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Effective Fuel Management for the Industrial Fleet: A Cognitive Approach

Abstract

Heavy industries across the world are at an inflection point, competing against low demand, declining commodity prices, and limited budgets for capital projects. Industry players are left with no choice but to seek out smart and cost effective ways for running operations, while gaining a competitive advantage.

Asset-intensive industries, such as mining, construction, manufacturing and logistics, are inherently reliant on heavy industrial fleets that run on diesel. Consumption of fossil fuel such as this puts significant pressure on OPEX. Moreover, health, safety and environmental (HSE) regulations, irrespective of industries, are becoming increasingly stringent, putting diesel-powered vehicles on the regulatory watch list. The paper will try to explore possibilities for reducing diesel consumption using various cognitive levers and an integrated end-to-end approach that aims to optimizing equipment operations as well as reducing instances of pilferage and carbon footprint.

Typical Asset Intensive
Industry Challenges:

- Operational complexity
  of managing a mixed
  fleet
- Silos of applications
  –missing a unified view
- OPEX reduction
- Stringent HSE norms
- Slower rate of adoption
  of new technologies

Introduction

For heavy industries, 'assets' mostly qualify as high-priced
industrial equipment, also known as heavy earth moving
machinery (HEMM). These machineries, which include haul
trucks or dumpers, loaders, dozers and lifting, and fixing
equipment, are intrinsic part of daily operations. Industries rely
on efficiency and effective utilization of these assets to achieve
higher productivity and lower operating cost (OPEX). Here, a
majority of equipment (such as dumper trucks and loaders) run
on diesel, and the remaining run on electricity (such as
draglines for surface mining, and 'longwall' and 'continuous
miners' used for underground mining operations).

Increased fuel consumption and the subsequent OPEX pressure
is a major concern for heavy industries. In fact, it can be a
serious growth inhibitor for a sector already struggling with
mounting costs and environmental concerns. Diesel powered
vehicle causes more environmental pollutions, by emitting
greenhouse gasses. The impact increases for aging vehicles.
We have noticed that per regulatory mandates, diesel vehicles
that are 10 years or older cannot be used in a number of metro
cities.

Although some fuel management solution providers operating
at a limited scale, the real opportunity lies in OPEX reduction
through fuel optimization. Most of the prevailing products or
solutions are for the petro retail space, and are not suitable for
managing complex heavy fleets typically found in mining,
construction, or manufacturing industries. Moreover, existing
solutions do not provide an integrated end-to-end view of fuel
consumption for decision support.

Smart Fleet Management System Imperatives

Traditional fleet management systems (FMS) leverage various
external sensors (GPS, payload on wheels, RFID tag, engine
temperature, tire pressure, and more.) for tracking equipment
and its health condition in real-time. These systems however
often fail to provide insights into fuel consumption with
reference to operating conditions and the operator's
performance. But times are changing.

Drowning in data but
starving for information

Off late, the majority of the industrial equipment come embedded with various built-in sensors provided by original equipment manufacturers (OEMs), including various fuel level parameters. These sensors generate streams of data, but not all of it is used to extract actionable insights. Data alone can't serve as decision support system, as there is a need to:

- Tap required sensor data

- Decide periodicity or frequency

- Filter data (outliers and anomalies)

- Correlate sensor data through analytics to interpret fuel consumption

- Provide decision support system for fuel optimization

Embracing a Cognitive Approach for Fuel Optimization

The Internet of Things (IoT) unfolds endless possibilities for effective asset management in a connected ecosystem. Cloud on the other hand provides a platform to host and analyze historical data. Enterprises can look towards crafting a fully connected FMS by leveraging:

IoT – A network of physical devices comprising sensors, actuators and connectivity to transfer data, which can be accessed through the internet. These sensors can capture real-time data from heavy equipment (for example, GPS, hour meter, speedometer, engine temperature, driver's behaviour, payload, fuel level, and more). While IoT devices can transfer data over a wide range of network (ZigBee, Wi-Fi, 3G/4G, LTE, and so on), actuators are reactive components, which can enable assets to operate accordingly.

Cloud – for collecting, filtering, correlating, and analyzing sensor data.

Cognitive command centre – for gaining real-time view into operations and decision support.

How will it work?

Let's consider a simplified load & haul scenario in open cast mining. Figure 1 highlights dumpers with various payloads waiting at a loading point for the shovel or loader. Once loaded, the dumpers move towards the dumping yard to complete one cycle. Once done, they return back to the loading point (The

time taken to complete one cycle is cycle-time and trip-count increased by 1 after completing one cycle. These are the key operations metrics).
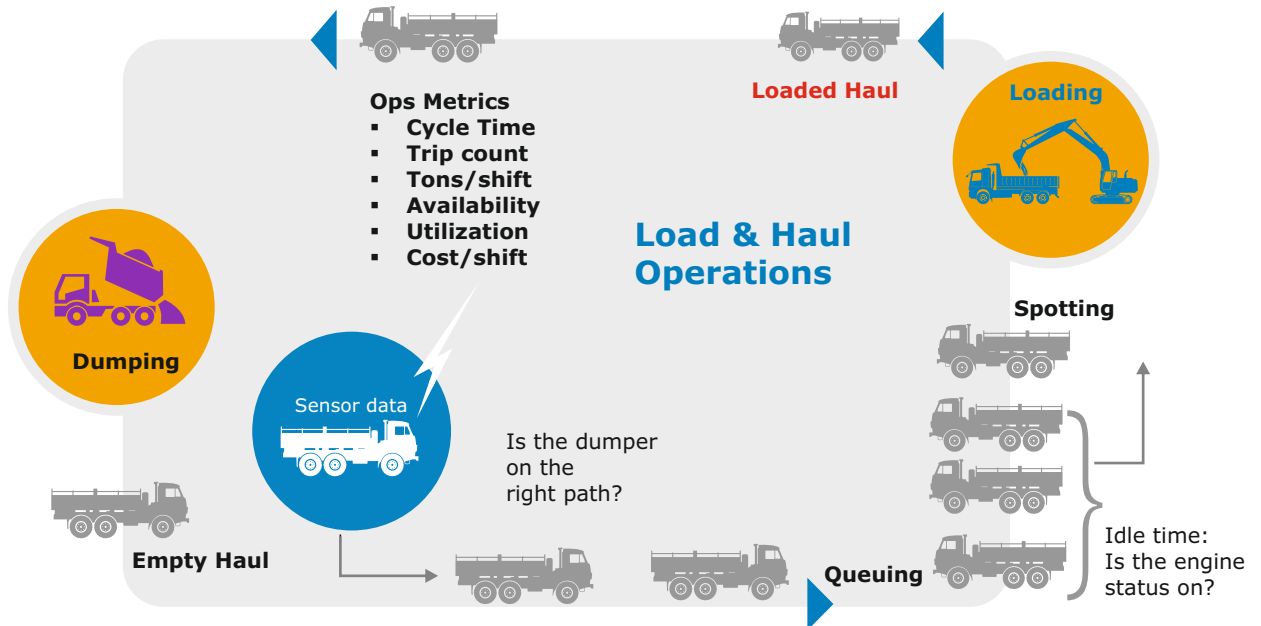

Ops Metrics
- **Cycle Time**
- **Trip count**
- **Tons/shift**
- **Availability**
- **Utilization**
- **Cost/shift**

Loaded Haul

Loading

Load & Haul Operations

Spotting

Dumping

Sensor data

Is the dumper on the right path?

Empty Haul

Queuing

Idle time: Is the engine status on?

Figure 1: Load and Haul in Mining

Figure 2 shows how this operation can be effectively managed through such a cognitive solution.

GPS Satellites   Wi-Fi/4G/LTE

Sensor data:
- GPS location, hour meter
- Vehicle's health & run condition
- Fuel level, speedometer

- Private
- Public

- Tracking scenarios
- Alert generation
- Reporting

IoT ⟷ Cloud ⟷ Command Center

Sample Fuel Analytics on the Cloud:
Production vs. Consumption:
    By operator/ vehicle
    By shift
Fuel consumption Factors Analysis:
Pattern analysis and reporting on:
    Daily refilling and consumption
    Pilferage

- Vehicle location not changing
- Engine status on
- Operator not responding

1

Idle Run Alert Generation

- Pilferage location detected
- Sudden drop in fuel level
- Engine status (?)
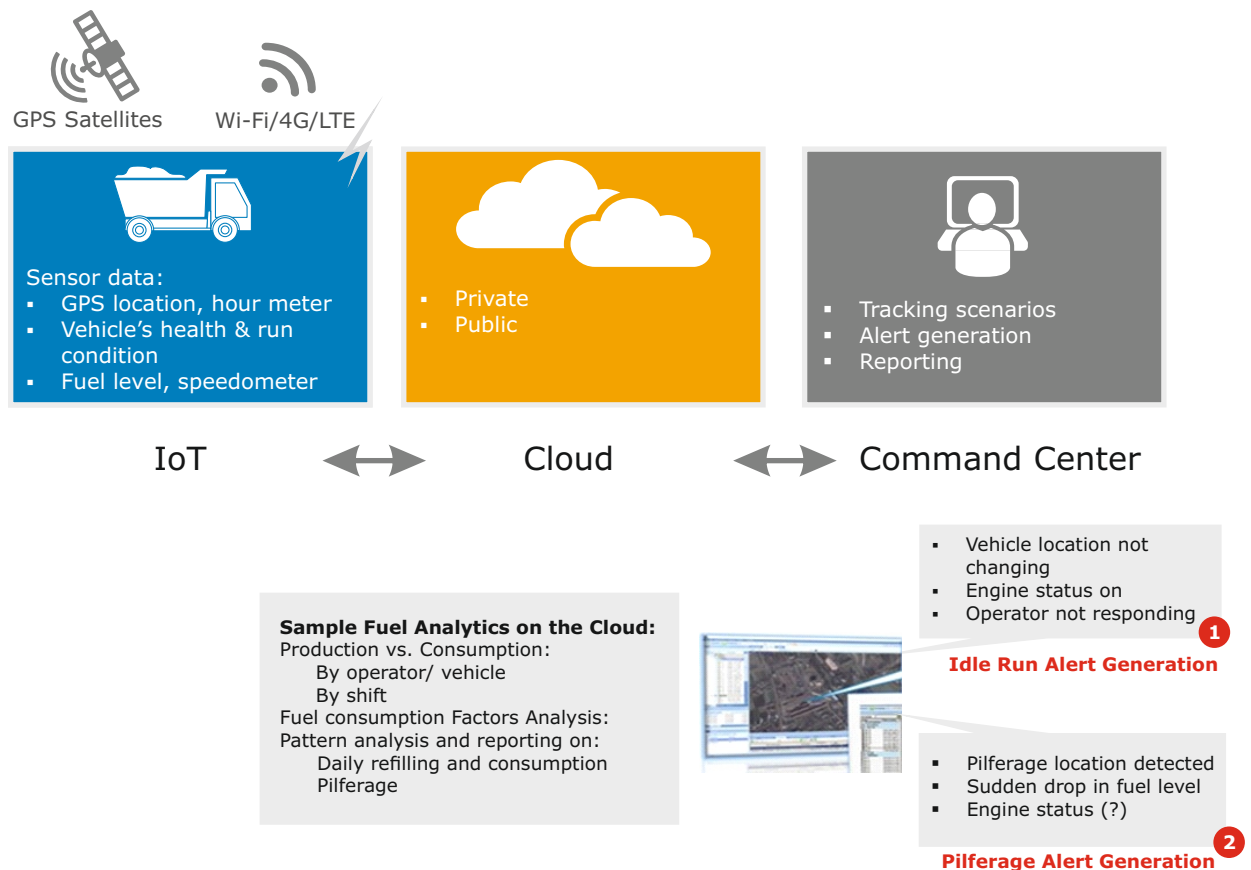
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Pilferage Alert Generation

Figure 2: Connected FMS

IoT devices capture the required information for effectively tracking equipment, its health and operating conditions as well as fuel consumption. While GPS is used for locating an asset in the field, sensors embedded on the asset can:

- Monitor engine on/off status, odometer reading, and so on

- Capture equipment health and operating parameters such as engine temperature, tire pressure, payload, speedometer reading, road-slope

- Accurately gauge fuel levels

Data captured from the sensors is pushed to the cloud (private or public) through gateway devices. Typically, data filtering (purging anomalies), processing, and storing is done on such a platform. Analytics runs on the cloud to correlate various time series data to provide meaningful insight. For instance, if a vehicle is stationary for 10 minutes, then its GPS coordinates have not been updated over time. At the same time, if the engine status is also on, it means that a machine is running idle and wasting fuel.

The command centre is the visualization layer for real-time operations. Here, various KPIs are monitored and accordingly actions such as sending out alerts or communicating with the equipment operator, can be triggered. Moreover, the system is capable of generating various reports such as:

- Production vs. fuel consumption

- By operator and vehicle

- By shift (summed up for all equipment to measure any shift-wise variance)

- Fuel consumption factors analysis (for discovering whether high fuel consumption is dependent on equipment, operator, and other factors)

- Pattern analysis, and daily refilling, consumption and pilferage records

The Way Forward

Diesel is one of the largest OPEX element, which continues to be a problem across heavy industries. As fuel prices increase, profit margins for these industries continue to erode. While environmentally friendly electric equipment is being adopted, it is still to reach a point where it can replace diesel-powered equipment. The current situation demands efficient alternate solutions for managing the diesel fleet. A smart fleet that uses a combination of emerging digital technologies, particularly IoT, cloud and analytics, will act as a strong interim solution. Such an FMS will need to be domain agnostic and provide end-to-end visibility into storage, operations, and utilization of fuel.

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Ashim is a functional consultant and Center of Excellence (CoE) lead in the Energy & Resources (E&R) domain within TCS' Business Process Services unit. He has a cumulative experience of 24 years in Consulting, Information Technology and Business Process Outsourcing service areas. He has worked for numerous mining, minerals and manufacturing customers across the globe for more than 12 years and has led several mining domain projects in areas of asset management, supply chain operations, safety & disaster management. He has also worked closely with mining regulatory bodies, global networking solution providers and mining equipment testing laboratories. Ashim holds a Bachelor's degree in Physics (Honors) from Calcutta University and a Master's degree in Computer Applications from Guwahati University.

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