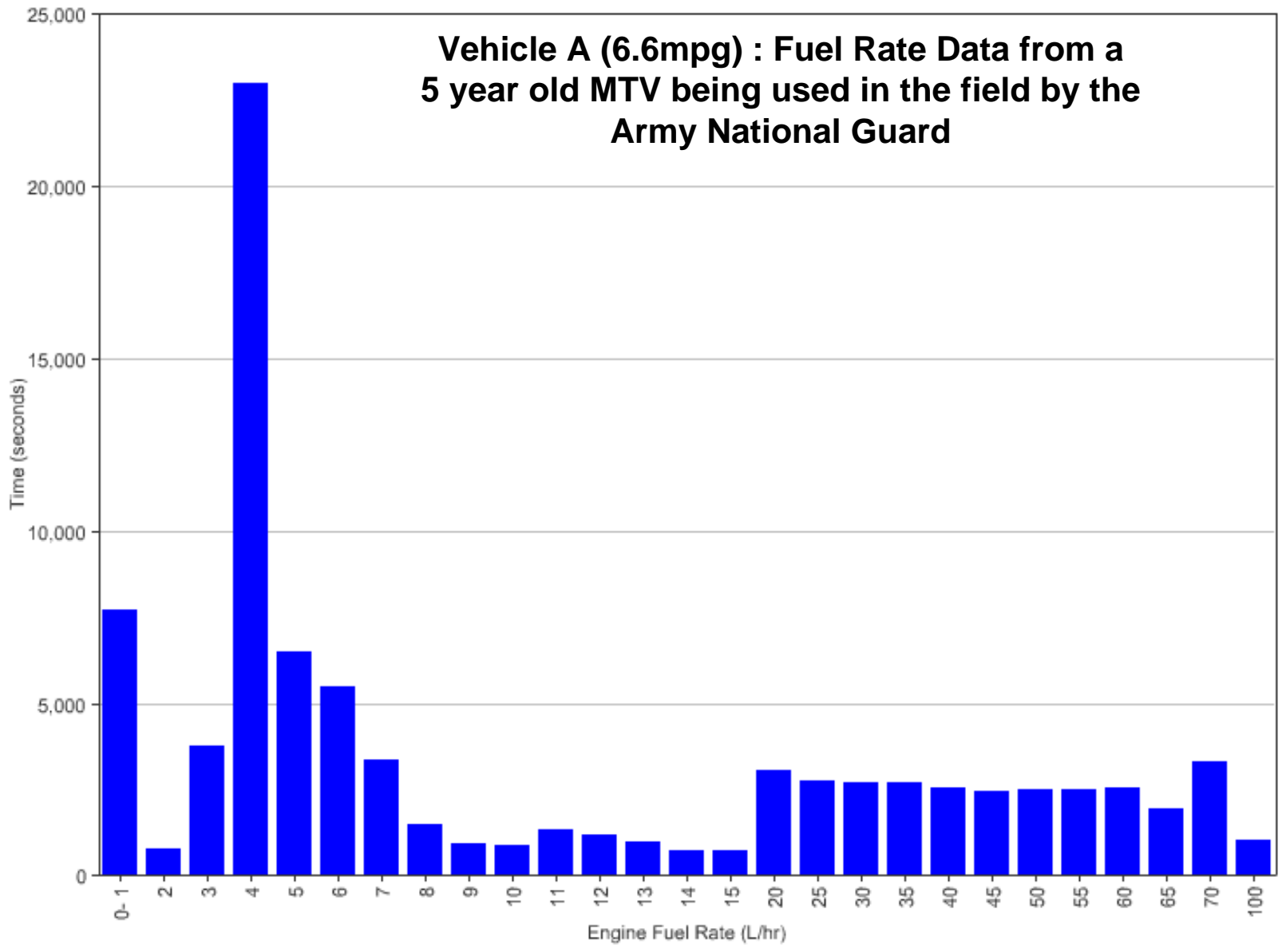




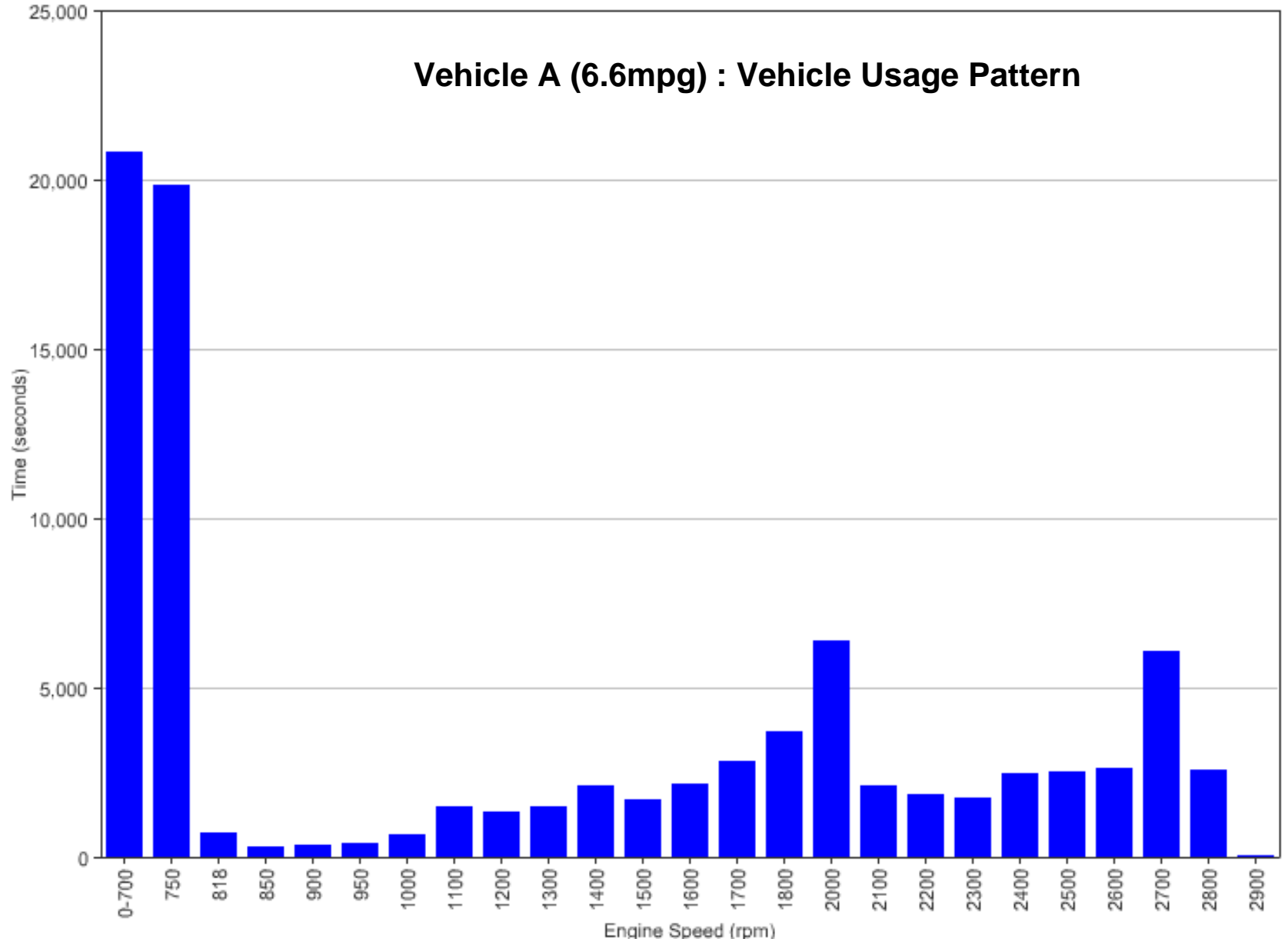
FUEL Efficiency Research with DRIVE and Army National Guard

- Comparison of two MTVs in same usage pattern
- FUEL : 6.6mpg vs. 4mpg economy savings
 - 2003-2004 model year MTVs being driven by the PA National Guard
 - Vehicles run same routes
 - Vehicles are identical configurations
 - Vehicle A : No issues
 - Vehicle B : Diagnostic faults related to fuel efficiency

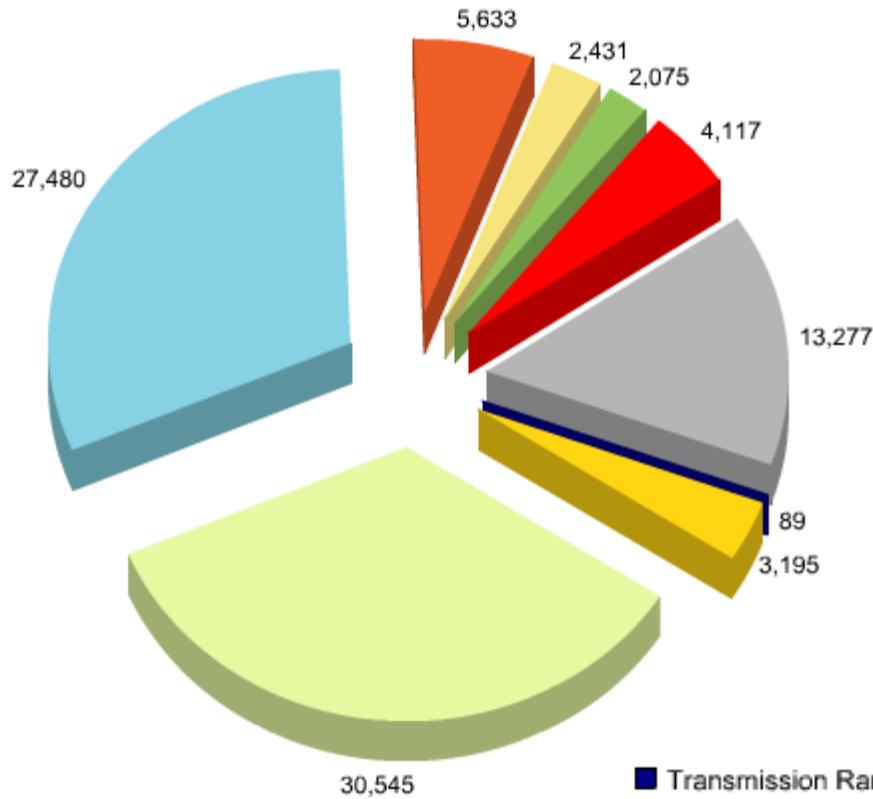




Parameter: Engine Speed View: Time (seconds)



Vehicle A (6.6mpg) : Transmission state, more detailed driving usage



- 34% of its time in neutral
- 31% of its time in 7th gear
- 45-50% of its time at idle

■ Transmission Range - 1
 ■ Transmission Range - 2
 ■ Transmission Range - 3
■ Transmission Range - 4
 ■ Transmission Range - 5
 ■ Transmission Range - 6
■ Transmission Range - 7
 ■ Transmission Range - N
 ■ Transmission Range - R

Vehicle A : Basic Review of Healthy Vehicle

- Vehicle fielded to this guard unit spends approximately :
 - » 34% of its time in neutral
 - » 31% of its time in 7th gear
 - » 45-50% of its time at idle
- This vehicle has numerous active fault codes some of which do not illuminate the malfunction indicator lamps.

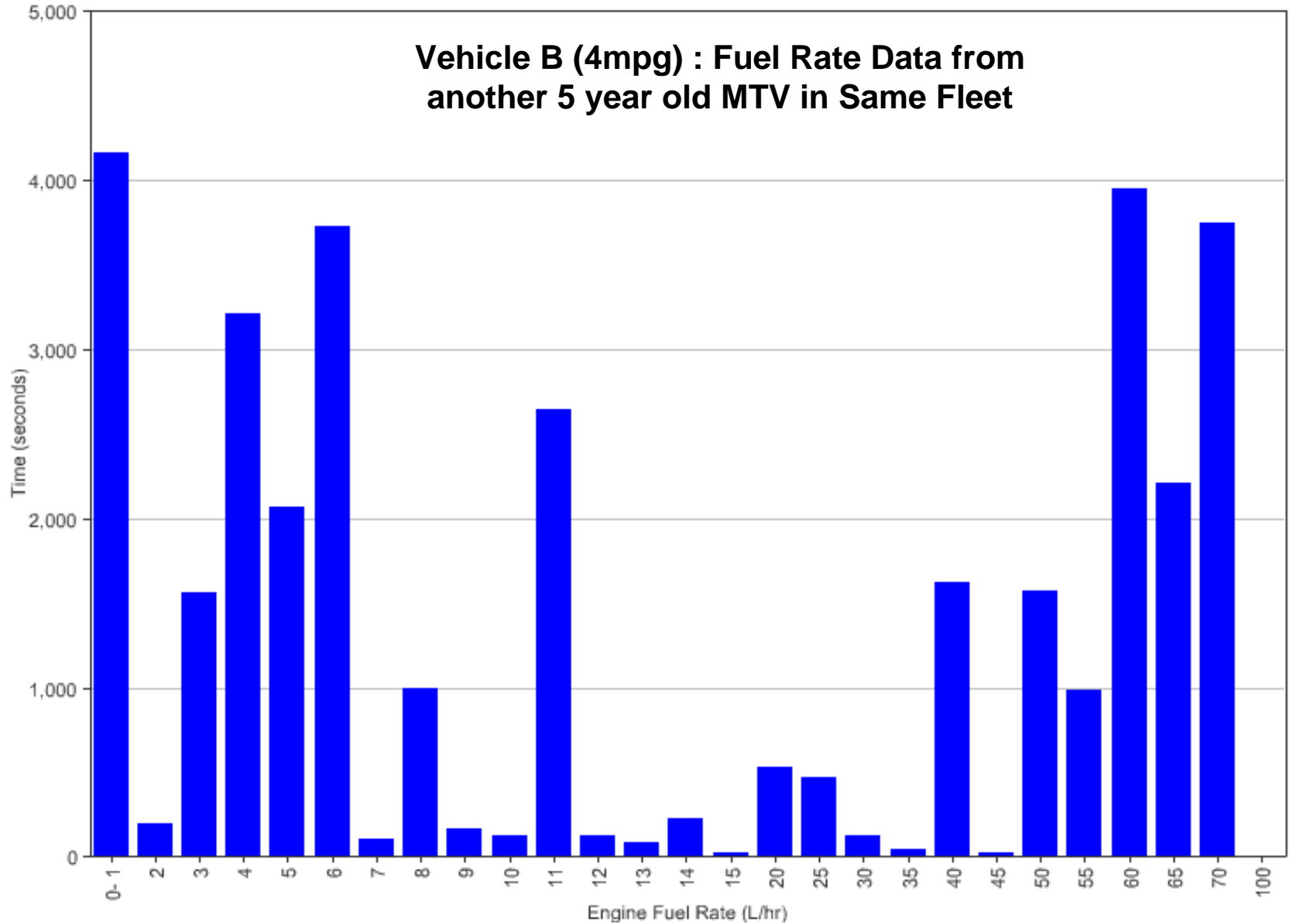


Vehicle Comparison

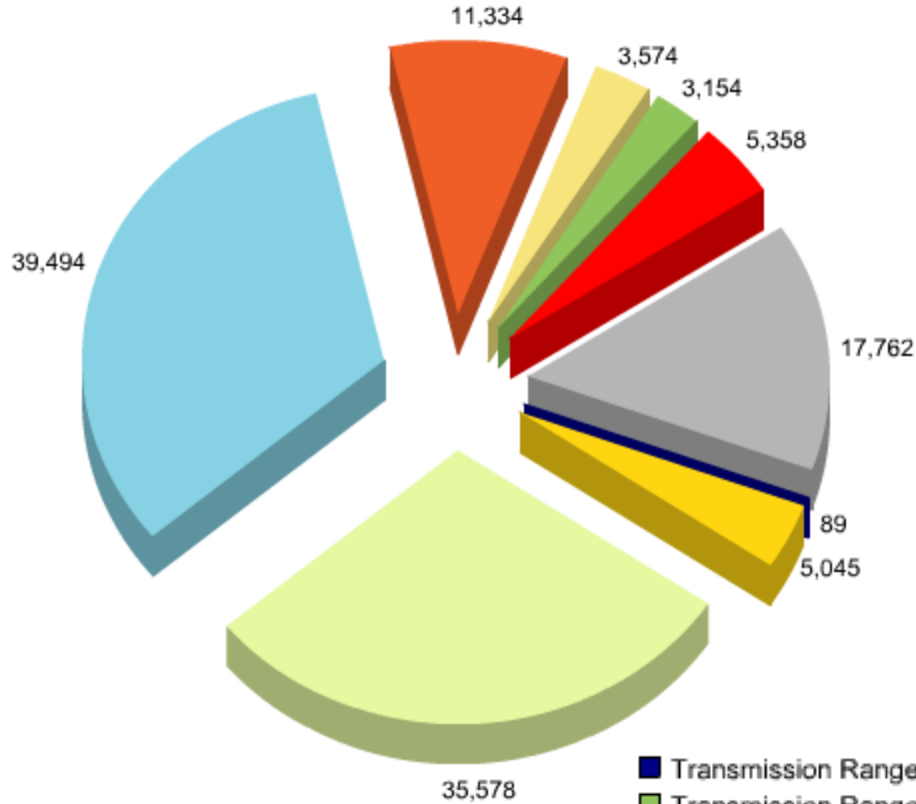
- When compared to another vehicle in the same fleet the presence of various fault conditions can lead to varying data and increased fuel consumption.



Parameter: View:



Vehicle B (4 mpg) : The Driving Pattern is Very Similar to the Healthy Vehicle A



- 29% of its time in neutral.
- 33% of its time in 7th gear.
- 40-45% of its time at idle.

■ Transmission Range - 1
 ■ Transmission Range - 2
 ■ Transmission Range - 3
■ Transmission Range - 4
 ■ Transmission Range - 5
 ■ Transmission Range - 6
■ Transmission Range - 7
 ■ Transmission Range - N
 ■ Transmission Range - R

Vehicle B (4mpg) : Basic Review of the Sick Vehicle

- Vehicle fielded to this guard unit spends approximately :
 - » 29% of its time in neutral.
 - » 33% of its time in 7th gear.
 - » 40-45% of its time at idle.
 - » 3 to 5% different use than Healthy Vehicle A
- This vehicle has numerous active fault codes some of which do not illuminate the malfunction indicator lamps.
- This vehicle has network faults that limit the data collection
- This vehicle's network is reporting only about 30% of the time.
- This vehicle's fuel consumption graph is skewed and indicates that the vehicle is consuming close to 50% more fuel than it's counterparts.
- When first instrumented in early 2008 these vehicles had numerous fault codes of which the operators where not aware.
- Nearly every major system was reporting fault codes
 - Engine, Central tire inflation system and brakes.



Vehicle B (4mpg) : Basic Review of the Under Performing Vehicle

- Both vehicles were experiencing injection actuation pressure system faults when first instrumented.
- Most faults occurred at higher RPMs (2k +)
- Most faults occurred before the engine was completely warmed up emphasizing the need for data capture on startup
- Operators reported that they noticed some vehicles seemed to require more fuel when refueling even though the general operation was basically the same.
- After repairs at depot the sick vehicle fuel consumption graph now indicates expected operation.

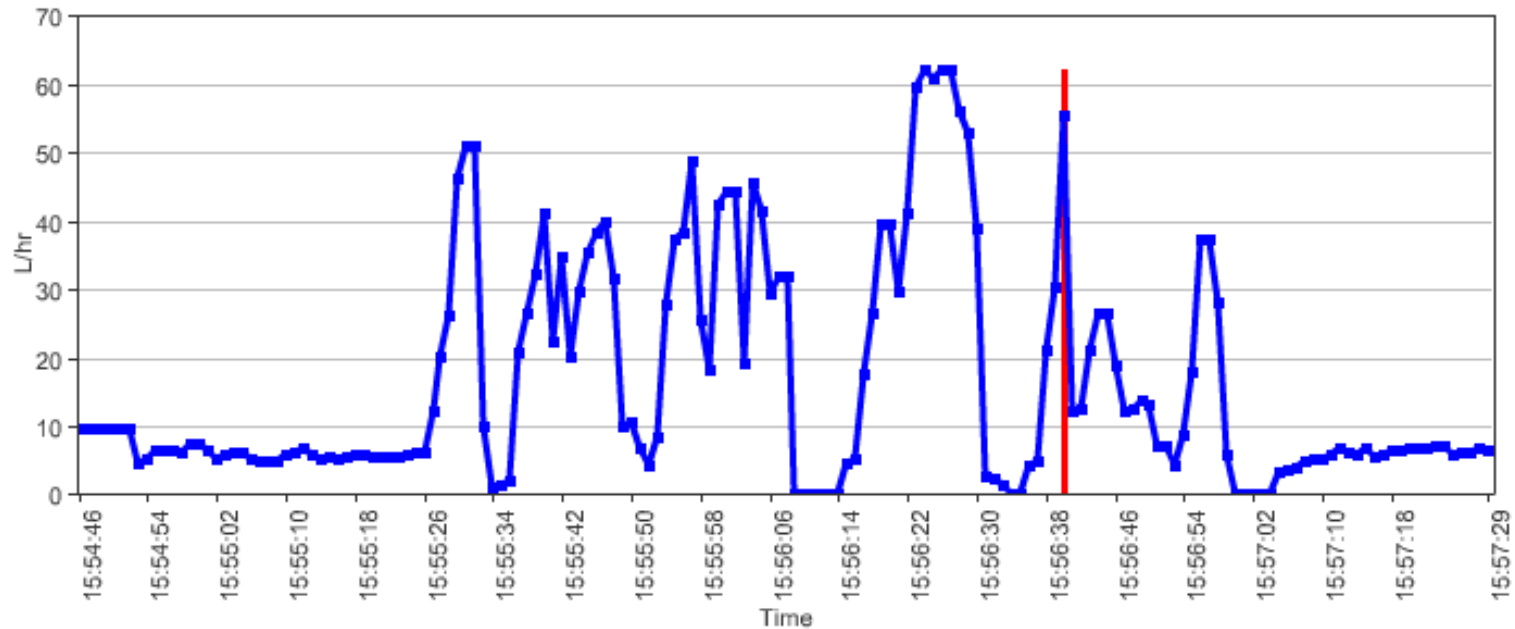


Vehicle B : Example of Fuel System Related Fault

Fault:

Parameter:

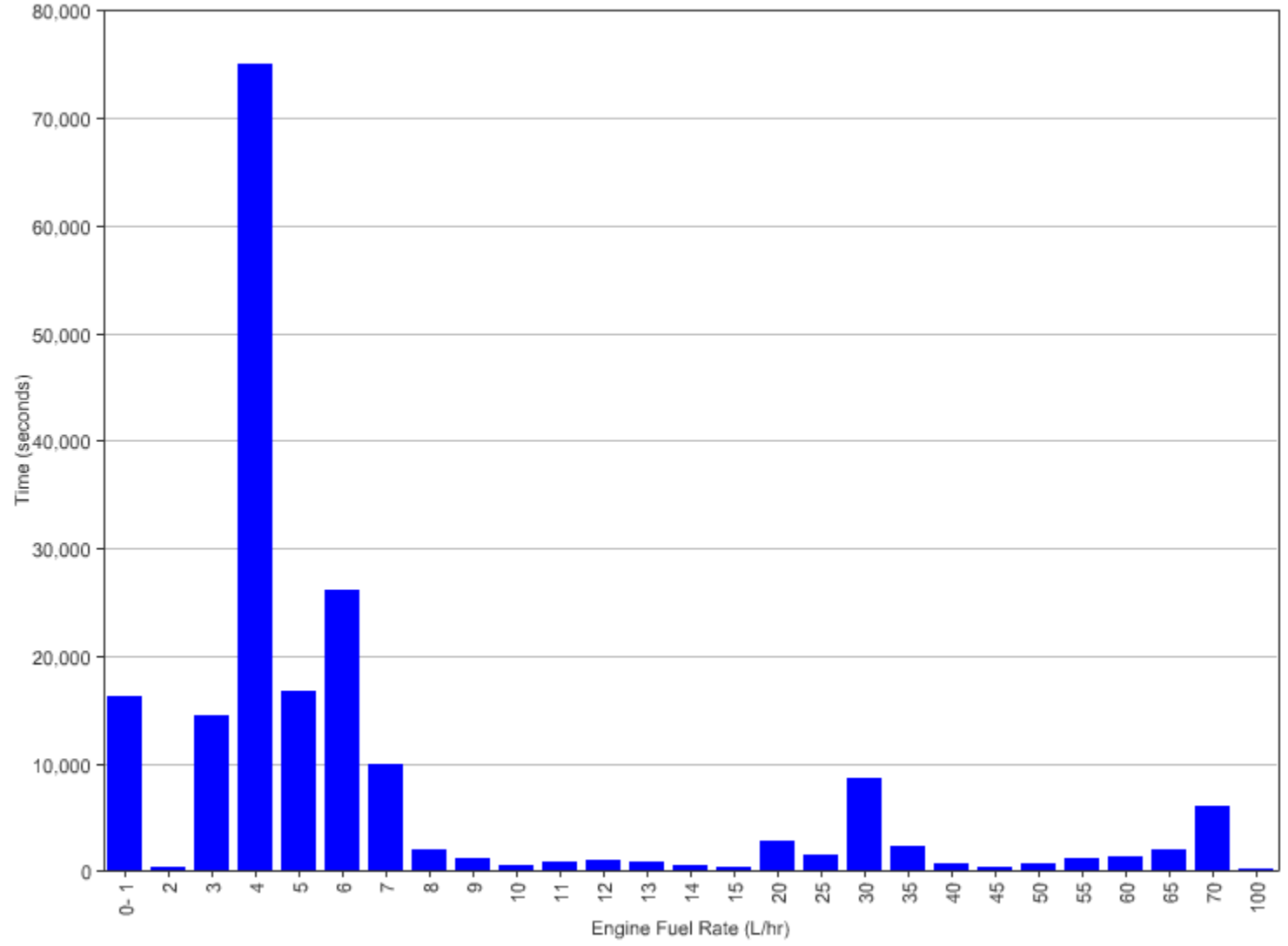
The red line indicates a fault. Click on the fault to display additional information.



Parameter	Value	Units
Wheel-Based Vehicle Speed	12.785156	kph
Engine Coolant Temperature	47.0	C°
Road Speed	15.0	kph
Engine Coolant Temperature	116.0	F°
Engine Speed	2140.375	rpm
Accelerator Pedal Position 1	86.8	%

Vehicle B : Corrected Fuel Consumption After Repairs

Parameter: View:



Our Family of DIME Products

Diagnostic Information Management Environment (DIME)



What is the DIME?

The DIME (**D**iagnostic **I**nformation **M**anagement **E**nvironment) is a **TRL 8** end-to-end **Lifecycle and Vehicle Health Management System** complete with on-board storage, GPS tracking, wired and wireless communication interfaces. DIME enables *Connected Vehicle* applications.

The system is capable of remotely updating and upgrading the system firmware and application code within seconds even in low communication bandwidth environments. This is accomplished via the DIME Data Management Center where data is stored, analyzed, distributed and displayed.



What is the DIME?

HARDWARE Features:

- Technical Readiness Level (TRL) 8
- **Ultra low power consumption (<25mW) in sleep mode with optional ZERO power draw configuration.**
- Low space and weight claim (approx 1.5 lbs)
- **Capable of start up and recording in less than 50ms**
- 802.11 b/g wireless interface
- 2 CAN channels capable of 1Mbps communications
- Ultra low cost hardware investment
- RS485 / RS422
- Capable of waking up from up to eight unique input sources (CAN Bias, CAN Activity, Ignition, J1708, RS232, RS422/RS485, External input, Real Time Clock)



What is the DIME?

HARDWARE Features continued:

- RS232
- Ethernet
- **GPS (Global Positioning System)**
- **Sensor interfaces (Analog and Digital)**
- Remote management / disablement of GPS/Wireless comms
- CAISI compliant via Ethernet connection
- Forms the foundation for any diagnostic system for any vehicle platform.
- Compatible interface with mounted and mobile vehicle display systems.
- Disposable technology, low logistics footprint



What is the DIME?

Embedded Software Features:

- **Remote configuration**
- Data compression techniques enabling performance in low bandwidth Military environments.
- **System processing of data from multiple data bus sources (CAN, J1708, RS485) simultaneously.**
- Capable of storing data in emergency power loss situations.
- **BIST (Built In Self Test)**





DRIVE Developments, Inc.

THANK YOU

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