

Lubrication and ISO 55000

Martin Williamson KEW Engineering Ltd.





My background...

- Graduate Mechanical Engineer (1989).
- Success with reliability in mining in early 1990s.
- Technical support in filtration & on-site oil analysis
- 18 years of experience in training and consulting
- 12 years of Oil & Gas experience
- 26 years of Mining experience
- 11 years of KEW Engineering
- 10 years with Noria Corp.





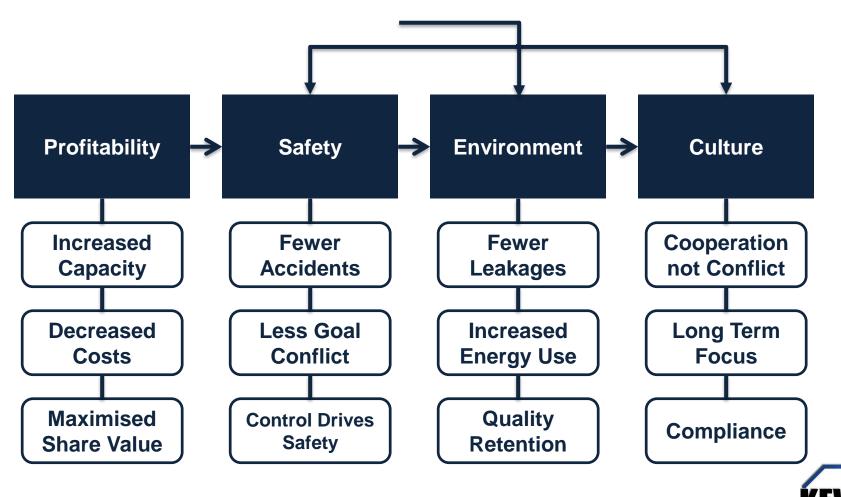
The Workshop

- A review of current culture in maintenance
- ISO 55001 what it is
- What ISO 55001 means for Maintenance
- How Lubrication fits within that context
- A step-by-step approach to designing for lubrication excellence within the framework of ISO 55001.



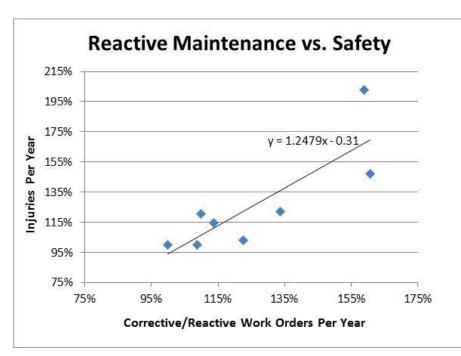


Social Responsibility



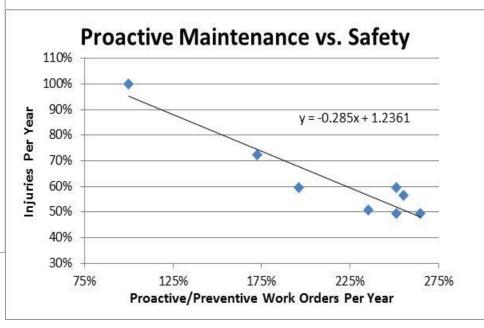


Safety Benefits



Doing more proactive work and less reactive work decreases injury risk. A planned job is a safe job.

Make the change from Reactive to Proactive.







Why PAS 55-1/ISO 55000?

- The financial benefits of Proactive Maintenance has failed to attract companies to properly manage their assets.
- The workplace Heath & Safety initiatives have failed to enforce Proactive Maintenance.
- Are we one BP-like disaster away from compliance?

The wheels may be in motion with PAS 55/ISO 55000





The Cost of Failure to Manage Physical Assets

Relative Share Price – 2003-2012: BP versus Chevron

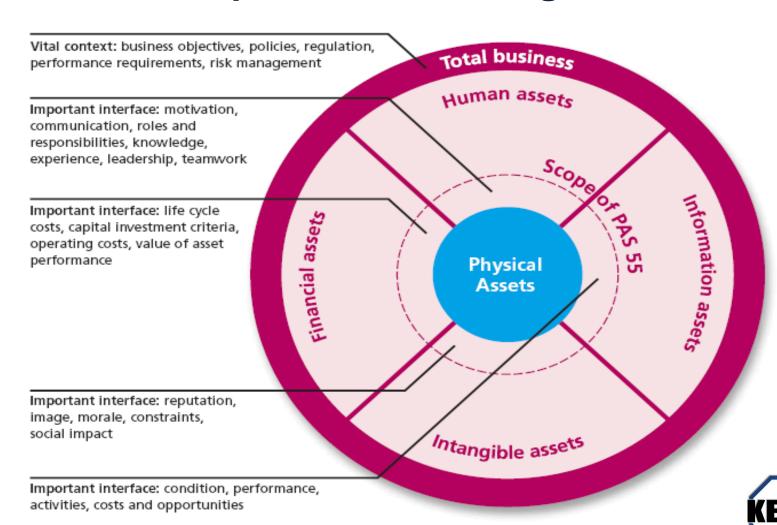


Note: 1 = Texas City; 2 = Prudhoe Bay; 3 = Deepwater Horizon



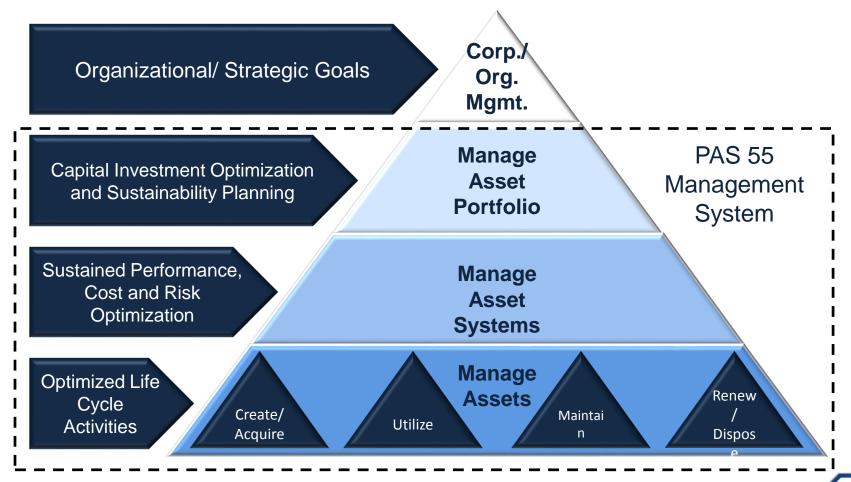


The Scope of Asset Management





PAS 55-1 Strategy







Compliance – PAS 55 Strategy / ISO 55000

4.7 Management Review

4.2 Asset Management Policy

4.6 Performance Assessment and Improvement

Act



Plan

4.3 Asset
Management
Strategy,
Objectives and
Plans



4.1 General Requirements



4.5
Implementation
of Asset
Management
Plans

Check



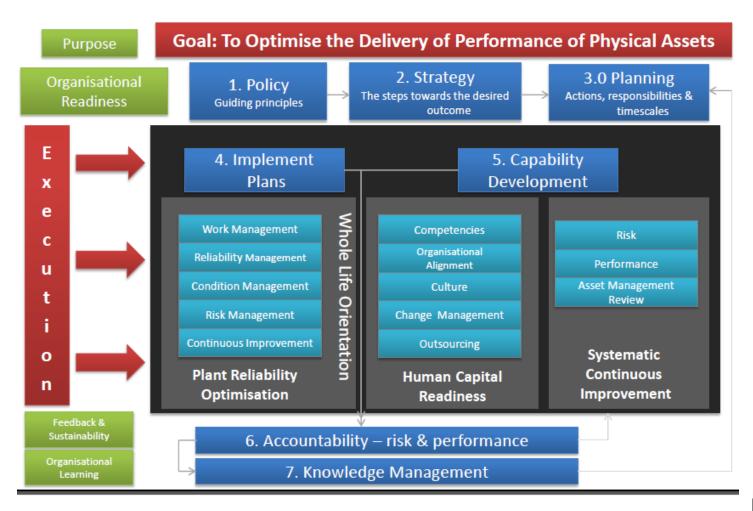
Do

4.4 Asset
Management
Enablers and
Controls





PAS 55 Implementation A3







Asset Management Policy

- Cleary defines equipment asset management policy
- Signed by the CEO and/or President
- Hung on the wall at all company locations
- Companion to quality, HS&E, environmental and other relevant policies

XYZ Company Equipment Asset Reliability Management (EARM) POLICY

XYZ is dedicated to achieving total customer satisfaction by providing high quality products, providing a safe and healthful place of work throughout all of XYZ skellbics, minimizing impact on the environment and generating profit to crosser what for its shareholders, employees and other satisfactions are shareholders, employees and other satisfactions.

As an Equipment Asset Dependent organization, XYZ recognizes the imponence of the reliability and dependability of its outperforms assets and, as such shall employ sensible offices towards eliminating or minimizing operational equipment a faulture that compromise our goals and mission.

XYZ shall, in all its locations where work is being carried out, promote the highest standards for Equipment Asset Reliability Management (EARM).

Our Policy is defined and strongly driven by the following management principles and behaviors. As such, we shall:

- Require commitment to EARM throughout all ranks and functional groups in the organisation because
 dependable equipment asset performance is necessary to achieve the organization's profit, Quality
 and Health, Safety and Environmental (HEE) goaley.
- Design and procure systems and equipment to achieve reliability, operability and maintainability, and minimize the life-cycle cost of ownership.
- Operate equipment assets correctly, within design limitations and in a consistent feation to minimize unnecessary stress and strain, which can compromise reliability.
- Maintain equipment with precision, emphasizing planned and proactive care to manage the known root cause of decementalization system degradation and respond effectively and efficiently to known equipment problems.
- Commit to collecting and systematically analyzing equipment asset performance data to enable informed decisions about assuring equipment asset health and reliability.
- Ensure all personnel are trained in EAM principles and empowered to locally manage their influence on the organization's global objective of equipment asset reliability, dependability and low life cycle cost of ownerability.
- Plan and perform work in accordance with the Quality and HSE Management System to achieve our commitments to quality, safety, environment, cost and achedule.
- Drive continual improvement and innovation based upon efficient business processes, well-defined measurements, best practices and customer surveys.
- Promote teamwork and use common language and processes

The above Policy provides the framework and sets the basis for essablishing and reviewing objectives at all relevant functions of 372 and its besidess. It shall be reviewed periodically for continuing suitability for fulfilling our mission.

DEO.	XYZ	Company	





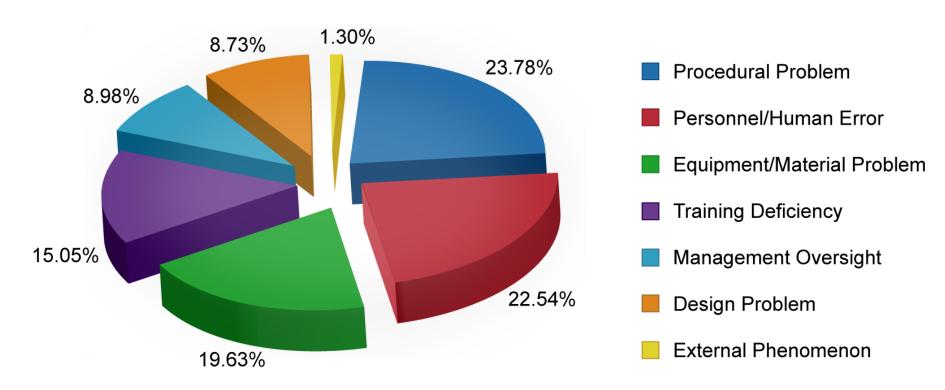
Summary

- The iron law of social responsibility may be slow to kick-in, but it's very sure and very onerous in it's effect.
- PAS 55 and ISO 55000 are voluntary standards. However, voluntary standards tend to become mandatory when they're ignored at the expense of the general public.
- As is always the case, first-world countries will endure the burden of mandatory asset management requirements, should they come to pass.
- The economic and safety drivers are sufficient to justify world-class asset management practices, as a community, we must do a better job at selling those benefits.





What Goes Wrong in the Plant?



Source: Troyer, D. – Reliable Plant Magazine





The Typical Human Failures

- Lack of communication
- Complacency
- Lack of knowledge
- Distraction
- Lack of teamwork
- Fatigue
- Lack of resources
- Pressure
- Lack of assertiveness

- Stress
- Lack of awareness
- Norms





Avoiding Human Error







Standardise for Success

Type	Description
1. Regulations	Formally established task management methods
2. Quality standards	Quality requirements specified by customer to suppliers
3. Specifications	Customer-specified restrictions and conditions placed on parts and equipment suppliers
4. Technical standards	Detailed standards for manufacturing that stipulate dimensions, temperatures, ingredients, etc.
5. Process standards	Detailed work procedures (processes) - usually seen in work procedures sheets and instruction booklets - often abridged versions of procedures found in manuals
6. Manuals	Handbooks of detailed descriptions of work methods
7. Circular notices	Notices to inform people of new or revised standards
8. Memos	Used to communicate to manage extraordinary circumstances not otherwised standardized - also used for other types of notices, minutes, in-house reports, etc.

Work orders to "inspect the machine" or "PM the machine" aren't procedures.

For Manufacturing:







Anatomy of a Good Procedure

Unique identifier Standard Maintenance NSP-S-002.01 . Train stell on the deployment of effective sampling pro-**General Considerations** The importance of oil sample quality can not be oversoon Sampling Procedure act. Poor samples had to poor decisions to act or not to act based upon falsely positive or negative oil analysis. **Drain-Port Location** This method of sampling involves the removal of lark and Some oil properties are preently borrogerous and relaeurop drain pluge no that a sufficient quantity of oil can tively unaffected by sample locations. They include: gravifate and drain into a sample container. Once the Visionity sample has been observed the plug is threaded back into the port. In some cases an equal embunt of makeup fluid - Neutralization number General must be active to the sums to make up for the fluid loss: > PTIR for avoideox, subtrion; olitation and editive levels to keeps familia is fool; valvier often reprocess the uses of a pripe ging and serves as the turk drain. considerations from . Throse include Material Requirements for Particle court Obtaining a Sample + Ministripe Assets including - You appropriate hand-wrench to seclect the pipe plug · West Sensite from the port A contilled chair capped sample container Some goneral sampling guitelines include: safety + X-larger flushing spiritalises Sample while operating under warnut application and elvároment stadišona - Skotliv label . Service from the pones "ser the cur" . Any other required documentation that old accompany Flush spotroom of Otters and downstream of components: the comple to assess the machina's condition > Applyingstyde Athleticing contained to If the surrections in I histoit teating sampling hardware that minimizes interfergare) for the swint for an isularide liabstrationy. seron and allows wengles to her drawn from the same place such firm. Sampling Procedure Maintenance and - Flush sampling ports whedively to seach the held of Draw sample during internal speciation or within 10 mile. - Kingley pricedown this minimizes data spelly and pain operation procedures sidercy and minimizes probadural roise and infoference + Line clave. Solling and solling where: must reflect the required Suintake all despiée Managaring environmental and - Record sampling hours to "time non making the data Analyze or sent the sample to the operating context of · Eirocete staff about the report of high quality oil samples to the the machine or maintenance throwns process. system.

Material and tool requirements for kitting

Details specific to the particular procedure

Pictures and graphics to complement text



The Best Practice is in the Details

Wrong	Right
Check oil pressure.	Confirm that oil pressure is between [X ₁] and [X ₂] psi.
Check temperature of DE bearing.	Confirm that temperature of DE bearing is between is below [X°] F.
Grease electric motor.	Using [Y] grease, apply $[X_1]$ grams to the DE and $[X_2]$ grams to the NDE bearings of the electric motor.
Tension belt.	Tension belt to [X] lbf, verifying with [Y] tensiometer. Recheck after [Z] operating hours and adjust if required.

Lack of definition in the variable aspects of maintenance – the X, Y and Z – is killing us.

We depend upon "Tribal Knowledge," which lacks precision.





How-To Guide To Maintenance Excellence



- Mimic the EAM/CMMS hierarchy.
- Extend the hierarchy where required.

Comply With:
DOE STD 1029
Writers Guide for
Technical Procedures

- Create standard maintenance templates.
- Identify fit, tolerance, quantity variables.
- Assign work plans to assets.
- Define variables for each machine.
- Include pictures or graphics where as appropriate.

- Modify equipment as required.
- Obtain required tools
- Train team members
- Create work management plans
- Implement metrics
- Modify reward systems
- Continuously improve





Lubrication Scheduling

Planned & Preventative Maintenance

- Small volume machinery
- General greasing

Condition Based Lubrication

Predictive Maintenance

- Wear Debris Analysis
- End of service life on large volume systems

Proactive Maintenance

- Oil maintenance on large volume systems
- Ultra-Sonic greasing
- Oil conditioning and filtering

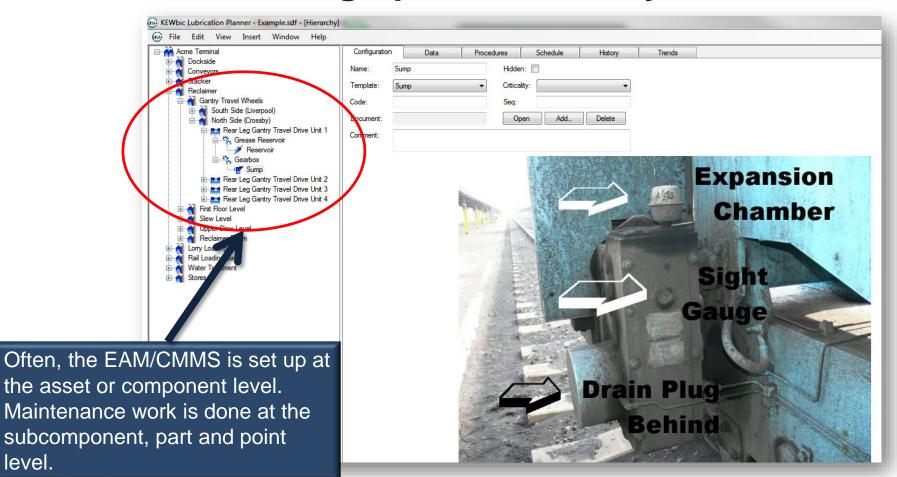
Breakdown
Maintenance
•NOT for
Iubrication

You need Procedures-based Lubrication Management





Setting up the Hierarchy





level.



The 5 Rights of Lubrication

The Right
Lubricant...
•Check the
colour coding!
•Do not mix
lubricants!





At The Right
Time...
•Aim for 100% on
lubrication PMs!
•Don't skip the
schedule!



With The Right Attitude
• Work Safe!

In The Right Quantity...
•Use the correct containers!







At The Right
Place...
•Check the
location and tag!





Example PM Procedure Elements

Instructions:

- 1. Remove the dust cap(s) from the 2 grease fitting(s) on the bearing housing(s).
- 2. Carefully clean the 2 grease fitting(s) with a clean lint-free cloth.
- 3. Inspect the 2 grease fitting(s) for damage replace if necessary.
- 4. Apply 6.7 ml/6.0 gm/6.0 shots of Shell Alvania RL3 grease to the Drive End (DE) bearing.
- 5. Apply 3.3 ml/3.0 gm/3.0 shots of Shell Alvania RL3 to the Non Drive End (NDE) bearing.
- 6. Apply grease at a rate of three (03) seconds per stroke cycle.
- 7. If back pressure exceeds 500 psi, slow greasing stroke.
- 8. If back pressure can't be held below 500 psi, discontinue greasing and report that bearing couldn't be greased due to excessive back pressure.
- 9. Reattach 2 dust cap(s), or replace if missing or damaged.

Visual Aids



With a very simple work instruction, the maintenance tech is equipped with the information necessary to carry out a precision lubrication – no guesswork!

Shell Alvania RL3





Use Pictures to Aid Inspection

LOOK For:

- ☐ Lube Level
- ☐ Lube Color
- ☐ Lube Leakage



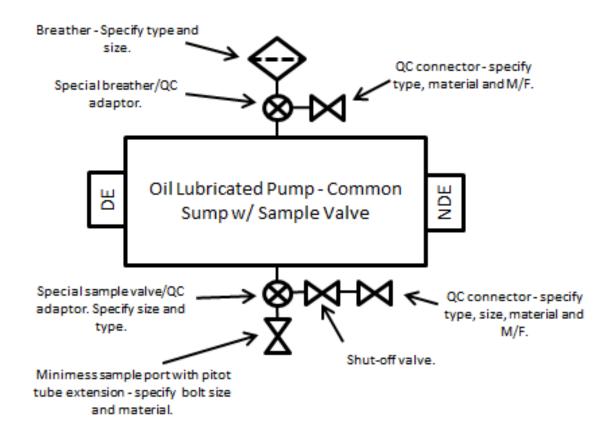






Equipment Modifications

It is sometimes necessary to modify the equipment to achieve reliability and maintainability goals.







Benefits of Procedure-based Manufacturing

Written Procedures

NORIA STANDARD PROCEDURES Standard Maintenance NSP-S-002.01 • Train staff on the deployment of effective sampling pro-General Considerations The importance of oil sample quality can not be overstated. Poor samples lead to poor decisions to act or not to act based upon falsely positive or negative oil analysis Sampling Procedure **Drain-Port Location** This method of sampling involves the removal of tank and Some oil properties are generally homogenous and relasump drain plugs so that a sufficient quantity of oil can tively unaffected by sample locations. They include: gravitate and drain into a sample container. Once the Viscosity sample has been obtained the plug is threaded back into the port. In some cases an equal amount of makeup fluid must be added to the sump to make up for the fluid loss. Neutralization number • FTIR for oxidation, sulfation, nitration and additive levels In large tanks a ball valve often replaces the use of a pipe plug and serves as the tank drain Other properties are very dependent upon sample loca-Material Requirements for · Particle count Obtaining a Sample · Moisture levels · An appropriate hand-wrench to extract the pipe plug · Wear levels from the port · A certified clean capped sample container Some general sampling guidelines include: Sample while operating under normal application and A larger flushing container · Bottle label · Sample from live zones "on the run" · Any other required documentation that will accompany Flush upstream of filters and downstream of components the sample to assess the machine's condition . Appropriate shipping container(s) if the sample(s) is Install testing sampling hardware that minimizes interfer-(are) to be sent to an outside laboratory ence and allows samples to be drawn from the same Sampling Procedure · Flush sampling ports effectively to reach the fluid of 1. Draw sample during normal operation or within 10 minutes of shutdown. · Employ procedures that maximizes data quality and consistency and minimizes procedural noise and interference · Use clean bottles and tubing where required · Sample at proper frequency · Record sampling hours to "time nor-· Analyze or send the sample to the lab immediately · Educate staff about the importance of high quality oil samples to the maintenance decision process. Copyright Noria Corporation, Duplication or copying without written permission of Noria Corp. is strictly prohibited



Clearly Define Preferred Practice



Consistency and Continuity



Reinforce Best Practice



Define Training and Certification



Enable Quality, Safety and Environmental Compliance

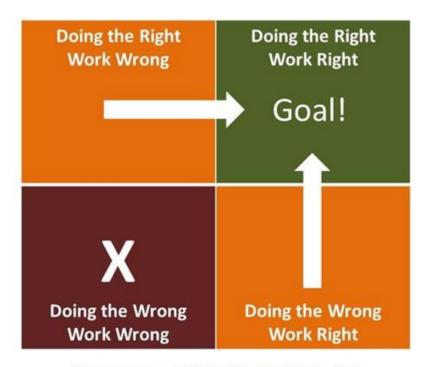




"Do the Right Work Right!"

- Find Work
 - Inspections and monitoring
 - Standardized work requests
- Manage Work
 - Systematic prioritization
 - Focus on leading metrics
- Prepare for Work
 - Standard work plans/procedures
 - Fit/ tolerance/ quantity/ quality details
 - Materials and tools
- Execute Work
 - Skills and training
 - Work quality assurance

Inspections, Monitoring , Planning and Work Management



Procedures, Skills, Tools, Materials and Work Quality Checks



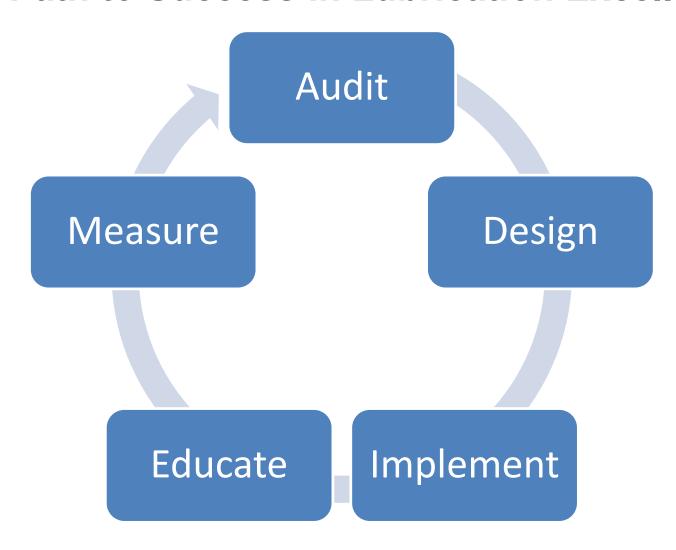


Designing for Best Practice and Lubrication Excellence.





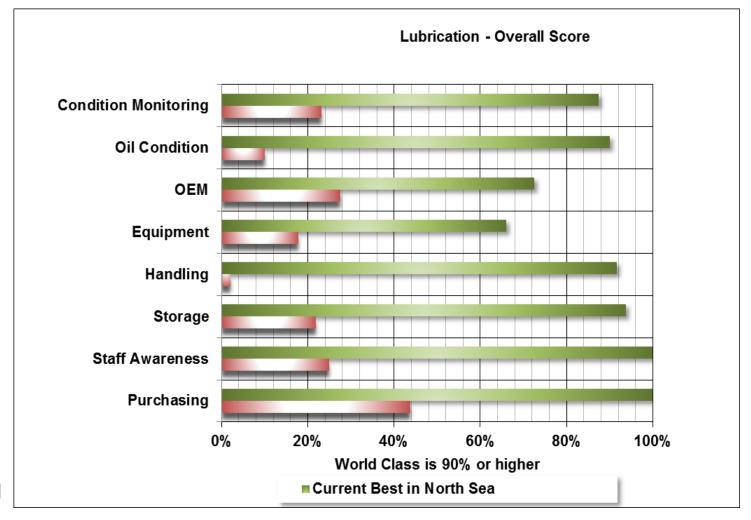
The Path to Success in Lubrication Excellence...





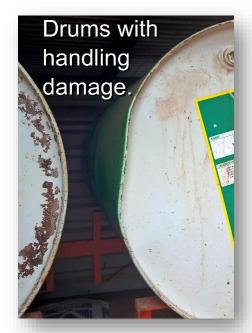


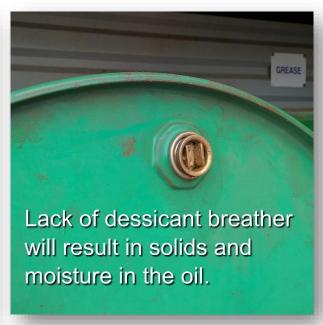
Audit Overview



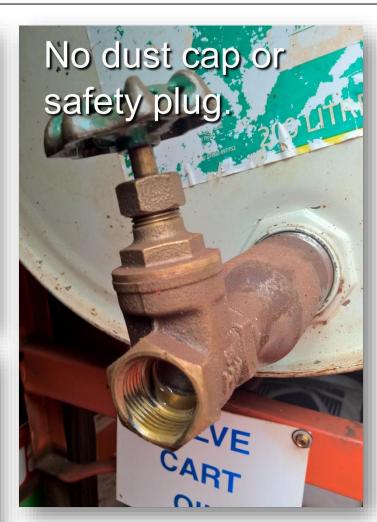








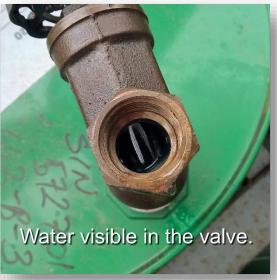


































What to look for in a solution

You need a solution that comprises of three basic sections:

- 1. Hierarchy
- 2. Templates
- 3. Procedures and Observations

In addition it should offer custom set-up of:

- 1. Routes
- 2. Reports
- 3. Roles
- 4. Asset Criticality
- 5. PM Priority

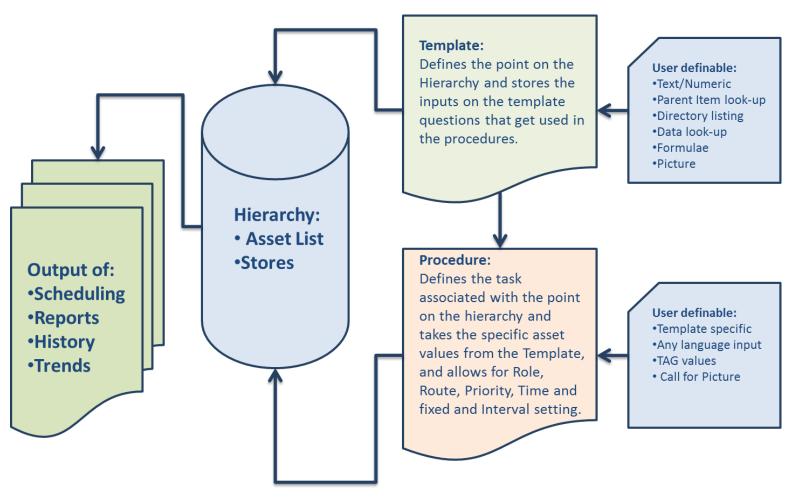
It should be flexible enough to allow for:

- 1. Image and PDF file attachments
- 2. Data look-up



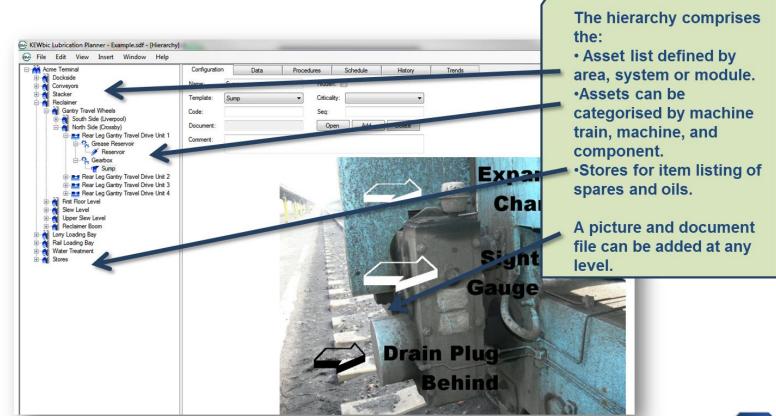


The basic structure you need





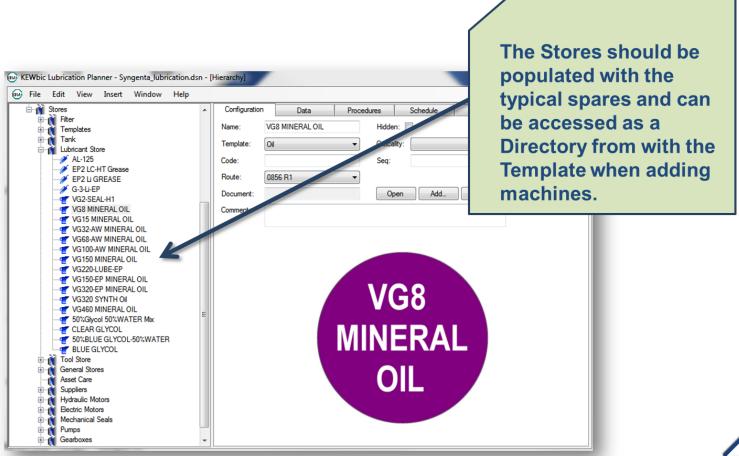
Notes on the Hierarchy







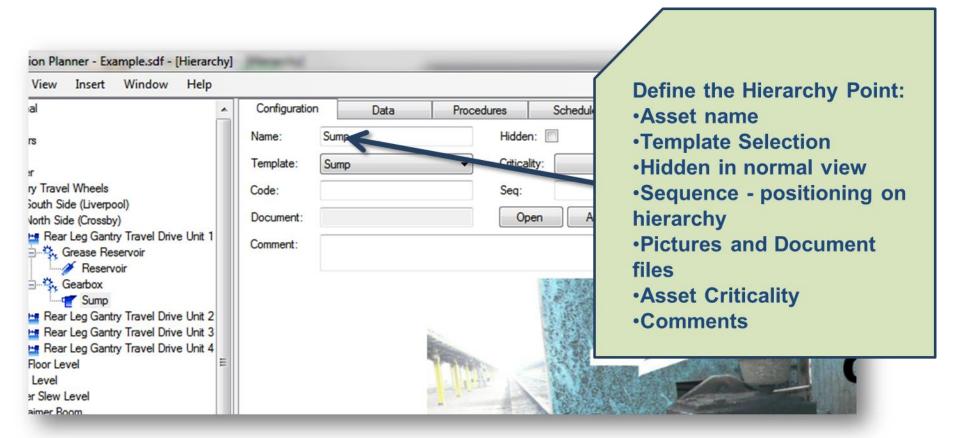
A note about the Stores







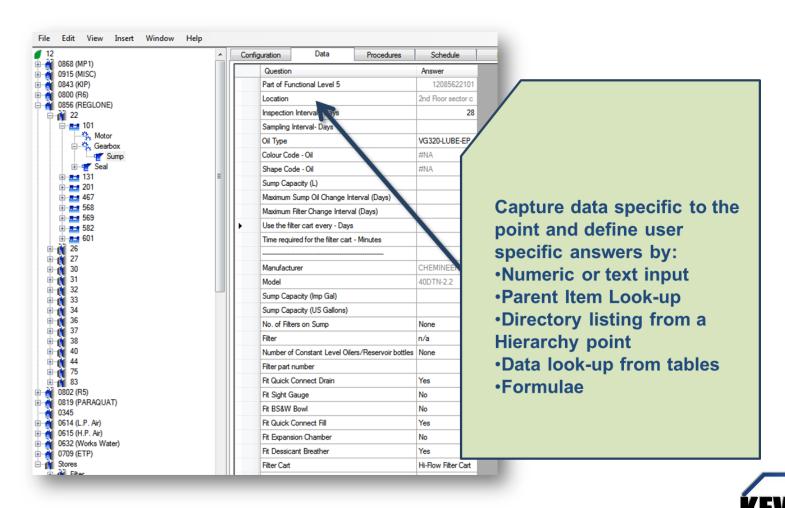
Define the point on the Hierarchy





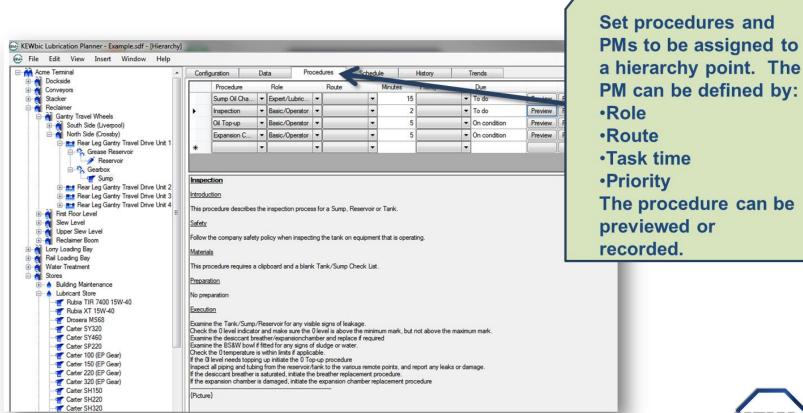


Define the data set to be captured





What to set in the Procedures function



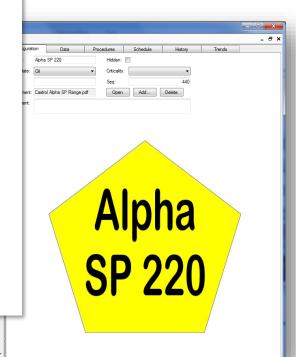




Step 1 - Set Up a Lubricant Store

- 1. Create a list of products
 - a. Oils & Greases
 - b. Filters & Breathers
 - c. Other machine spares
- 2. Identify the specifications of each product
- 3. Identify the supplier details
- 4. Rationalise and Consolidate Inventory
- Assign a generic code and colour/code symbol for each product
- 6. Each machine point will link back to the products in the Store so future lubricant supplier changes won't need a rewrite of the database.

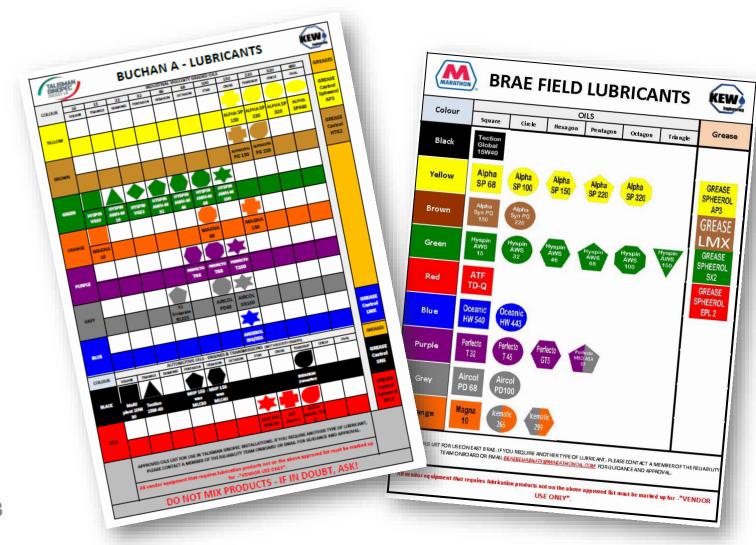








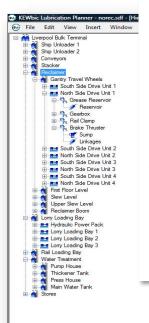
Create visual charts for easy identification







Step 2 - Map the Plant



- 1. Create a Hierarchy of Assets by Area or Module
- 2. Define the tag system (SAP/Maximo etc.)
- 3. Split the Asset Train into individual Machines
- 4. Split the Machine into Lubrication components
- 5. Physically check each machine against the registered Asset Base to ensure it is correct







Step 3 – Identify the Asset's Lubrication Needs





- 1. Assess each machine for the information required.
- 2. For Sumps, Reservoirs and Tanks:
 Determine the volume and identify the location of drains, gauges, breathers, filters etc.
- 3. For greased Bearings and Seals:

 Measure the bearing or seal dimensions to calculate the number of shots of grease, and identify factors that will influence the interval.
- 4. For automated greasing systems: Identify the volume and all greasing points for inspection.
- 5. Establish intervals for each activity.
- 6. Select all the Procedures for the above.

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		Brown
bove.		1.0
		1.0
Grease Guaritty - gris (Galcu	ilateu)	11
Regreasing Interval - Months	(Calculated)	9
Corrected Regreasing Interva	al - Months (Calculated)	9
Number of Shots - (Calculate	d)	22
Greasing Interval - Months (N	Manual Entry)	
Grease Quantity - grammes (I	Manual Entry)	
Number of Shots - (Manual E	intry)	0







Step 4 – Add in Best Practice and Reliability

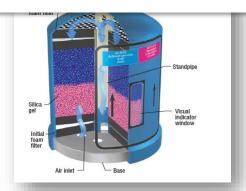


Assess each machine and identify if the following upgrades are needed:

- a) Fitting Quick Connectors on the Fill and Drain Ports
- b) Fitting improved Breathers
- c) Fitting better Sight Glasses/Gauges
- d) If required, fitting Oil Analysis Sampling Points.
- e) Adding additional filtration or upgrading the existing filtration.
- f) Adding piping to the Grease Points to allow for safe access to grease the machine.











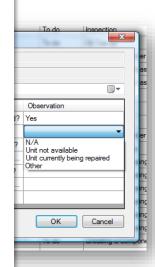


Step 5 - Assign Procedures for each Lubrication Point



- Select a resource level or role for the task
- 3. Enter a time to complete the task
- Assign a priority and route for the task 4.
- **5**. Scope or Purpose
- 6. **Materials List**
- **Tools List**
- Safety issues
- **Preparation Checklist**
- **Actual Task Description/Routine**

Allow for a sign-off for each time the procedure is used, and if required to enter a reason for noncompletion.







Sump Oil Change Introduction

Role

Sump Oil Cha... ▼ Expert/Lubric... ▼

This procedure details changing the oil on a small volume sump

All Safety rules must be obeyed.
Follow all Regulation Lock-out Procedures.
Wear appropriate Regulation PPE.
WARNING - Oil can be a safety and health hazard - read the MSDS

The necessary tools to remove the drain plug Green OilSafe containers filled with 80 Litres of Carter 220 (EP Gear, Olean rags Oil Absorbent mat

The procedure should be completed as soon as possible after shutti Tape off the area in accordance with company safety policy.

Once the unit is available, lock out the machine in accordance with Place Drain Container under the drain port

Undo dan pluy be aware of hot oil. Allow a lot dam completely the dam pluy. After a humber 10 minutes rest that plus a lot of the container to fill the super will be 100 of cafer 200 (EF Gear). Ensure the oil level is consect. First the fill rest of accornect the hose from the hand pump. Dear to any waste and spit oil. Lessope the freshelm to make sure it is still serviceable - replace if no Remove the lase.

Waste disposal bag for oil contaminated waste

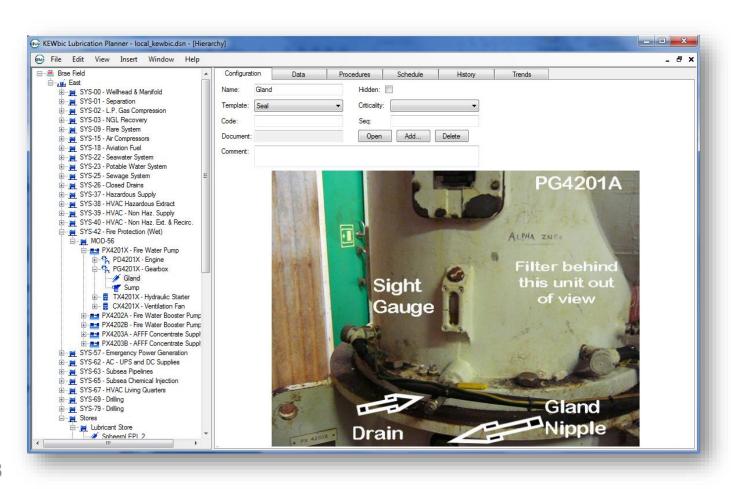
Undo drain plug - be aware of hot oil.

lestart the system.

▼ Basic/Operator ▼ Oil Top-up ▼ Basic/Operator ▼ OA-Gearbox ▼ Expert/Lubric... ▼ Expansion C... ▼ Basic/Operator ▼



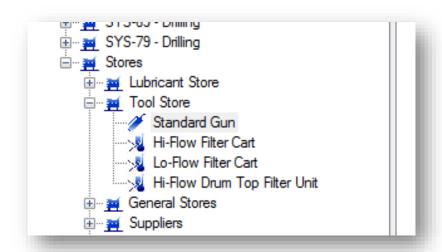
Embed images in the procedures for clarity







Build in flexibility



Changing supplier of your grease gun?
The new gun gives 50% more grease
per shot.

Worried about over-greasing using the existing calculated number of shots?

Assign the appropriate filter cart or grease gun to each machine. In the Tool Store, assign a grease gun output for each shot and assign a flow rate for each filter cart.

If you change suppliers and the values change, a single re-entry here will automatically update every affected procedure with the new number of shots or time required for filtration.





Step 6 - Complete the Procedures Library



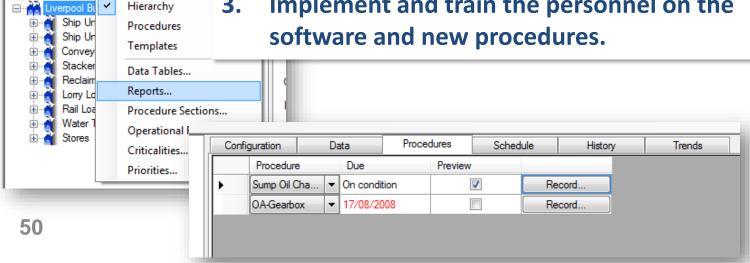
KEWbic Lubrication Planner - norec.sdf

Insert

Wind

On completion of the procedures creation the following steps are taken:

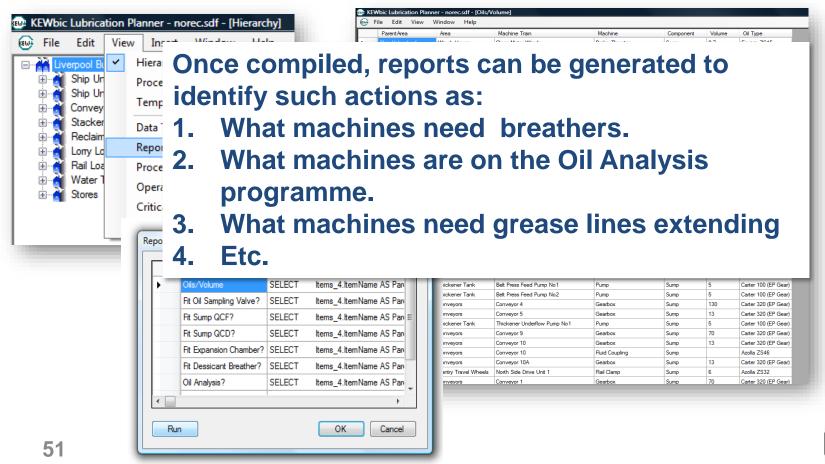
- Rationalise the Lubricants and check the **Colour Coding.**
- Re-check the Lubricant PM Routes and Schedules for the Lubrication Tasks and Oil **Analysis Sample Collection.**
- Implement and train the personnel on the **3**. software and new procedures.







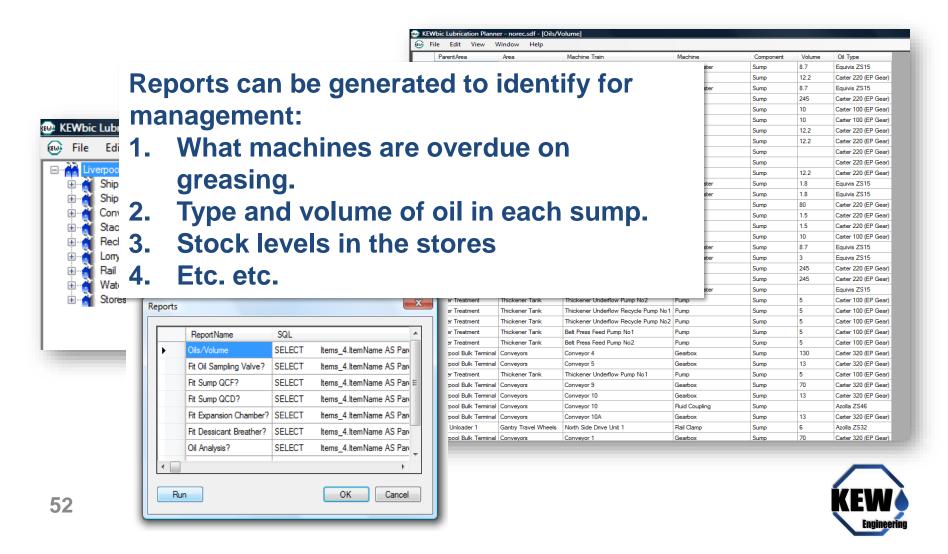
Use Reports to aid planning and upgrades





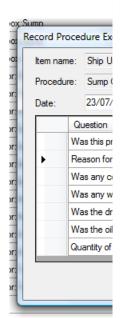


Use Reports to aid scheduling





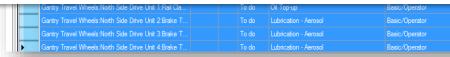
Daily Routines & Planning

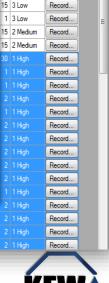


Daily Routines should be selected for a daily listing or for a time period and sorted based on:

- Area
- Route
- Task Priority
- Skill Level
- Task or Procedure type

The Procedure must be recorded as completed or not completed





Record..

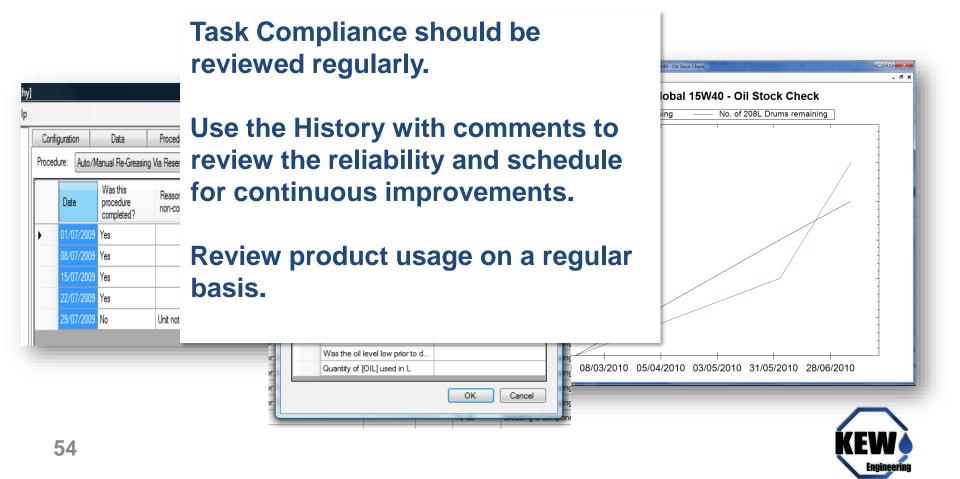
Priority 2 3 Low

2 3 Low

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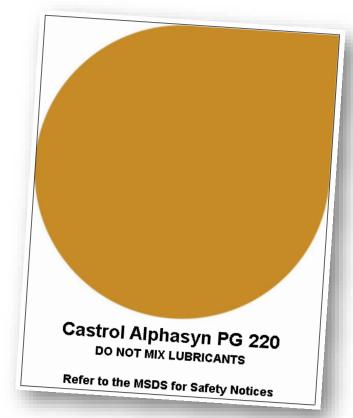
Trends & History – Compliance & KPIs





Other useful features to include

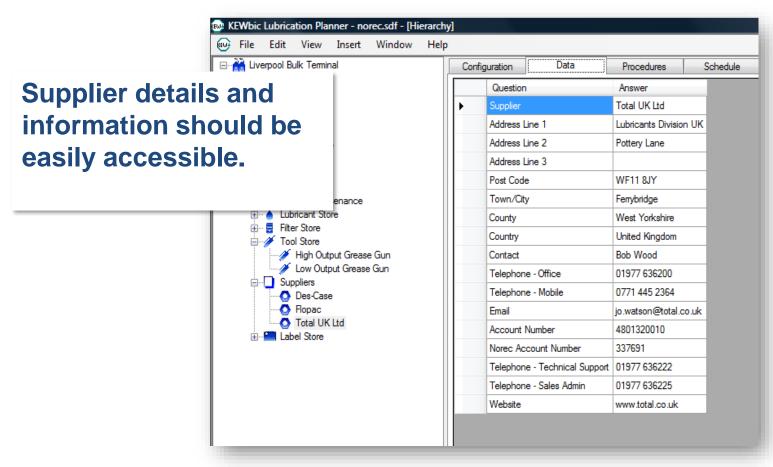
Make it easy to print a label Oil & Grease drums.







Other useful features

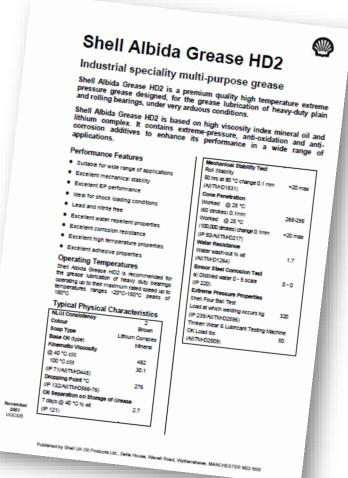






Other useful features

Supplier and OEM SDS & PDS files should be easily accessible as an embedded file.







Getting Lubrication Right.

- You will not make it happen on your own. To improve your lubrication management systems you will need buy-in from numerous people i.e. management, operations, and maintenance people.
- A culture change is required. Changing a culture takes a long time and a
 lot of effort. It has been likened to turning a super-tanker around i.e. it is a
 slow gradual process.
- Educate and lead by example. The way to change the culture and get buy-in is by making people aware of the improvement programme and then educating people to make them aware of their roles and responsibilities, also making them aware of the potential damage and impact of not having a good lubrication management processes.





Get the basics right

Additional Golden Rules:

- Make the easy thing to do the right thing to do.
 - To go a little further on this, if a dirty old oil jug is laid on a pump bedplate, then the Operator may use this because it is the easiest option.
- Encourage 'Best Practices' by setting up a purpose built storage unit in the area, with the correct lubricant, in the correct sealed container.
 - Get good storage and decanting procedures in place.
 - Educate people on the correct procedures to be used.
 - Have a colour code system to avoid cross contamination.
- Train people in key roles (quality training).







Thank you.

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