VERIDAPT

Best Practice Guide
Fuel Management [Mining]

Achieving profitable and highly effective fuel management

EDITION 02—2020

Effective fuel management key principles

Factors leading to increased profitability

Implementing best practice

VERIDAPT

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Best Practice Fuel Management **[Mining]**

This document has been prepared by **VERI**DAPT in collaboration with a panel of world-leading mine managers.

Contents

1 Why fuel management matters

Fuel and lubricants can be among your mine site's biggest expenses. The way in which you purchase, store, manage and use fuel and lubricants can make
an enormous difference to your bottom line. Effective fuel and lubricant management can help you reduce your operating costs, increase your productivity and reduce risks.

To help you achieve better fuel and lubricant management on your mine site, the expert team at VERIDAPT has worked closely with some of the world's largest and lowest-cost miners to develop this best practice guide. The recommendations in this guide have been implemented by the world's largest, most technologically advanced and lowest cost mines to reduce fuel costs and improve productivity.

This document can help you:

- Understand the basic principles of fuel and lubricant management.
- Realise the crucial benefits of implementing an effective fuel management system.
- Determine how best to implement, manage and operate a fuel management system.
- Identify specific areas of best practice when it comes to ongoing fuel and lubricant management.

Best practice fuel management will not appear on your mine overnight. It will take management commitment, time, and some good decisions. Don't be overwhelmed by the process of establishing best practice fuel management. Understand the condition of your current fuel management system, identify priority areas, and then plan and implement a continuous improvement program. Step by step, by following the practices in this guide, you will see profitable improvement and should see paybacks of one year or less.

This document is focused on optimising fuel management across the supply chain, as well as on measuring and controlling fuel usage through data collection, aggregation, reporting and analytics. Our recommendations do not include infrastructure maintenance and management (e.g. tank farm operation), or product standards (e.g. specifications or testing regimes for lubricants). However, our recommendations may overlap with some of these areas.

Who is VERIDAPT?

For nearly twenty years, VERIDAPT has been helping the mining sector understand and optimise its hydrocarbon use. Our enterprise-grade proprietary fuel management solution, AdaptFMS, was developed specifically for mining organisations. It provides on-site hydrocarbon control and monitoring, and manages billions of litres of fuel across mine sites owned by seven of the world's ten largest mining companies. In preparing this document, we have leveraged our extensive experience in deploying and operating Adapt FMS in over 50 large scale mines, all over the world.

2 Effective fuel management: the key principles

Establishing and maintaining a high performing Fuel Management System (FMS) requires careful consideration. While there are numerous technology options available, and various different ways to measure and manage your fuel usage, it's important to ensure you are investing in a solution that will deliver the best possible returns over its lifecycle.

When selecting a Fuel Management System, it's important to focus on three key principles:

- **Integration:** Does your FMS provide seamless integration between its hardware and software component to ensure you receive data effectively?
- **Scalability and adaptability:** Can your FMS adapt and scale to suit your specific needs and the size of your mine site(s)?
- **Built for purpose:** Is your FMS equipment specifically designed for the rugged nature of a mine site to ensure value and longevity?

2.1 Integration

An effective FMS (also known as a Hydrocarbon Management System) monitors fuels, lubricants, coolants and grease, or any other liquid that needs to be monitored and controlled. As such, effective fuel or hydrocarbon management requires seamless integration between its various hardware and software components, shown in Figure 1. These components can include:

Field instrumentation including level gauges and flow meters to monitor current inventory levels and the flow of inventory in and out of storage tanks.

Vehicle identification devices fitted to vehicles to enable automatic identification. Some tags are available which also monitor operating and idle time between refuelling. Identification data is transmitted to the enterprise application to confirm dispense authorisations.

HMI/controller that provides a user interface for field operators to deliver, transfer and dispense fuel and lubricants. The controller also executes business logic such as authorisation rules based on equipment and user credentials, and aggregates and buffers data before synchronisation with a centralised application.

Enterprise application software allowing data analytics and reporting while providing administration of permissions, authorizations, and reconciliation. The centralised application can also be used by external parties such as suppliers for Vendor Managed Inventory (VMI) if web enabled or operating as a SaaS solution.

2.2 Scalability and adaptability

To deliver unique and relevant insights, an effective FMS must be scalable and able to adapt to suit your particular mine site and supply chain.

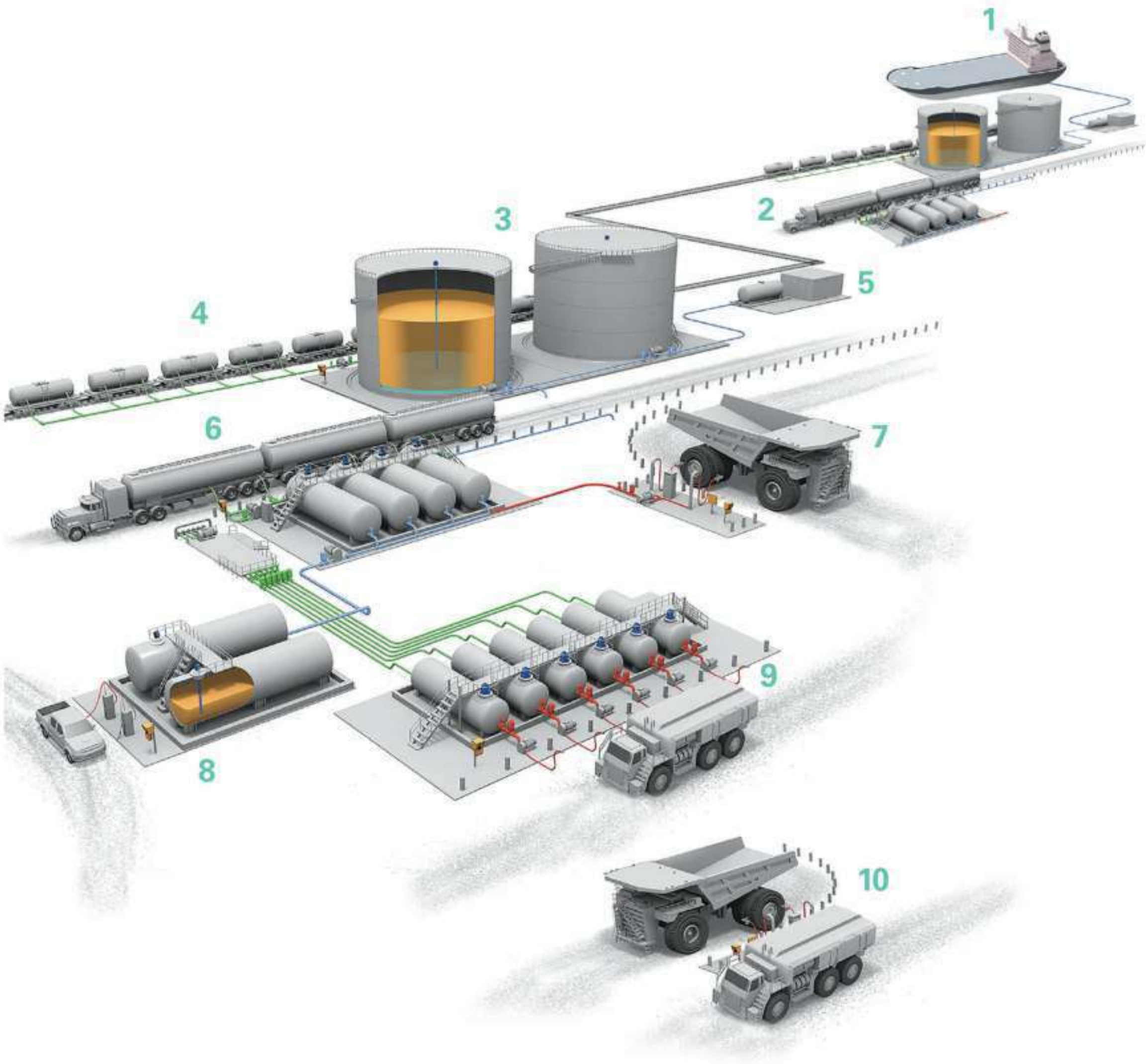
Your FMS may, for instance, simply monitor a small number of discrete fixed tanks and dispensing points. Or, it might manage a complete supply chain spaning bulk fuel deliveries from ships to large terminals, the scheduling and monitoring of fuel distribution via road or rail to sites, transfers within sites and the ultimate distribution to fuel-consuming assets from fixed locations or service trucks. If you operate a large, global enterprise, your FMS may even need to cover multiple sites and monitor your fuel use across a particular country, continent or the globe.

To achieve maximum scalability and adaptability, your FMS should:

- Provide comprehensive fuel and oil management by monitoring and controlling deliveries, distribution, dispensing, transfers and storage from a central application.

- Utilise field measurement instruments and control hardware to capture transaction and inventory level data and push this to a central software application.
- Only dispense fuel and oils to authorised equipment items which are identified by a PIN or RFID tag (an additional layer of accountability could be added by requiring user authorisation at the dispensing or delivery point which is reported as part of the transaction record).
- Utilise a controller to authorise and record transactions as products are delivered to storage tanks and dispensed to equipment. The controller should identify and authorise the equipment and may also capture engine hours or kilometres. It should be able to manage multiple meters from which volume data is received and perform multiple simultaneous delivery and dispensing transactions. The controller should also be able to interface with level gauges to provide tank volume and level data in the field and capture and record data.
- Be capable of monitoring lubricants and coolant products which, when effectively and accurately monitored, can provide equipment maintenance and performance insights.
- Be able to support several delivery/dispensing points across a site (note: a controller and a collection of meters connected to tanks is called a delivery/dispensing point). Service (or lube) trucks are both tanks and dispensing points with their own controller monitoring all meters on the truck. All transactions should be sent to the enterprise software and monitoring application, which can collect, aggregate, export and display the data in a variety of ways to the user, and provide alerts and alarms as required.
- Provide all of this information via an interface for operators in the field, including delivery drivers, operators, or service technicians. This interface should support workflows and procedures that ensure safety, good environmental stewardship and accurate data collection. It should also ensure the correct products go to the equipment, load plans and deliveries as scheduled, with minimal errors and omissions.

Figure 1: How FMS can operate across a mining network or site



KEY

1 Ship to terminal
2 Rail and road gantry and distribution
3 Site bulk storage
4 Rail offload facilities
5 Power generation
6 Road tanker delivery
7 Heavy vehicle refueling and lubricants
8 Light vehicle refueling and lubricants
9 Transfers from site storage to service trucks
10 In pit and service truck refueling of heavy vehicles, equipment and light vehicles

2.3 Built for purpose

Regretfully, too many mines have implemented an FMS adapted from, say, air transport, only to find that the equipment has a very short life in harsh mine site conditions. Ensuring all hardware deployed is fit for purpose for mining is essential to ensure value and longevity. It's important to remember that creating hardware that is rugged enough for the mining industry does add additional costs. However, it also means reduced servicing and downtime. If your equipment is offline, you will be losing valuable data and the effectiveness of your FMS could be compromised.

Considerations for suitable hardware include:

Temperature: To operate effectively, your FMS should have an operating temperature range of-40 to +70 degrees Celsius. Be mindful that, in many cases, the conditions that the internal components will be subjected to will be far higher than ambient.

Water: Water ingress is a risk, particularly on controllers mounted on service trucks. Look for devices that exceed IP66 which tests with strong jets of water. Note that a higher IP rating does not necessary mean better protection. For example, IP67 tests for submersion can in some instances be less relevant than water jet tests, and not as applicable in the mining and rail environments as IP66.

Vibration and shock resistance: Service trucks can be subject to high levels of vibration, particularly as they may travel on haul roads that are far harsher than the highway conditions some controllers are designed for. Additionally, there are often additional pumps and sources of vibration on the equipment which can contribute to the challenge. Look for MIL spec 810G or similar.

Power: On vehicle installations, electrical robustness can be notoriously difficult. Ensure the hardware you choose is specifically designed to allow for this. In fixed locations, challenges can also exist with unreliable power, generators, and solar systems. Is your controller designed for these conditions, or would it be better suited to a service station environment? Do you have effective backup power to ensure data validity and safety?

Usability: There are new controllers coming to market with touchscreens to take advantage of the more sophisticated user interface that can be provided. Many are not rugged enough for the mining environment. For example, resistive touchscreens can be damaged easily, many touch screens are not damage resistant, and screens are commonly not bright enough for effective daylight use. A screen should have 1000 nits of brightness – yet 350-400 nits is common amongst poorer quality equipment. Look for rugged touchscreens that can withstand impacts.

Serviceability: In a mining environment, failures can occur and it is critical to get back online quickly. An effective FMS will have a modular design that allows speedy rectification and replacement when faults are identified.

3 The benefits of a best practice fuel management system

3.1 Benefits

The benefits of an appropriate fuel management system fall into four key categories. These are:

1. Labour Savings

Automating

- record keeping and reporting in one centralised location.
- tank gauging to remove manual dipping.

Implementing

- vendor managed inventory.

Improving

- cost allocation and control.

2. Non-labour Cost Reduction

Controlling and Measuring

- subcontractor access to fuel and lubricants.

Increasing

- increasing access to rebates via more accurate reporting.

Reducing

- theft and misconduct.
- stock levels though better inventory management.

Eliminating

- stockout events at fuel and lubricant facilities, especially for remote locations.

Scheduling

- maintenance based on fuel or lubricants burned.

Monitoring

- lubricant top-ups between maintenance to identify faults early.
- facilities performance such as flow rates or filter condition to optimise replacement.

Providing

- traceability of fuel and lubricant products to individual equipment items in case of contamination.
- automated confirmation of delivery volumes to ensure accurate deliveries.

3. Productivity Improvements

Reducing

- the number and frequency of refuelling events.
- the time of each refuelling event through measurement and benchmarking of operators.

Improving

- service truck productivity by monitoring throughput and benchmarking.

Validating

- business improvement projects using data.

Using

- data to optimise fleet purchase decisions.

Identifying

- anomalies and outliers to stop waste and prevent large spend on equipment repairs.

4. Risk Management & Improved Governance

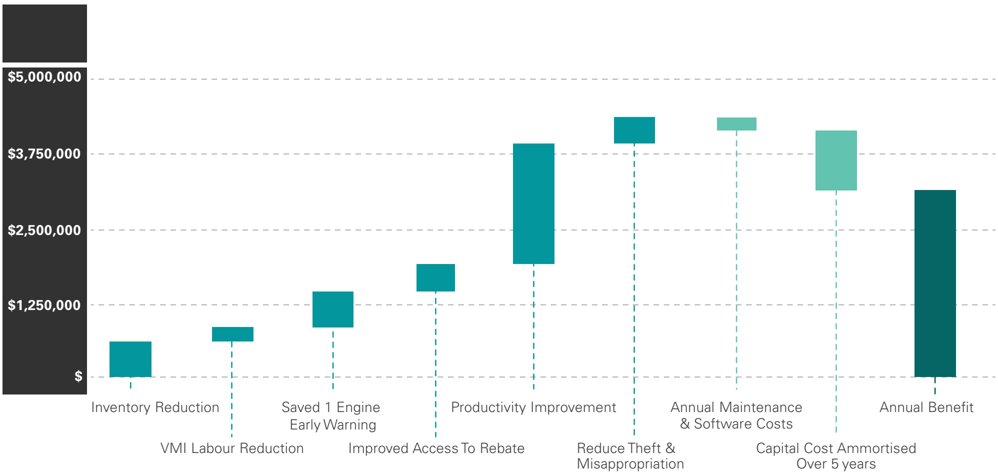
Improving

- the quality and consistency of captured hydrocarbon data by implementing standardised data capture and storage.
- compliance with various legislative requirements (such as occupational health and safety, dangerous goods and mine safety) by significantly reducing the need for manual data recording.
- reporting to government (such as Department of Environment, National Greenhouse and Energy Reporting, National Pollutants Register) by capturing and storing more complete and accurate hydrocarbon usage data.
- claims for carbon taxes or other rebates such as by the Australian Taxation Office fuel rebates by ensuring more accurate, consistent, and timely documentation.

3.2 Ratio of Benefits

Productivity is a key benefit of a best practice. Figure 2, for instance, outlines the ratio of benefits that can be obtained by implementing FMS best practice. Importantly, it shows that productivity improvements can significantly outweigh cost savings. Improving productivity generally leads to a reduction in the number of heavy vehicles operating on a mine site, providing a disproportionally large benefit. Please note that the outcomes in Figure 2 have been taken from an actual Australian mine site which spends $110m per annum on fuel and lubricants.

Figure 2: Quantum savings from FMS Implementation.



4 Key success factors

There are four key factors that are essential in determining the likely, and long-term, success of your FMS.

These include:

Accountability: Are your key stakeholders aware of their role, and committed to delivering successful outcomes?

Resourcing: Do you have sufficient resources and have you correctly assigned the right people?

Reconciliation: Do you have processes and systems to ensure that all inflows and outflows across your operation reconcile to within a suitable error limit so you can be confident you are optimising fuel and lubricant use?

Data maintenance and integrity: Do you have checks and processes in place to ensure that only correct data enters the system on an ongoing basis?

4.1 Accountability

A fuel management system spans many areas of your mining organisation, and departmental accountability is critical. Each stakeholder needs to be aware of their role in delivering successful outcomes. Mines with poor fuel management performance often lack overall management of fuel and lubricants at a site. Typically, different departments within a mine will have very separate responsibilities. For instance, this could include:

- Supply chain / warehouse department – responsible for managing Inventory and re-ordering.
- Infrastructure maintenance department – responsible for maintaining FMS non mobile equipment.
- Fleet / service truck maintenance department- responsible for maintaining FMS mobile equipment.
- Production/operations management – responsible for refuelling intervals and consumption and for managing some fuel efficiency projects.
- Corporate management (finance / environmental / corporate

governance) – responsible for high level decisions on fuel and lubricants.

While there are multiple tiers of coordination and effort required to implement a best practice FMS, core requirements such as system maintenance, data integrity and effective reconciliation are pre-cursors to any additional benefits. For these to occur, a consolidated and collaborative effort is essential. Once these precursors are satisfied and maintained, the focus should be on driving performance.

To ensure optimal accountability in your operation it can be helpful to allocate efficiency activities and KPIs to relevant teams. Figure 3 provides an example of the link between FMS components, efficiency activities, resultant benefits and KPIs.

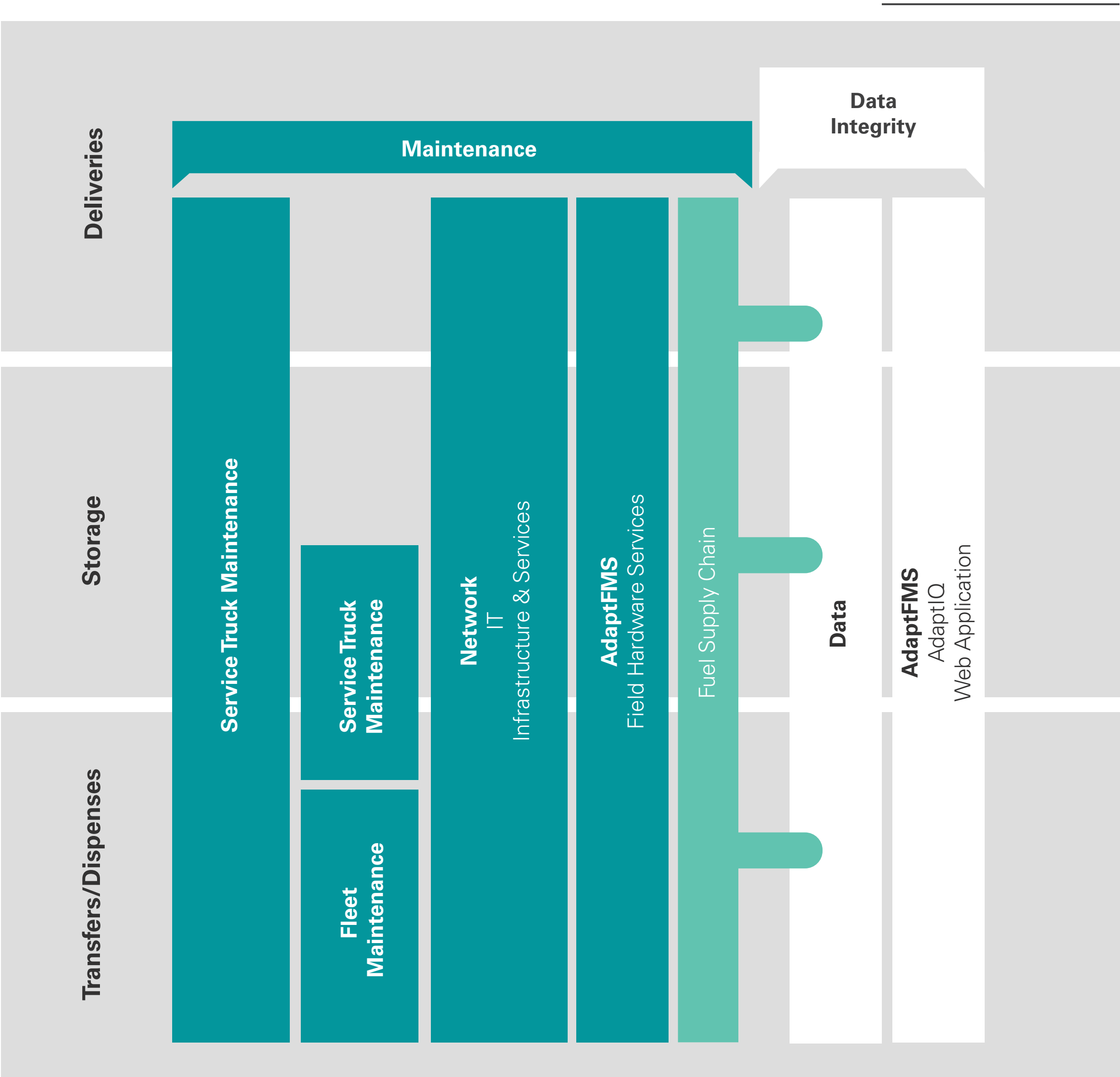
4.2 Resourcing

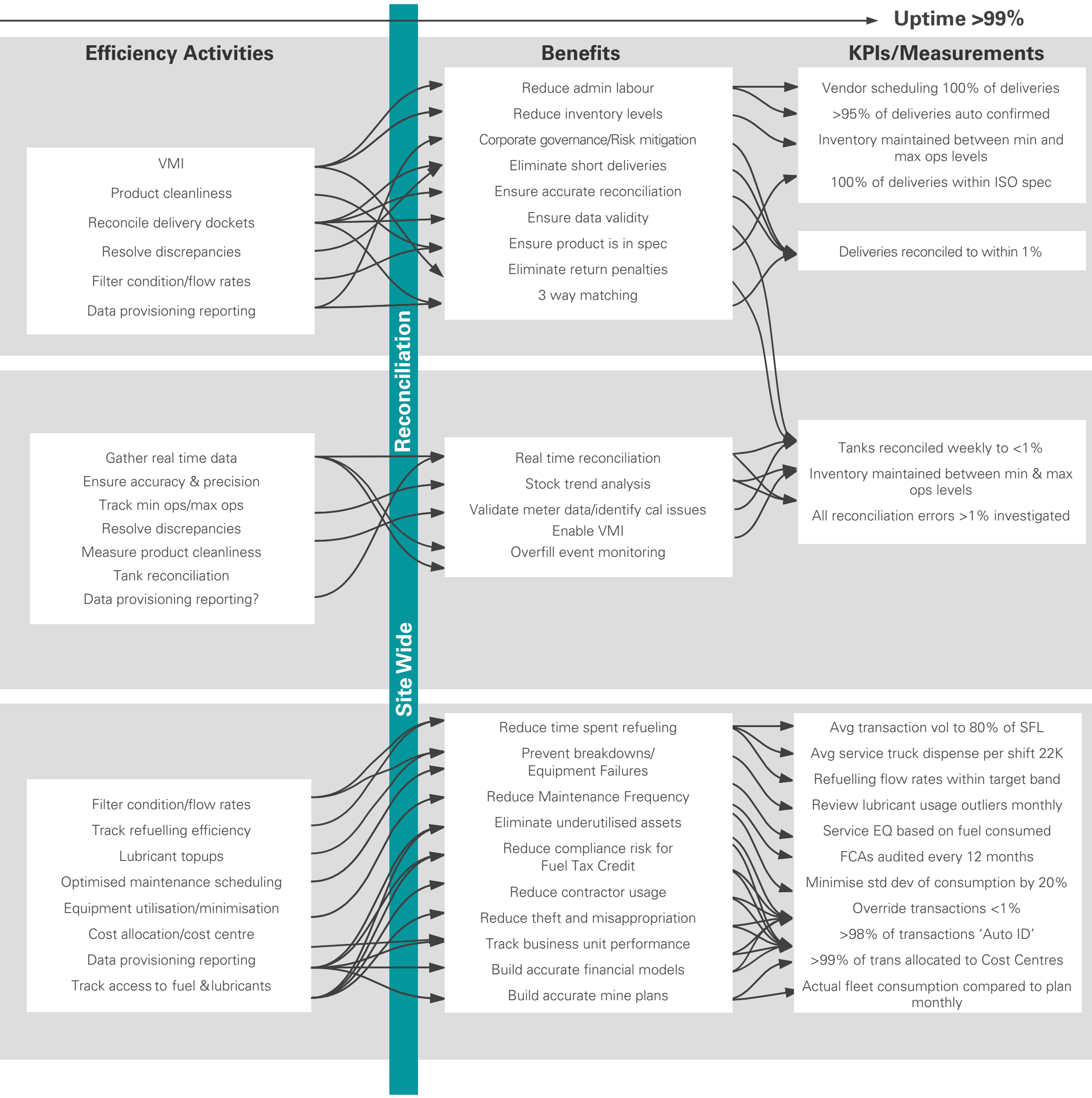
From a resourcing perspective, best practice FMS management across multi-site enterprises requires three key initiatives.

1. Appointing a dedicated corporate FMS manager, who reports to production/operations. This person would:
   - Benchmark performance across sites to improve fuel management outcomes.
   - Coordinate data and IT standards for the FMS.
   - Centrally manage the enterprise software application across the company.
   - Drive best practice and coordinate user groups and business feedback for continuous improvement.
   - Drive integration with other relevant business systems such as ERP and fleet management.

2. Appointing a "fuel champion" on each site, who would be the main contact for the FMS vendor. This person would:
   - Coordinate all intra-departmental hydrocarbon activities

Figure 3: A best practice FMS, indicating link between activities, benefits and KPIs




Uptime >99%
Efficiency Activities
Benefits
KPIs/Measurements
Reconciliation
Site Wide
VMI
Product cleanliness
Reconcile delivery dockets
Resolve discrepancies
Filter condition/flow rates
Data provisioning reporting
Reduce admin labour
Reduce inventory levels
Corporate governance/Risk mitigation
Eliminate short deliveries
Ensure accurate reconciliation
Ensure data validity
Ensure product is in spec
Eliminate return penalties
3 way matching
Vendor scheduling 100% of deliveries
>95% of deliveries auto confirmed
Inventory maintained between min and max ops levels
100% of deliveries within ISO spec
Deliveries reconciled to within 1%
Gather real time data
Ensure accuracy & precision
Track min ops/max ops
Resolve discrepancies
Measure product cleanliness
Tank reconciliation
Data provisioning reporting?
Real time reconciliation
Stock trend analysis
Validate meter data/identify cal issues
Enable VMI
Overfill event monitoring
Tanks reconciled weekly to <1%
Inventory maintained between min & max ops levels
All reconciliation errors >1% investigated
Filter condition/flow rates
Track refuelling efficiency
Lubricant topups
Optimised maintenance scheduling
Equipment utilisation/minimisation
Cost allocation/cost centre
Data provisioning reporting
Track access to fuel & lubricants
Reduce time spent refueling
Prevent breakdowns/ Equipment Failures
Reduce Maintenance Frequency
Eliminate underutilised assets
Reduce compliance risk for Fuel Tax Credit
Reduce contractor usage
Reduce theft and misappropriation
Track business unit performance
Build accurate financial models
Build accurate mine plans
Avg transaction vol to 80% of SFL
Avg service truck dispense per shift 22K
Refuelling flow rates within target band
Review lubricant usage outliers monthly
Service EQ based on fuel consumed
FCAs audited every 12 months
Minimise std dev of consumption by 20%
Override transactions <1%
>98% of transactions 'Auto ID'
>99% of trans allocated to Cost Centres
Actual fleet consumption compared to plan monthly

- Ensure the database is up to date with all equipment items
- Review reports and analytics to drive performance
- Ensure FMS equipment is maintained correctly.
- Manage the site FMS continuous improvement program.
- On-board new staff and provide basic training and set-up for new employees.
- Ensure fuel management policies are maintained.

3. Classifying the FMS as a primary requirement for production. This is critical in ensuring the FMS obtains a high profile within the site to attract suitable resources and to ensure the benefits of the system are realised.

4.3 Reconciliation

Data completeness and accuracy is critical to the implementation success of your FMS. Maintaining the completeness and accuracy of your FMS data is important in delivering the benefits of the system and maintaining the trust of users and stakeholders.

Without trust in the data, users are less likely to action the insights gained from an FMS. A tank-by-tank inventory reconciliation of fuel and lubricants, down to the level of the fuel consuming asset, is critical to the success of any fuel management system.

The required accuracy is determined by the goals identified for system implementation – yet maintaining the reconciliation within the target level is a critical KPI. The requirement to reconcile each individual tank, rather than the site as a whole, is driven by the improved ability provided to identify and resolve system anomalies or issues.

The achievable accuracy of reconciliation is dependent on a number of factors including the accuracy and precision of any measurement transducers and hardware, maintenance and calibration of the system, as well as environmental factors. What is important is that a threshold is set and there are key system users accountable for its achievement.

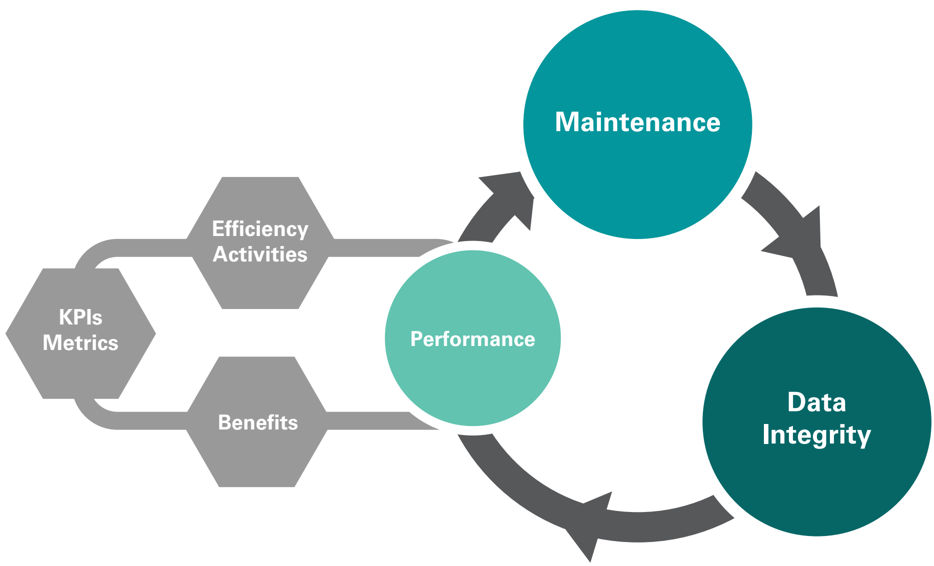
Once a suitable reconciliation error is achieved, your business can focus on the many other benefits possible from your FMS implementation, with the knowledge you are able to trust the data and insights provided by the system.

4.4 Maintenance and data integrity

If a tank-by-tank reconciliation KPI can ensure that the data is complete and reliable, system maintenance is the precursor to ensure quality data input. Whether it be an SLA with your vendor, or maintaining the system yourselves, clear system availability metrics and an understanding of their impact is key.

Figure 4 provides an outline of best practice fuel management, in which maintenance enables data integrity, which enables performance.

Figure 4: The importance of maintenance on performance



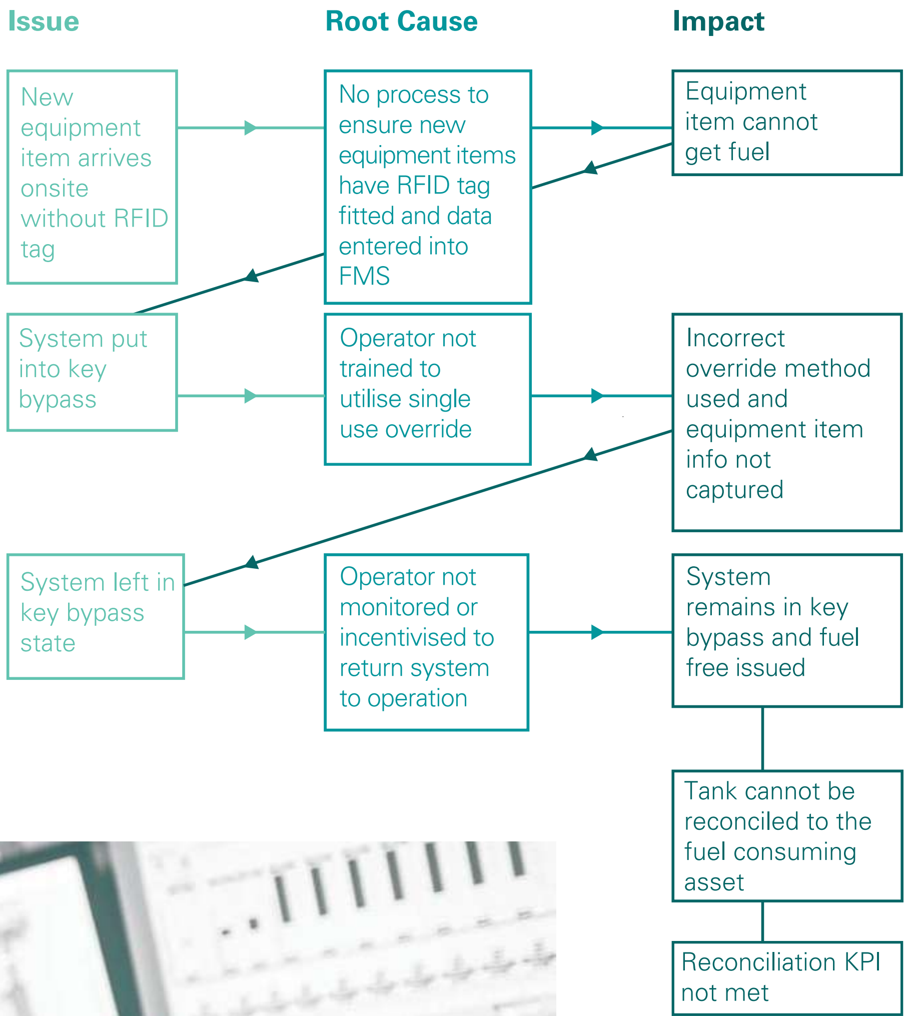
Once a foundation of maintenance and data integrity is established, the value of the FMS can be driven during the performance phase.

An FMS implementation will enable the performance of efficiency activities which deliver benefits or value to your business, and should be measured using relevant KPIs.

Without the support of teams in the field, small issues, such as a new equipment items not being authorised for fuel, can lead to larger issues such as the system being bypassed and not returned into operation. This can have a detrimental impact on data integrity way beyond the magnitude of the initial problem.

Figure 5, for instance, shows a simple example of how a small issue, such as a new equipment item arriving on site without an RFID tag, can have a big impact.

Figure 5: An example of the importance of data integrity



5 Best practice initiatives and KPIs

The following initiatives can help ensure best practice fuel and lubricant management across your mine site(s). Please note that these recommendations have been prepared by FluidIntel, in conjunction with representatives from some of the world's most successful mining operations.

The initiatives include:

- Appoint a fuel champion,
- Measure system uptime,
- Conduct tank inventory reconciliation,
- Conduct regular maintenance and administration,
- Enable vendor managed inventory,
- Monitor deliveries,
- Develop a "no free fuel" culture,
- Check service truck productivity,
- Optimise the refuelling process,
- Identify irregular fuel (and lubricant) consuming assets,
- Monitor flow rates,
- Use fuel burn to determine preventative maintenance,
- Measure fuel quality, and
- Implement solutions at the gantry.

5.1 Appoint a fuel champion

The single most important activity for FMS best practice is to ensure a fuel champion is appointed at each site. This person should have authority across all departments for maintaining, monitoring, analysing and reporting on fuel management activity to drive performance.

Recommended KPI: Provide a regular system uptime report to a senior manager.

5.2 Measure system uptime

If you operate large mine site, your FMS may contain over 500 components at more than 50 locations. It is critical, therefore, that your fuel champion is confident that each component is operating in order to ensure that the correct data is being collected to drive performance and to help manage FMS maintenance programs.

Your fuel champion should therefore prepare a regular system uptime report which includes the following:

- Metrics for online status. Are the field controllers pushing all the data to the web application?
- Are the connected peripherals (e.g. RFID readers, tank gauges) connected and operational?
- Are any system components bypassed? If so, for how long?
- What percentage of transactions are automatically identified? How many have required a manual PIN? Have there been any system overrides or bypasses?
- Can each tank be accurately reconciled with all dispenses accounted for to the fuel consuming asset?

Recommended KPI: System uptime should be accurately measured and reported on weekly, with an outcome of >98%.

5.3 Conduct tank inventory reconciliation

Tank inventory reconciliation is a core KPI that should be established for any FMS, as it indicates overall system health. Typically, there are five key steps required to enable tank reconciliation. Following is an overview of these steps. However, be aware that in some circumstances, there may be infrastructure limitations that prevent this approach.

Step 1: Monitor deliveries

This step requires either flow meters with adequate air eliminators to remove entrained air, or a gauged transaction service which can calculate deliveries based on changes in tank volume measured by the level gauges and accounting for any simultaneous dispenses. The most suitable approach is determined after consideration of each tank and its associated infrastructure.

Having the right technology at the delivery point can enable you to collect and aggregate this data and capture input from the delivery driver, such as company name, driver ID, docket number and docket volume. This is important data for reconciling any discrepancies.

Step 2: Monitor inventory levels

Accurate level gauges are a critical component in realising the many benefits of a FMS. As well as the gauge itself, it's important to ensure it is calibrated correctly, the strapping table is accurate (a strapping table converts a level/height into a volume) and it has reliable network connectivity. Some gauges can recalibrate themselves, or require minimal calibration, so the maintenance of the gauge is often model specific and any manufacturer's guidelines should be followed.

Step 3: Monitor dispenses and transfers

The final component of tank reconciliation is to monitor all dispensing and transfers out of the tanks. Each dispense or transfer out must be to an identified equipment item or tank. This is important, as many of the benefits possible from a FMS require that dispensing transactions are traced to an equipment item rather that accounted for in bulk. This also helps to identify and rectify any discrepancies when this additional level of traceability is available.

Step 4: Implement automatic equipment and personnel identification

One of the most important factors in ensuring data accuracy and accountability in the reconciliation process is implementing an auto ID of the fuel consuming asset. It is recommended that you authenticate heavy, medium and light fuel consuming equipment via ID tags. Increased data quality, accuracy and accountability can be achieved by identifying operators via a personnel identification system. Best practice FMS operation assumes both equipment and personnel ID is enabled and manual ID is available as back up, but disabled.

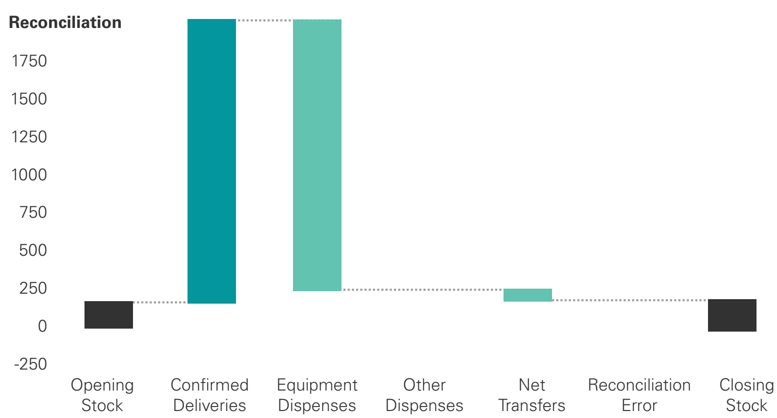
Recommended KPI: When it comes to tank inventory reconciliation, the level of reconciliation is dependent upon the measurement transducers available, the size of the tank and calibration. However, as a general rule, less than +/-1% should be achieved, and some sites achieve less than 0.5%. Additionally, to ensure that fuel and lubricants are being accounted to the individual asset, a KPI that measures the number of key bypass or supervisor override transactions should be less than 1%. This allows for some equipment items that are missing RFID tags to be refuelled, but to still have the fuel captured and accounted for.

Step 5: Monitor performance

Regular monthly reporting is essential in tracking your reconciliation performance. Your reports should indicate your key reconciliation error percentage, and an error trend report should also be run to indicate any trends in your errors. Following are examples of reports from FluidIntel's proprietary system, AdaptFMS, which are used to measure tank inventory reconciliation.

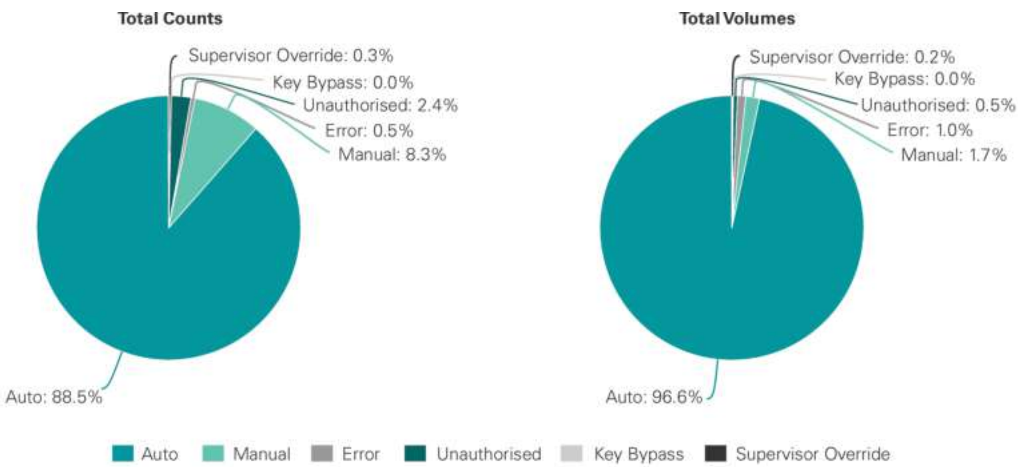
Figure 6: Reconciliation and Rebate Report.

Overview	
Opening stock	158 546.55L
Deliveries	
Confirmed	▲ 1 501 078.00L
Unconfirmed	0.00L
Rec. adjustments	-4 901.12L
Dispenses	
Equipment	▼ 1 440 254.56L
Other	▼ 0.00L
Net Transfers	▼ 45 014.98L
Closing stock	169 453.89L
Reconciliation Error	
Total	▼ 4 901.12L
As Outlow %	▼ 0.33L



AdaptFMS's Reconciliation and Rebate report (Figure 6) is an example of an error trend report. It shows the results for a virtual tank (3 x 100,000L interconnected tanks). It details opening stock levels for all confirmed deliveries, which are credits to the tank inventory level, and all dispenses and transfers out of the tank, which are debits. Other dispenses should be within the target band. These are an accumulation of bypass transactions or errors. In this figure, the difference between opening stock plus deliveries minus dispenses minus transfers and closing stock is the reconciliation error for the period. The report also includes any unconfirmed deliveries in the table, so a check can be made to ensure all deliveries are accounted for. This value is not included in the reconciliation error calculation. If the error is outside of the KPI level, an investigation as to the cause of the error should be conducted.

Figure 7: Monthly Error Transactions. Transaction analysis for one month showing unauthorised and error transactions that required investigation.



The ***monthly error transactions diagram*** (Figure 7) shows a site summary for a month. The left hand pie chart highlights the percentage of transactions of each type, and the right hand pie chart indicates the volume that this represents. The full report contains details that allow a number of important insights:

- For the month of the report, 88.5% of the transactions and 96.6% of transaction volumes were automatically identified.
- 8.3% and 1.7% were the corresponding values for manual transactions. The reason for the larger number of manual transactions to volume ratio is that most manual transactions were smaller oil and coolant transactions in the workshop which were performed manually, and light vehicle transactions for non-tagged vehicles.
- 0.2% of volume was dispensed via supervisor override which is acceptable, given the requirement to refuel equipment and vehicles that may not have working ID tags or were not in the equipment database.

In this example, of concern and worthy of investigation are the unauthorised and error transactions. Unauthorised transactions indicate that product flow has occurred without a corresponding transaction being authorised. Error transactions are generated if there are issues closing the transaction.

The large count of unauthorised transactions (2.4%) with a smaller corresponding volume (0.5%) is an indicator that there are many small volumes being created outside of an open transaction. Commonly, this is due to meter rattle (the meter vibration and sending pulses the system picks up as flow, solved by using quadrature meters) or small volumes generated on pump start-up or after a transaction has closed. Once diagnosed, these can be resolved. There is also 1% of error transactions, indicating an issue with the flow measurement hardware. The next step is to determine the locations.

Figure 8: Location of error and unauthorised transactions.

Totals	Auto	Manual	Error	Unauthorised	Key Bypass	Supervisor Override	Total
Volume	447,486.70 L	0.00 L	88,116.00 L	28,639.80 L	0.00 L	0.00 L	564,242.50 L
Count	650	0	32	55	0	0	737

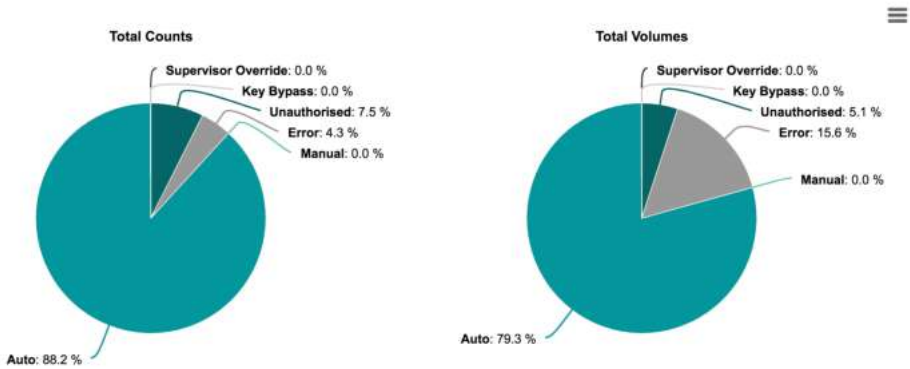
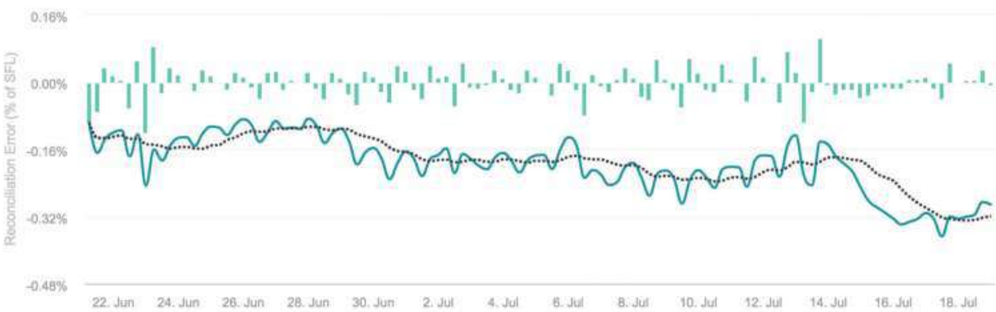


Figure 9: Daily transaction type breakdown.

The *location and error and unauthorised transactions diagram* (Figure 8) allows mine operators to investigate, in detail, the individual dispense points highlighted in the site report that are responsible for the error and unauthorised transactions. In this case, a single location was responsible for most of the issues.

The *daily transaction type breakdown diagram* (Figure 9) provides a day-by-day breakdown so operators can isolate incidents that have caused the issues, and investigate these further.

Figure 10: Daily reconciliation error trend.



By isolating incidents and determining the root cause, important changes in culture can be made, such as ensuring that system issues are reported and resolved promptly. In this case, the report indicates that a flow meter was not resetting and was creating erroneous transactions.

If issues are not explained by previous investigations, studying a *daily reconciliation error trend* report can help. The ***daily reconciliation error trend*** graph (Figure 10) shows the daily reconciliation error in a tank for a month when calculated inventory levels are compared to tank gauge readings.

There will typically be a gradual trend in one direction as flow meter error will drift in one direction (this can be complicated when there are multiple outflow meters connected to a tank). Any large spikes, or an increase in the rate of change, can indicate a problem that may impact accurate reconciliation.

By analysing trends, a hypothesis can be developed and investigated. The errors highlighted by Figure 10 show that the accumulated error is within the range expected from the flow meter. However, the latter increase in error should be monitored, and the meter recalibrated if necessary.

5.4 Conduct regular maintenance and administration

In order to achieve the recommended KPI of reconciling all tanks to <1%, regular maintenance and administration is vital. Site hardware must be regularly maintained, system and database administration needs to be well managed, and system instrumentation should be regularly calibrated.

Recommended KPI: For diesel meters, six-monthly calibrations and 12-monthly calibrations for lubricants and coolant are recommended.

5.5 Enable vendor managed inventory

A best practice FMS should have web-enabled reporting to provide viewing of real time data to numerous authorised personnel from any location. This enables vendor managed inventory to be established, where vendors completely manage bulk fuel resupply to the site. This has the benefit of reducing internal site staff requirements for tank dipping and reorder requests, and can also lower the price of fuel delivery by reducing inconvenience events for the fuel supplier.

To ensure the success of any vendor managed inventory system, it’s important to ensure that:

- A selected list of hydrocarbon vendor personnel be given viewing access to the system. Vendors should only be set up to see tanks that are relevant to their contract.
- An automatic email is set up to generate and send stock on hand reports, with desired frequency.
- System alarms should be set up at min-op and max-op levels. The min-ops is the minimum inventory level that the site can safely carry without impacting operations. A lower min-ops level means cash not tied up in inventory. This is determined with consideration of the following:
  - Site total consumption;
  - Volatility or change in consumption;
  - Length of the supply chain;
  - Risks to the supply chain such as weather, road closures, supplier lead times; and
  - Flexibility of the supplier.

The max-ops level also can impact the inventory costs. A lower max-ops reduces inventory levels overall and is generally a function of the min-ops level. A site must determine how narrow the band between the max-ops and min-ops levels can reasonably expect to be, and this is often negotiated with the supplier. By setting a min-ops and max-ops level and providing real time inventory data to the fuel and lubricant suppliers, a more disciplined and safer supply chain can be implemented with less over-ordering and, importantly, protection from running out of fuel. Many miners use this functionality to significantly reduce their inventory holdings.

The fuel champion should view at the frequency of once a week the tank history page, to monitor and assess vendor performance.

Recommended KPI:

- Min-ops and max-ops levels should be established and monitored for optimisation of inventory.

- Vendor KPIs should include the number of drift events out of the "management band", e.g. a maximum of one per month.
- Days of inventory held should be monitored.
- Vendor managed inventory implemented.

If you are managing the inventory internally, the same principles apply. The setting and managing of a tight storage band will result in fewer delivery rescheduling and diverting events, partly executed deliveries and similar events with cost penalties.
Please also refer to the following section, *Monitor deliveries*, for further tips on vendor management and verification.

5.6 Monitor deliveries

Delivery monitoring is one of the fundamental steps towards ensuring good governance. Data from your FMS can also be used for mandatory environmental and tax related submissions to local and federal government. Automated calculation engines should be provided within your software and should be easily activated. In the case of diesel tax rebate calculation, it's important to ensure that your system administrator changes the rebate rates at six month intervals, in sync with the current government policy.

From a corporate perspective, your FMS represents an independent and auditable third party system for event and transaction record keeping. Manual overrides and changes should be traceable and easily validated.

Your FMS should also allow for cost allocations of fuel and hydrocarbons to configurable ERP codes such as for site departments, business divisions, contractors and more.

The FMS should enable a three-way match, meaning it should be able to compare metered volume to driver entered docket volume and allow a comparison to invoiced volume.

Any discrepancies identified through this method should be investigated as a mandatory procedure and embedded as part of the vendor's contract. This will ensure you only pay for fuel that was delivered and will enable you to identify any administration and billing errors.

To enable a three-way match, your site must ensure delivery meter monitoring of the inflow, and that the tank gauges are regularly calibrated.

A delivery variance report should be run at the minimum interval of once per month, and/or coinciding with goods receipt/invoice approval process. The delivery variance report should compare the primary volume, as set in the system, to the secondary volume.

An example of this process is to set the metered volume at the point of delivery as the primary, and set the docket volume entered by the driver as the secondary volume. If there are tank level readings available for the period in which the delivery occurred, the enterprise software should execute an algorithm to calculate what the delivery would have been according to the level gauge. This should take into account any dispenses that would be occurring at the same time.

Recommended KPIs:

- Where meters are used, they should be calibrated at all delivery locations. Meters should have an accuracy of +/-0.55.
- If level gauges are used to monitor deliveries utilising the gauged transaction algorithm (GTS) (which is available in FluidIntel's AdaptIQ software), gauges with a +/-1mm accuracy in reference conditions and better than +/-4mm installed accuracy should be used, particularly in larger tanks.
- Reduce material delivery variance by 50%. Identify and investigate all delivery variances over 4% within 72 hours of occurrence. Set alarms to notify the fuel champion immediately

if an out of tolerance delivery occurs.

- Where a delivery driver notes a discrepancy greater than 2% between the delivery docket and the inflow meter, they must report the incident to their supervisor for notification to the client within 24 hours of occurrence.

5.7 Develop a "no free fuel" culture

There may be circumstances on site where fuel must be obtained, but the FMS is not allowing a dispense to occur. There can be numerous reasons for this – though the reality is that it typically occurs very rarely. To ensure sites can obtain fuel at all times despite the FMS operation, the system can be bypassed. On sites with a poor fuel management culture, employees can abuse this function and many systems can remain in bypass for significant periods of time unnecessarily, making it difficult or impossible to meet reconciliation targets.

To redress this, FluidIntel has developed multiple features in support of the best practice of developing a "no free fuel" culture on a mine site. The basic functionality starts from the use of a supervisor override code for unauthorised equipment. A remote supervisor override, which uses a one-off system generated code for single transaction approval, can be beneficial.

A best practice FMS should also include a dispense limit feature, to allow the system administrators to limit the volume dispensed to any specific equipment item over a set time period. Typically used for light vehicles and a contractor fleet, this function can set weekly dispense limits and can stop a dispense once a limit is reached.

It's also beneficial to have a key switch which can by-pass your FMS. In bypass mode, the system controls and authorisation functions are fully bypassed and controls handed over to manual operation. Best practice recommends that bypass keys are kept in a central maintenance office, away from the dispense locations, and handed out only in the case of system malfunction or emergency.

Recommended KPI: Less than 0.5% bypassed transactions recorded annually.

5.8 Check service truck productivity

VERIDAPT has tracked thousands of service truck shifts, and seen a wide range of performance between sites and operators over time. The data indicates that the best operators are up to 120% more effective than the least effective operators. Service trucks are a high value asset, with significant operating and maintenance costs. Optimising the

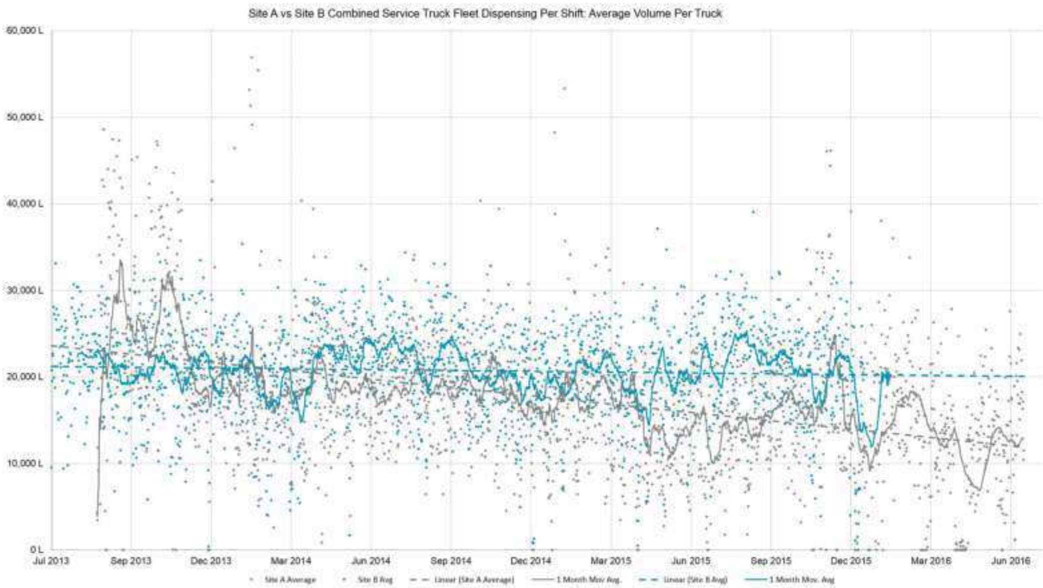


Figure 11: Service truck benchmarking between site A and B.

productivity of service trucks creates a valuable productivity gain and can save a site millions of dollars per annum.

Figure 11, for instance, compares service truck dispensing per shift between two similar sites run by the same company. It indicates that at one site, productivity has been decreasing over time, while the other is being maintained. Acting on this data can substantially improve productivity and lead to a reduction in the number of service trucks and operators required.

Recommended KPI: The volume of fuel dispensed per shift target is the most relevant KPI that can be implemented. Operators can be benchmarked against each other and coached to improve their performance. This can result in reduced standard deviation and increased mean, resulting in more operators performing at or near best practice.

5.9 Optimise the refuelling process

Refuelling fixed and mobile assets is a constant process, and large sites have tens of thousands of fuelling and lubricant transactions per year. The cost to the business of these activities can be significant. The time spent actually pumping fuel is only a portion of the time spent refuelling, which can also include driving to refuelling areas, operators climbing down off equipment, or service trucks attending fixed assets in remote locations. Reducing the number of refuelling events can increase the effective availability of equipment, reduce labour, and minimise the instances of potentially hazardous activities relating to refuelling, such as exiting equipment and moving around heavy equipment.

VERIDAPT has reviewed refuelling cadence across numerous mines sites and has identified great variability between sites, as shown in figure 12. It's important to note that sites use different methods and processes for refuelling, meaning it can be difficult to make direct comparisons between all sites. However, it is clear that reducing refuelling events means more availability of equipment.

Figure 12: Refuelling comparison for site A and site B

Figure 12 compares the refuelling practices of two sites. The x-axis of the graph indicates how much of the total equipment tank capacity was filled in the transaction, and the y-axis indicates the frequency with which it occurred. For example, the far left column indicates that approximately 6.5% of the time, site A operators refuelled less than 5% of the tank capacity. Alternatively, site B filled 5% of the tank capacity about 3% of the time.

Higher columns to the right would indicate the sites were filling up more of the tanks' capacity per transaction. The colours in the stacked column represent different categories of equipment. Values over 100 indicate whether the equipment was overfilled or incorrectly set up in the equipment profile. The large green bar for site A was an incorrectly configured class of equipment.

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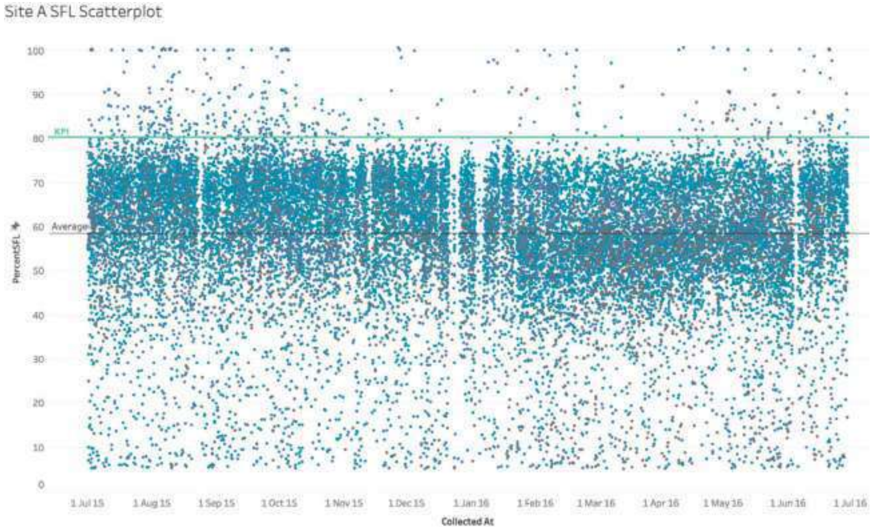
Figure 13: Comparison between sites A and B, for haul trucks.

Further insight into the refuelling process is demonstrated by Figures 13, 14 and 15, which provide a more detailed view – in this case, comparing haul trucks. This is an interesting group of vehicles to compare, as they are the most tightly controlled equipment in terms of utilisation.

Figure 13 again provides a comparison between site A and B, but only for haul trucks. It should be noted that haul trucks are filled more efficiently (meaning when they are closer to empty) than the rest of the general fleet. However, there is still a large difference between the two sites. Care must be taken in these comparisons, as there may be valid operational reasons for the differences. This graph can also indicate areas of improvement. In this comparison, most haul trucks at site A refuel when they are 35% full, while at site B, they are 20% full.

Figure 14 shows refuelling as a percentage of SFL for a haul truck fleet as a scatter plot, with each dot representing a refuelling transaction and each colour a model. Transaction volumes below 5% have been

Figure 14: Refuelling as a percentage of SFL for a haul truck fleet.



excluded. A data point at 100 indicates the tank was completely empty when refuelled. A data point at 50 indicates the tank was half full. The average remaining tank capacity was over 40% and the green line represents a KPI of 20% capacity remaining when refuelled. 24,000 transactions were analysed.

Figure 15: Refuelling as a percentage of SFL for a haul truck fleet.

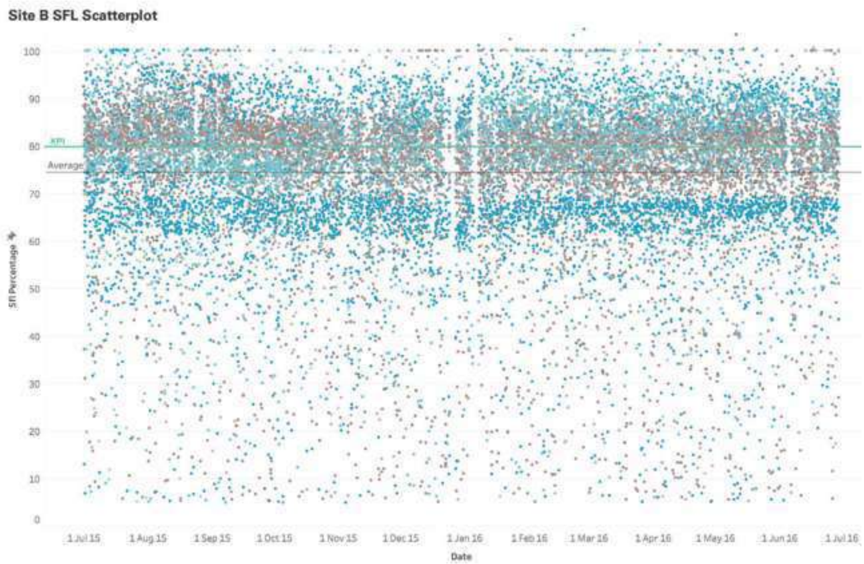


Figure 15 shows refuelling as a percentage of SFL for haul truck fleet for a comparative site. The green line represents a KPI of 20% capacity remaining when refuelled. 20,000 transactions were analysed. Please note the greater transaction volume as well as the narrower distribution.

Haul trucks are analysed in Figures 13, 14 and 15 as they are the most significant fuel consuming asset. However, improvements are available when looking at all fuel consuming assets as they tend to be even more widely distributed. The reduction in fuelling events could number in the tens of thousands.

VERIDAPT provides benchmark data on key metrics for customers on a monthly basis to track refuelling cadence, as well as the ability to compare various sites.

Recommended KPI: A site should consider its operations, practices and infrastructure when setting refuelling optimisation KPIs. One potentially powerful KPI is optimising when haul trucks are refuelled – for example, only refuelling when the fuel tank is 20% full. At the least, sites should measure refuelling cadence and look to improve it.

5.10 Identify irregular fuel (and lubricant) consuming assets

The effectiveness and power of this analysis depends on excellent database maintenance. All fuel-consuming items should be tagged, grouped and categorised as per company-wide agreed principles.

On a monthly basis, we recommend analysing all categories, starting from the heavy users and working through to the light vehicles, identifying the top 10 fuel users per category and then analysing root causes.

Identifying anomalies in coolant and lubricant use can also help prevent engine failures and major repairs. With the right fuel management system in place, it is possible to view lubricant/coolant consumption per diesel usage at a fleet/category level to easily identify equipment items which are deviating from the norm.

Recommended KPI: A site should aim for a baseline standard deviation of fuel consumption per category and reduce it by 20%.

5.11 Monitor flow rates

A best practice FMS should be able to monitor and report on flow rates at each dispensing point. This data is instrumental in detecting potential issues with pumping systems, filtration systems, control system tuning, and potential meter factor drift. This data is a useful leading indicator for potential system issues and can be used to justify or investigate future modifications of pumping systems.

Monitoring dispense point flow rates not only identifies minor issues before they become big disruptions to refuelling operations, but also ensures that vehicles' refuelling time is minimised to get vehicles back into production faster.

It's recommended that each dispensing point has, at a minimum, transactional peak and average flow rate monitoring enabled for every transaction, with more granular in-depth analysis conducted on at least two transactions per month.

Analysis of data can identify optimal filtration swap out times and alarms should be established on potential pumping faults based on trends and statistical analysis.

Recommended KPI: Alarms should be set when the flow rate drops 20% below optimum level. All alarms should be investigated to identify the root cause.

5.12 Establish a leak and calibration early warning system

In order to identify potential issues such as tank leaks, meter calibration issues or missed transactions, it can be beneficial to use statistical inventory analysis to provide a reconciliation adjustment service. This can create a transaction at the end of each day based on the difference between monitored and calculated tank levels.

Systems should allow for setting coarse alarm limits to trigger immediate user attention to investigate potential field hardware issues, missed transactions or meter calibration errors. The system should also monitor small errors which are within the alarm limits but over a longer configurable time period, which can suggest potential issues or instrumentation errors.

Recommended KPI: Monitor tank reconciliation on a weekly basis and investigate large deviations of 1% or more

5.13 Monitor overfill events

Overfill event monitoring allows you to keep a record of any potential spill events on site. In this case, your FMS is used as an independent record keeping platform, assisting in any compulsory environmental submissions to federal government regulators. This feature also allows for alarming and future prevention of recurring events through analysis of frequent alarms.

It's recommended that alarm limits are set to ensure minimal activation, and that all events are thereby handled immediately upon detection. Setting the limits appropriately is critical for ensuring minimisation of false or frequent alarms, and thereby reducing the risk of operator alarm fatigue and potential high risk situations being ignored.

All alarm events should be reviewed on a monthly basis to investigate any potential or likely issues with tanks and alarm limits.

Recommended KPI: No overfill events recorded on site.

5.14 Use fuel burn to determine preventative maintenance

Fuel burn can be used to establish preventative maintenance intervals. The concept is that fuel burn is a better indication of engine work and the requirement for maintenance than engine operating hours, as it accounts for idling and long hauls out of deep mining pits. This technique for scheduling maintenance can significantly reduce maintenance costs.

Implementing a fuel burn-based preventative maintenance program for mining vehicle fleets will optimise your maintenance scheduling and will eliminate preventative maintenance tasks from being performed both too soon and too late. The benefits are savings via a decrease in unscheduled maintenance, more efficient maintenance schedule, environmental impact and more.

Recommended KPI: Measure and compare current scheduled maintenance intervals against fuel burn to identify if over - or under - servicing is occuring.

5.15 Measure fuel quality

A best practice FMS should also provide you with real time data on your fuel quality - particularly particulate levels using inline particulate monitoring.

In some regions, fuel quality can be variable, or the supply chain (including the destination tanks) can introduce impurities. A quality FMS will provide an ISO count for each delivery and or dispense to ensure that the fuel delivered is of the required quality.

Minimising filter blockages, fuel injector problems and related issues can lead to substantial savings. It can also be possible to track each dispense and the corresponding ISO count to each equipment item, providing an audit trail of fuel quality.

Recommended KPI: Refer to required local/international standard. All fuel delivered is to the agreed ISO quality. All fuel dispensed to equipment is within OEM standards.

5.16 Implementing solutions at the gantry

Where fuel is dispensed from a terminal to satellite sites, a best practice FMS should enable you to plan and track all fuel movements. It should allow you to:

- Schedule fuel deliveries to individual tanks on site, including tracking which compartment of the fuel trailer or locomotive is allocated.
- Generate load plans which include appropriate fill levels in each compartment for axel loading during transport and any special requirements dictated by the route, for example.
- Provide a user interface and workflow for delivery drivers to load their trucks with a minimum of error and maximum safety.

6 How to implement a best practice FMS

To operate as effectively as possible, your FMS needs to be customised to your mine site's specific needs.

Following is an overview of the six key steps in implementing an effective FMS.

6.1 Step 1: Audit and stakeholder workshop

Before commencing any activity, it's important to conduct a detailed workshop with all key stakeholders, as well as to conduct an audit of your existing infrastructure.

This will help you determine:

- What FMS infrastructure is currently in place.
- What stakeholders want from better fuel and lubricant management.
- Major issues and priorities relating to fuel and lubricant management.
- How your site currently operates and manages fuel supply, storage, and dispensing.
- What volumes are consumed by product.

6.2 Step 2: Create a business case

After the site audit and stakeholder workshop, a detailed business case should be developed for stakeholder approval.

This should include:

- Documentation of current fuel and lubricant management practices at your site, key personnel involved, and key management personnel involved.

- Options for FMS implementation.
- Stages of FMS development and implementation.
- Detailed costings and costed benefits with financial business case.
- Lifecycle costs such as software support, hardware maintenance and end of life parts replacement.
- Recommended processes and procedures to be implemented.
- Management presentations.

6.3 Step 3: Design and Install

Once the project is approved, a detailed design and installation should be completed. Typically, local installation teams that have long servicing relationships with the mine can be engaged to conduct the majority of installation activities with design, supervision, commissioning, training, and handover completed by the FMS contractor.

6.4 Step 4: Establish KPIs

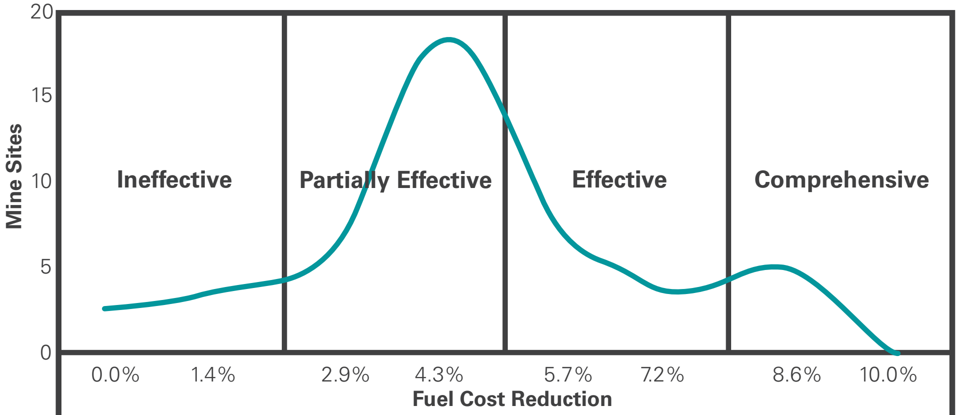
Once installed, ongoing measurement of your FMS is vital.

Your FMS will enable you to determine which metrics you can use as a baseline for improvement and establishment of progressive performance KPIs.

6.5 Step 5: Identify benchmarks and performance management criteria

Once sufficient data is obtained from your new FMS, you can begin benchmarking to drive performance improvement. FluidIntel has considerable data across numerous metrics for managing fuel and lubricants on mine sites. All our benchmarking data is anonymous, so one mining company cannot identify another company's data. In addition to benchmarking quantitative data across specific KPIs, FluidIntel also has a qualitative bell-curve to help companies in the planning stages of implementing FMS to understand where they sit (see Figure 16).

Figure 16: Fuel permformance by customer & qualitative benchmarking categories



Ineffective	Partially Effective	Effective	Best Practice
• Have limited or no formal systems of managing fuel. • Manual tank dipping with irregular cycle. • Manual data capture & recording or reporting via spreadsheet. • Carry too much or too little inventory. • Difficulty managing fuel supplier. • Theft & contractor misappropriation high but not transparent to mine. • Poor culture around fuel generally. • Can't reconcile fuel use to within +/-10%. • No clear roles & responsibilities for fuel management across mine. • Reporting on an ad hoc basis based on inaccurate and/or untimely data.	• Have implemented some hardware & perhaps software to manage fuel but site not completely covered. • Reconciliation ineffective and based only on matching supplier delivery dockets with invoices. • May have vendor managed inventory, but inventory still not optimised. • Limited dispensing control. • Theft & contractor misappropriation still an issue. • Fuel management culture poor- lots of bypass of system. • May have automated tank levels. • Don't use software often and still maintaining spreadsheets. • Fuel consuming asset list not well managed, disused equipment still on. • No clear roles & responsibilities for fuel management across mine.	• Vendor managed inventory in place & inventory optimised. • Minimal effort required to gather data as all processes automated. • Dispensing control. Reconciliation +/-2%. • Generally good culture around fuel managment. • Theft & contractor misappropriation controlled. • Have on-site fuel champion operating across departments. • Fuel equipment list up to date and well managed. • Regular reporting and engagement with senior management. • Suitable FMS maintenance arrangements in place ensuring high up time.	• Transfer & dispense management to high quality. • Reconciliation +/-1%. • Fuel champion diligent & has engendered strong fuel culture at site. • Oils managed also. • Have integrated fuel reporting with ERP & Vehicle software to report entire fuel chain. • Have detailed processes to measure fuel efficiency programs & optimise fuel use. • Continuous improvement program in place. • Detailed use of data analytics to improve productivity. • Senior management engaged in continuing to drive FMS benefits & savings.

6.6 Step 6: Compile a continuous improvement plan and lifecycle management plan

To remain effective, your FMS must be continually reviewed and measured, to ensure it stays relevant and current. A costed lifecycle plan should include establishment costs, maintenance over asset life, a software licence fee and support, and end-of-life replacement for components.

It's important to remember that best practice cannot necessarily be achieved immediately. However, if you install a fit for purpose FMS and follow the recommendations in this document, then your site will move towards its goal of best practice and improved profitability.

7 Summary

Fuel and lubricants are major expenses for mine site operators. However, with a best practice FMS in place, you can start to generate cost savings, ensure productivity improvements and reduce risks. As the concept of the digital mine gains traction, operating a high quality FMS with real time data and analytics is also becoming increasingly essential.

Best practice fuel management is about establishing the systems and building a culture that optimises all aspects of fuel and lubricant use.

The broadest measure of success is being able to achieve site-wide reconciliation of deliveries and dispenses of less than 1%. This ensures that data is accurate and that your team is doing the right thing. Good performance in the area of reconciliation also allows your senior management team to make better decisions, knowing the data they are acting on is accurate.

Each mining company and site operates differently, and as a result you will want to prioritise the implementation of best practices in a way that suits your purposes. However, most of the principles and practices outlined in this document will be applicable to your mine, at least to some extent. The benefits generated by implementing a FMS are likely to be the sum total of numerous small improvements. However, a reasonable expectation should be a payback on your FMS investment in around one year.

Find out more

To learn more about fuel management and how a FMS could benefit your mine site, visit VERIDAPT.com

8 Glossary

8.1 Abbreviations

AS	Australians
AS/NZ	Australian and New Zealand
FI	FluidIntel
FMS	Fuel Management System
HMI	Human Management Interface
HV	Heavy Vehicle
IP66/67	International Protection Marking for water ingress protection
ISO	International Organisation for Standardisation
KPI	Key Performance Indicator
LV	Light Vehicle
MCC	Motor Control Centre
MIL	United States Military Standards
NSW	New South Wales
OEM	Original Equipment Manufacturer
RFID	Radio Frequency Identification
RTM	Remote Tank Monitoring
SaaS	Softare as a Service
SFL	Safe Fill Level
VMI	Vendor Managed Inventory
WA	Western Australia

9 Definitions

AdaptIQ	This is the data presentation and web interface software for AdaptFMS. All transactions and tank levels can be viewed from this web page.
AdaptMAC	This is the HMI field Controller of AdaptFMS. The AdaptMAC is placed at all dispense, delivery and tank locations. AdaptFMS gives sites the ability to control who and what can consume hydrocarbons.
Authorisation	Authorisation is given through numerous methods including Automatic and Manual Transactions.
Automatic Transactions	An Automatic Transaction is where AdaptFMS has used RFID technology to authorise the movement of Hydrocarbons.
Delivery	A delivery is the point where the Hydrocarbon enters the site from a third party. A field user or equipment can be disabled in AdaptIQ.
Disabled	Once Disabled, that user or equipment is no longer authorised to start a transaction at an AdaptMAC.
Dispense	A dispense is the final movement before it is consumed.
Enabled	A field user or equipment must be enabled in AdaptIQ in order to start a transaction at an AdaptMAC.
Equipment	Equipment is regarded as anything which consumes a hydrocarbon. This includes, light and heavy vehicles, locomotives, tug boats, generators, pumps, etc.

Field User	To be authorised to start a Transaction at the AdaptMAC, a person must first be added to AdaptIQ as a Field User.
Manual Transactions	A Manual Transaction is where AdaptFMS uses a unique number to authorise the movement of Hydrocarbons. The number is stored in AdaptIQ and must be entered at the AdaptMAC.
Movement	A movement is where the hydrocarbon is tracked from the time it enters a site to the time it is consumed. A movement includes a delivery, transfer and dispense.
Nits	Measure of screen brightness or luminance. Also measured in Candella Cd/m2.
Product	This refers to the hydrocarbon being tracked.
RFID Transaction	The use of Radio Frequency Identification Tags and readers to authorise or open a transaction.
Source Tank	This is typically the tank where the hydrocarbon is stored before a transfer or dispense occurs.
Target Tank	This refers to the tank where the hydrocarbon is being moved to during a Transfer Movement.
Transaction	This is a record of a movement including date and time, product, location and who performed the transaction.
Transfer	A Transfer is where hydrocarbons are moved from one tank to another but is not consumed.

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