DELIVERING UNDER PRESSURE

How lubricants can help construction companies increase equipment productivity and reduce total cost of ownership

FOREWORD

A message from Thomas Mueller, Shell Lubricants Global Sector Manager for Construction

Globally, the construction industry is growing, with total volume of output expected to increase by around 85%, to $15.5 trillion worldwide by 2030[1]. Despite the optimistic global outlook, the majority (57%) of this global growth is set to take place in China, India, and the US, while in many countries the pace of construction growth is still far from pre-recession levels.

Working closely with customers in the construction industry for decades, Shell Lubricants understands the challenges companies are facing in the current climate. Even in areas of continued growth, projects are increasingly competitive and companies are feeling the pressure of tighter deadlines, slower payment terms, and smaller margins.

We see many customers extending equipment life beyond warranty and opting to rent rather than purchase new machinery in an effort to maximise availability of capital and minimise operating costs. Those investing in new equipment are looking for technology that offers cost-saving potential, such as telemetry systems that can help identify problems before they result in breakdown, or new-generation hybrid excavators that can help reduce fuel consumption and cut emissions.

Many companies already apply total cost of ownership (TCO) evaluations, knowing that reducing TCO over the lifetime of any machinery is key to extracting the best possible value from the investment. Yet **the impact of lubrication on TCO is too often underestimated[2].**

According to an international industry study commissioned by Shell Lubricants, 67% of companies do not believe that selecting a higher quality lubricant can help to reduce unplanned downtime, and 54% do not expect it to help cut maintenance costs[3].

Shell Lubricants believes companies can achieve significant cost savings by upgrading their lubrication processes. Taking better care of equipment can contribute to savings from lower maintenance costs, reduced unplanned downtime and improvements in productivity. These potential savings go far beyond what can be achieved by selecting lubricants on the basis of lowest price per litre. There are two key elements to seizing this opportunity. The first is **selecting the right lubricant**; the second is **effective lubrication management**.

In this paper, we explore the tangible business benefits possible from effective lubrication procedures. Case studies illustrate how construction companies around the world have successfully worked with Shell Lubricants to reduce costs and improve productivity.

I hope you find this paper both informative and useful.

1 Global Construction Perspectives and Oxford Economics, 'Global Construction 2030'

2 Total Cost of Ownership (TCO) is defined by Shell Lubricants as the total amount spent on industrial equipment, including cost of acquisition and operation over its entire working life, including costs of lost production during equipment downtime

3 This survey, commissioned by Shell Lubricants and conducted by research firm Edelman Intelligence, is based on 406 interviews with Construction sector staff who purchase, influence the purchase or use lubricants / greases as part of their job across 8 countries (Brazil, Canada, China, Germany, India, Russia, UK, US) from November to December 2015

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1. TOTAL COST OF OWNERSHIP: UNDERSTANDING THE POTENTIAL

Shell Lubricants believes that there is potential for lubrication to deliver significant business value by contributing to improved productivity and reduced costs. However, the potential impact of lubricants is often significantly underestimated.

Understanding how lubricants contribute to Total Cost of Ownership (TCO) is the first step to realising potential savings.

THE IMPACT OF LUBRICATION IS UNDERRATED

53% of companies believe they can reduce costs by >5% through effective lubrication.

But only 22% think savings could exeed 10%[3]

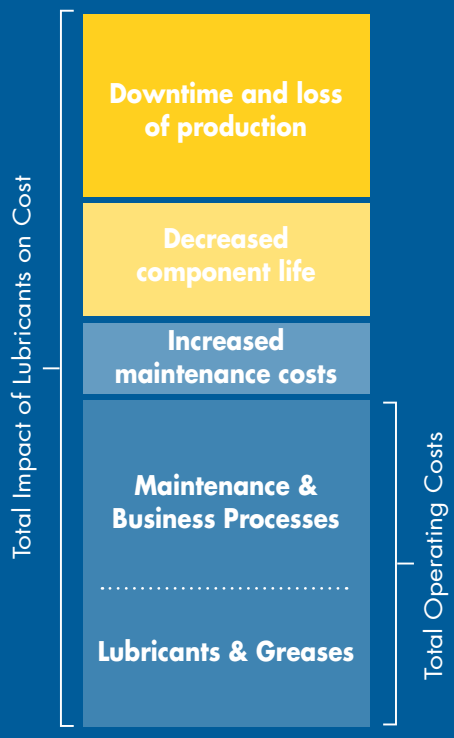
Total Cost of Ownership (TCO)

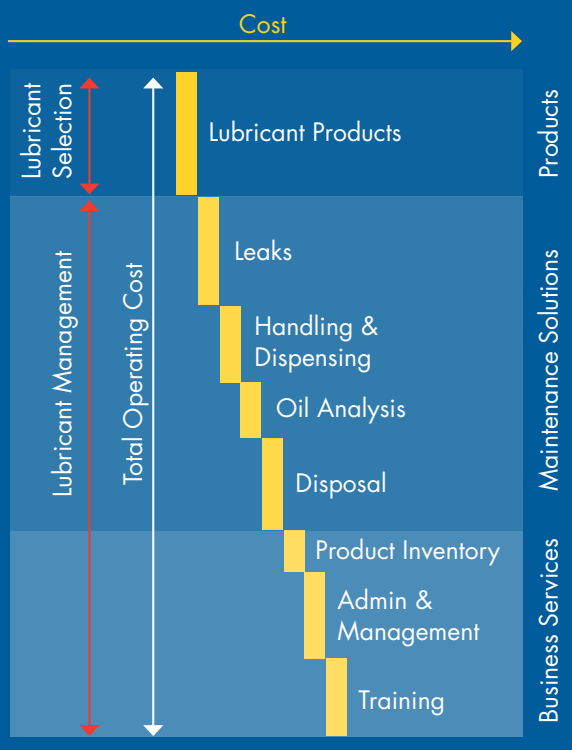
When evaluating the effect of lubricants on TCO, Shell Lubricants considers the end to end impact on maintenance budgets and processes, but also any costs related to lost production during equipment downtime. Optimising lubrication can have a significant impact on component life, maintenance costs, and unplanned downtime so can contribute to cost savings far higher than the price of the lubricant itself.

Seizing the Opportunity

Lubricant product selection or management can impact many elements of a company's maintenance budget. Seizing the cost-saving opportunity depends on addressing two equally important elements:

1. Selecting the right lubricant or grease - the right product
2. Effective lubrication management – including the right storage & handling, the right place, the right time, the right amount, the right monitoring and the right people





UNLOCKING COST SAVINGS IN CONSTRUCTION BY UPGRADING EQUIPMENT LUBRICATION

COMPANIES UNDERESTIMATE POTENTIAL PRODUCTIVITY IMPROVEMENTS FROM EFFECTIVE EQUIPMENT LUBRICATION

Only **32%** believe effective lubrication can help improve **equipment availability**

41% understand how **improved wear protection** can result in cost savings

THE BENEFITS OF HIGHER QUALITY LUBRICANTS ARE OFTEN OVERLOOKED

67% do not expect they can help reduce **unplanned downtime**

54% do not expect they can help **cut maintenance costs**

LACK OF LUBRICANTS EXPERTISE CAN BE A BARRIER TO SAVINGS

67% think they do not conduct **staff training** on lubricants as regularly as they should

Only **47%** consider lubricant product performance an important purchase consideration

28% have all the **correct lubrication management procedures** in place[1]

THIS IS HAVING A FINANCIAL IMPACT

87% have experienced unplanned downtime in the past 3 years

60% admit this was due to their incorrect selection and /or management of lubricants

25% believe costs exceeded **$250,000**[2]

EFFECTIVE EQUIPMENT LUBRICATION CAN HELP **REDUCE UNPLANNED DOWNTIME AND LOWER MAINTENANCE COSTS**, CONTRIBUTING TO LOWER TOTAL COST OF OWNERSHIP (TCO)*

SHELL LUBRICANTS WORK WITH CUSTOMERS TO HELP DELIVER TCO SAVINGS

At least **$139 million** savings delivered to customers worldwide (2011-2015)[3]

260 Shell Lubricants technical specialists help customers reduce TCO through effective lubrication

OEM and customer collaborations enable Shell Lubricants to develop products that help improve equipment reliability and productivity

Shell Lubricants Services to help upgrade lubrication management:

- **Shell LubeAdvisor** — Helping identify and seize savings
- **Shell LubeExpert** — Expert advice on-site
- **Shell LubeAnalyst** — Lubricant monitoring
- **Shell LubeCoach** — Staff training

This survey, commissioned by Shell Lubricants and conducted by research firm Edelman Intelligence, polled 406 decision makers in the construction industry in 8 countries (Brazil, Canada, China, Germany, India, Russia, UK, US) from November to December 2015.

* Total Cost of Ownership (TCO) is defined by Shell Lubricants as the total amount spent on industrial equipment, including cost of acquisition and operation over its entire working life, including costs of lost production during equipment downtime.

1. Shell recommended procedures include delivery and storage, oil change, oil dispensing systems, efficient grease lubrication systems, oil analysis and training employees in lubricant selection or management.
2. $ figure based on converting local currency into equivalent $ amount.
3. Based on savings delivered to Shell Lubricants customers from 2011-2015.

SHELL LUBRICANTS
TOGETHER ANYTHING IS POSSIBLE

2. LUBRICANT SELECTION

Each piece of construction equipment made by different original equipment manufacturers (OEMs) has its specific lubrication requirements. OEMs define the minimum requirements for lubricants or greases, but not all products that meet these standards deliver the same level of performance.

2a. LUBRICATION CHALLENGES

Working conditions in the construction industry are often severe. The equipment's design characteristics, operational parameters and environment must all be considered when selecting the lubricant. Factors like temperature, humidity and location all pose different challenges for lubrication, particularly as many companies seek to diversify into quarrying and cement production.

Below are three of the construction industry's primary lubricant applications, along with some examples of specific lubrication challenges. In all cases, **selecting the right lubricant is a critical first step in improving productivity and realising significant TCO savings.**

THE BENEFITS OF HIGHER QUALITY LUBRICANTS ARE UNDERESTIMATED

When purchasing lubricants, only 47% of companies believe product performance should be an important consideration.[3]

ENGINES

Effective engine lubrication is critical to protect high-cost equipment, and minimize downtime due to frequent oil changes, maintenance or even component failures.

1. Wear protection

Viscosity Control in Extreme Conditions: Engine wear as a result of metal-to-metal contact can occur at low speeds, high loads or cold starts. In construction equipment, where engines are subject to heavy loads, shock loading and extended periods of idling, wear protection is particularly important. At engine start-up, particularly in cold climates, the oil must remain thin enough to circulate quickly to protect critical components. Once the engine is operating under full load, the oil must remain thick enough and provide the necessary protection to help prevent abrasive wear.

Soot build-up: Accumulation of soot can lead to oil thickening and abrasive wear. This is a particular challenge in countries with high-sulphur diesel fuels, and when exhaust gas regeneration (EGR) is applied as an after-treatment system. Extended periods operating at idle load makes an engine particularly susceptible to higher rates of soot generation.

2. Corrosion protection

Gases and acids are generated as a natural by-product of the combustion process. The lubricant neutralises these acids to help avoid corrosion. This is particularly important in engines with Babbit-based plain bearings, which can be very susceptible to acid attack.

3. Long Oil Life

Oxidation, soot accumulation and oil thickening, and the build-up of acids in the lubricant all contribute to oil aging. High quality synthetic engine oils with the right base oil and additive technology -including anti-oxidant additives - can maintain performance characteristics for longer in the presence of contaminants and by-products[4].

4 Compared to lower quality mineral oil alternatives

"We know things don't always go to plan on a construction job. For example, a common issue in construction equipment is fuel injector malfunction. When this happens, it can allow unburnt fuel to enter the combustion chamber and dilute the oil, impairing its performance and contributing to engine component wear. However, a high quality lubricant can still protect your engine even after being diluted with fuel or coolant, helping prevent unplanned shutdowns so you can carry on and finish the job."

Thomas Mueller, Shell Lubricants
Global Sector Manager for Construction

HYDRAULIC PUMPS

The hydraulic system is at the heart of many critical pieces of construction equipment. Hydraulic fluid plays a vital role in ensuring continuous and smooth equipment operation, energy savings and long machine lifespan.

1. Wear protection

Any damage to hydraulic pumps can significantly reduce equipment efficiency and service life. The hydraulic fluid helps keep moving components apart to avoid metal-to-metal contact and wear. To ensure equipment remains protected in all conditions, it is important that the hydraulic fluid is able to remain thin enough in cold environments to circulate quickly to critical components, and then thick enough when equipment is operating at higher temperatures to continue to protect against abrasive wear.

2. System Efficiency

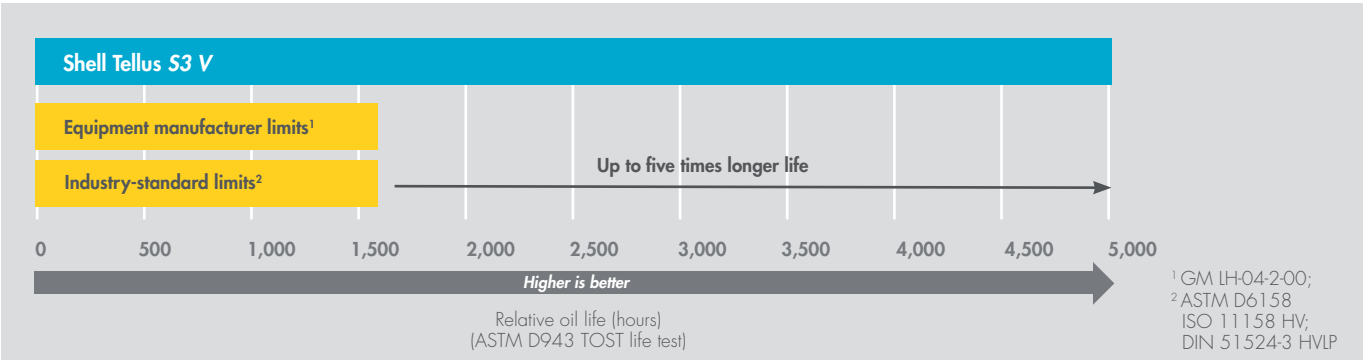
A hydraulic fluid needs to protect, lubricate and transmit power efficiently. When equipment works on hilly terrain, it can result in air being injected into the oil, which may cause cavitation in hydraulic pumps. The right hydraulic fluid must therefore offer reliable air release, excellent filterability and improved cleanliness.

3. Oil Life

An oil that resists degradation can help to increase oil drain intervals (ODIs). Longer oil life can enable equipment to operate for longer without interruption, for reduced maintenance requirements and enhanced productivity.

Helping improve productivity by extending maintenance cycles

Shell Tellus S3 V achieved up to five times longer oil life in the industry-standard oil life test than the industry minimum.



AXLES AND TRANSMISSIONS

Driveline technology is critical to construction equipment. Component life, equipment downtime and oil drain intervals - and therefore TCO - can be significantly impacted by the quality of the oil.

1. Friction characteristics

Powershift transmissions use a series of friction plates to help engage and disengage gears. The lubricant plays a critical role in transmitting frictional force, so its frictional characteristics are important for effective operation and smooth shifting. Too little friction and the plates can slip, making gear changes difficult. Too much friction, and excess heat generation can cause damage to equipment and shortened lubricant life.

2. High loads and contact pressures

In gear motors, the lubricant must help improve bearing life, and give excellent protection against gear wear and pitting. Low temperature performance, shear stability and high oxidation stability are also important. In differential gears, specific contact pressures can be so high that the transmission oil is squeezed away, allowing metal-to-metal contact. The use of lubricants with extreme pressure additives helps prevent the contact areas of the teeth micro-welding together.

3. Wear Protection

Oxidation stability and corrosion protection are also important to maintain oil performance. High quality transmission oils with good oxidation resistance can resist degradation and break-down over time[5], thereby reducing downtime required for frequent oil changes.

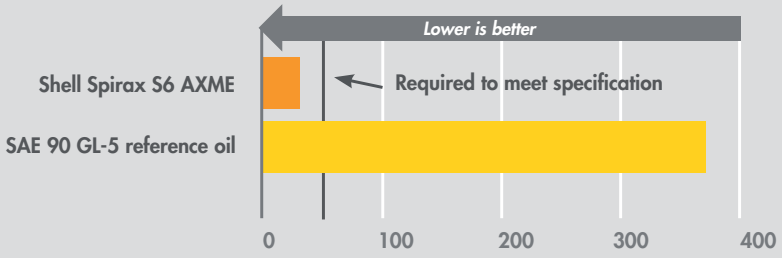
4. Long Oil Life

Oxidation stability and corrosion protection are also important to maintain oil performance. High quality transmission and gear oils with good oxidation resistance can resist degradation and break-down over time , thereby reducing downtime required for frequent oil changes.

Improved protection against wear, pitting and corrosion can help to extend component life and maximise return on equipment investment.

Shell Spirax S6 AXME offers high oxidation resistance, to help prevent the formation of damaging deposits in gears, and delivers excellent wear protection even in extreme conditions.

FZG slow-speed wear test results, Shell Spirax S6 AXME compared to SAE 90 GL-5 reference oil, over 120 hours:



Pinion and gear wear (mg)
(FZG C/0.05/90:120/10)

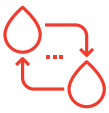
5 Compared to lower quality mineral oil alternatives

HEAVY DUTY GREASES

Robust, high-performing greases are essential to keep heavy duty machinery working efficiently.

1. Contamination control

Contamination ingress is a common cause of equipment failure. Exposure to high levels of dust, dirt, rain and snow requires greases that can maintain an adequate lubricant film and continue to flow while also flushing out contamination.



2. Grease life

The longer a grease lasts, the longer components last and the less lubrication maintenance is required. Extra-long-life synthetic technologies can double grease life for some applications, helping simplify maintenance procedures and reduce operating costs.

3. Wear Protection

Protecting components from wear is fundamental to prolonging equipment life and preventing costly delays from unplanned downtime. Greases must therefore be able to protect bearings and other vital components under extreme temperatures, heavy loads and contaminated conditions.

WORKING WITH ORIGINAL EQUIPMENT MANUFACTURERS (OEMS)

To help deliver value to construction companies of all types and sizes, Shell Lubricants invests significant resources in Technical Partnerships and collaborations with OEMs.

These range from product development collaborations to field testing programmes, and aim to ensure that our lubricants are designed to perform in real-world applications, to help extend equipment life and protect against unplanned downtime.

Shell Lubricants has over 3,000 equipment manufacturer recommendations or approvals across our lubricants portfolio, from the likes of Caterpillar, JCB, Sany and Volvo, as well as component manufacturers, such as Bosch Rexroth, Carraro and ZF Friedrichschafen.

2b. DELIVERING SAVINGS WITH HIGH QUALITY LUBRICANTS

A high quality oil or grease that helps keep equipment clean of deposits and effectively protects against wear and corrosion can help extend equipment life, reduce the frequency of breakdowns and increase the machine's availability. **This could significantly decrease spend on spare parts and maintenance.** Lubricants that successfully limit friction can also cut the amount of power required to operate and cool equipment, helping to reduce energy costs.

MISCONCEPTIONS ABOUT LUBRICANTS ARE COMMON

67% of construction companies do not believe higher quality lubricants can help reduce unplanned downtime

and

54% do not expect they can help reduce maintenance costs[3].

"Buying cheaper lubricants can be a false economy. A less effective lubricant rarely results in immediate equipment failure, but can lead to increased maintenance costs over time. For example, reduced wear protection can lead to more rapid degradation of components, resulting in increased costs of replacement and lost productivity during unplanned downtime. As such, lubricant selection should be always based on a well-considered TCO calculation, rather than just price-per-litre."

Thomas Mueller, Shell Lubricants
Global Sector Manager for Construction

CASE STUDIES

The following case studies demonstrate how Shell Lubricants has worked together with construction companies to support them in selecting high quality lubricants to help generate substantial cost savings[6].

UPGRADING AND CONSOLIDATING TRANSMISSION OIL PORTFOLIO SAVES CANADIAN COMPANY USD $140,298[6]

The Challenge

Sureway Construction in Alberta, Canada, uses heavy-duty equipment for construction and earth moving in temperatures ranging from –25 to +40°C.

The company was using separate lubricant products for final drives and transmissions. In the summer, the company mixed the products together so they would provide protection under the higher temperatures and more severe duty cycles. Yet another lubricant was used for some of the heavier equipment in winter.

The company faced the challenges of managing oil changes and mixing the products, which required considerable resources, so approached Shell Lubricants for advice.

The Solution

Shell Lubricants technical experts recommended that Sureway should change to Shell Spirax S6 CXME 10W-40, for use throughout the year. A field-test was conducted to assess the lubricant's performance for 18 months to confirm that it met Sureway's needs. The product withstands the wide temperature range and meets the Caterpillar TO-4M specification.

The Results:

Switching to Shell Spirax S6 CXME 10W-40 enabled the company to:

- Avoid premature oil changes
- Reduce oil consumption
- Increase productivity through less downtime
- Lower maintenance costs.
- Reported annual cost savings amount to USD $140,298

6 For each case study, savings/benefits were reported by one customer. Actual savings/benefits will vary. More detail is available on request

ENGINE OIL UPGRADE ENABLES INDONESIAN COMPANY TO DOUBLE OIL DRAIN INTERVALS, SAVING **USD $22,915**[6]

The Challenge

Indonesian company PT Usaha Era Pratama Nusantara provides logistics services in the Port of Surabaya, Indonesia. The company operates nine reach stackers in dusty, humid conditions with temperatures of about 35°C. The reach stackers are powered by Volvo TWD 1240 and MAN D2824 engines. The company wanted to change to a lubricant with a longer oil-drain interval but one that also met the equipment manufacturers' specifications, so sought advice from the local Shell Lubricants distributor.

The Solution

The Shell Lubricants distributor recommended that the company should change the engine oil to Shell Rimula R4 X 15W-40, which is designed to deliver acid and corrosion control, protection from engine wear and deposit control. In addition, the company was offered two Shell Lubrication management services; Shell LubeSurvey, in which Shell Lubricants technical experts assess the customer's site and recommend complete lubrication systems, and Shell LubeCoach training programme to help employees understand the importance of lubrication to successful day-to-day operations.

The Results

- Engine oil-drain intervals doubled, from 250 to 500 hours
- This helped reduce lubricant and filter consumption and maintenance costs
- Reported annual savings total USD $22,915

WATER RESISTANT LUBRICANT REDUCES DOWNTIME SAVING USD $3,800,000[7]

The Challenge

Consorcio Camargo Correa, a Brazil-based construction company, was constructing a large dam in Venezuela. Extracting stone from the river to be crushed for cement was resulting in water contamination of the grease, which led to decreased life of their bucket pins and bushes. As the bucket pins and bushes needed replacing every 250 hours, this resulted in increased downtime for its excavators and mounting maintenance costs. A water-resistant lubricant was becoming increasingly critical for reducing the company's spiralling costs.

The Solution

Shell Lubricants technical experts recommended Shell Gadus S3 V460D 2, a grease with strong water resistance, to suit the project's working conditions. Shell Gadus S3 V460D 2 is a high-performance, high temperature grease for slow-moving, heavily loaded large bearings subject to shock loads. It is designed to offer lasting protection even in the presence of large amounts of water.

The Results

Switching to Shell Gadus S3 V460D 2 delivered considerable cost savings and significantly improved productivity:

- Reported annual cost savings amounting to USD $3,800,000
- Increased excavator component life from 250 to 350 hours
- Increase productivity through less downtime
- Lower maintenance and labour costs
- Longer component life

7 The savings indicated are specific to the calculation date and mentioned site. These calculations may vary from site to site and from time to time, depending on, for example, the application, the operating conditions, the current products being used, the condition of the equipment and the maintenance practices.

3. LUBRICATION MANAGEMENT

Even the best lubricant cannot perform effectively if it is not applied and managed correctly.

Effective lubrication management is vital to unlock potential TCO savings. It helps deliver value from reductions in lubricant consumption, maintenance and operating costs.

Only 28% of companies have all the recommended procedures in place to manage lubricants effectively*

and 67% admit they don't conduct staff training on lubricants as regularly as they should.[3]

*Procedures included: Delivery and storage of lubricants, Oil change procedures, Oil dispensing systems, Efficiency of grease lubrication systems, Oil analysis, Training employees in lubricant selection and/or management

3a. CHALLENGES AND SOLUTIONS

The following examples detail some of the key lubrication management challenges that construction companies commonly face, the importance of taking action to address these, as well as the available Shell Lubricants Technical services to support.

SHELL LUBRICANTS' SIX STEPS TO GOOD LUBRICATION MANAGEMENT

1. **Right storage & handling** – the lubricant must be stored in the right conditions and handled correctly to avoid contamination and preserve its key characteristics
2. **Right place** – for the oil or grease to reach the right surface it must be properly applied to the equipment
3. **Right time** – the correct frequency of oil change or re-greasing ensures the lubricant reaches the surface at the right time. Delays can result in accelerated wear
4. **Right amount** – the correct volume of lubricant or grease applied and topped up to protect moving parts effectively
5. **Right monitoring** – regular sampling and analysis to ensure the lubricant remains fit for purpose and check for early indications of equipment wear. Inspections also ensure the consistent application of the first four steps
6. **Right people** – the competence of those who lubricate equipment can greatly affect its positive impact, particularly when it comes to ensuring all of the above happens

The Challenge: Right storage and handling

Contamination control is critical to reducing component wear and maximising overall equipment performance. How the oil or grease is stored, handled and transported through the construction site greatly impacts the likelihood of contamination.

Storing drums in a sheltered place and wiping the top clean before it is opened will help limit the risk of contamination by water and particles. Applying filtration can also help maintain and enhance product cleanliness before oil enters equipment.

The Solution: Expert advice and staff training

Underpinning good lubrication management practices is industry knowledge and expertise. One of the core lubrication management services offered by Shell Lubricants is building technical competency across a customer's organisation. This is delivered through Lubricant Technical Advisors, supported by a team of Global Product Application Specialists and Lubricants Services Experts. They regularly visit customers to share expertise about lubrication management.

"One common issue we come across when visiting customer sites is contamination of the lubricant as a result of the way it is stored and handled. If the product contains contaminants before it even enters the equipment, its performance can be severely impaired. We have seen customers who make seemingly small improvements in lubricant storage and handling realise savings of thousands of dollars from reduced equipment downtime."

Nils Richardt,
Shell Lubricants Product Application Specialist

The Challenge: Right Monitoring

Regular monitoring and analysis helps ensure the lubricant or grease is functioning well and remains fit for purpose. Lubricant analysis is vital to business continuity. Owners and operators of mission-critical assets need advance warning of mechanical problems that are likely to damage equipment, reduce productivity and increase maintenance costs.

The Solution: Oil Condition Monitoring Services

Oil condition monitoring services, such as Shell LubeAnalyst, can provide early warning of equipment wear or lubricant degradation, enabling the lubricant to be changed before issues escalate and thereby helping reduce the frequency, time and cost of maintenance. This also helps improve productivity due to greater equipment availability

Shell LubeAnalyst data show that 27% of engines,

36% of gearboxes, and

30% of hydraulic systems harbour imminent or incipient failures.

DELIVERING BUSINESS VALUE THROUGH LUBRICATION SERVICES

Shell LubeAnalyst

Lubricant Analysis
A global oil and equipment monitoring service that helps customers assess lubricant condition, identify potential problems, and benchmark equipment performance against comparable oil samples from around the world. Available in 95 countries and 28 languages, it has more than 60,000 users worldwide, and analyses over 750,000 samples a year. The service allows customers to monitor equipment without interrupting operations, and provides guidance on interpretation of results.

Shell LubeAnalyst Lite

Rapid On-site Analysis
Shell LubeAnalyst Lite on-site analysers deliver fast, comprehensive test results for machine lubricants including engine and gearbox oils, hydraulic fluids and power steering and transmission fluids. Maintenance staff can test lubricants on-site at any remote location and get results within 15 minutes. The service can help limit downtime and lower maintenance costs by capturing early signs of abnormal wear, and helping extend oil-drain intervals.

Shell LubeAdvisor

Identifying and Seizing Value Opportunities
Specialised Shell Lubricant Technical Advisors (LTAs) conduct site surveys to help customers identify areas for improvement in lubrication. All stages of the lubrication process are addressed, including product selection, delivery, storage, distribution across the site, product application and disposal of used lubricants. Changes are implemented and measured through 'Value Improvement Projects'.

Shell LubeCoach

Upskilling Employees
A customised training programme, led by Shell technical experts with substantial in-field experience, which offers practical coaching to customers' staff on lubricant management techniques.

8 Shell LubeAnalyst Lite complements the off-site, laboratory-based service offered by Shell LubeAnalyst. Shell LubeAnalyst remains the recommended analysis service when extreme precision is more important than fast results. Shell LubeAnalyst Lite is not currently available in all regions.

3b. UNLOCKING VALUE THROUGH EFFECTIVE LUBRICATION MANAGEMENT – CASE STUDIES

The following case studies show how Shell Lubricants technical experts have worked together with construction companies to help upgrade lubrication management processes and generate substantial cost savings[9].

Over the last five years, Shell Lubricants has documented projects that delivered $139 million in savings to customers worldwide[10]. These savings represent only a portion of the real-world total, which could be as much as 10 times higher. This indicates great potential for cost savings and productivity increases across the industry through lubrication excellence.

CONSTRUCTION COMPANY EXTENDS OIL DRAIN INTERVALS AND SAVES USD $172,000[9]

The Challenge

Construction company Al-Watanyiah United Engineering & Contracting in Oman operates in remote locations in mountainous and desert regions. The company operates excavators, cranes, diggers and dredgers from Volvo, Komatsu, CAT, JCB and XCMG, in dusty environments in temperatures of between 30 and 50°C. The company wanted to enhance the equipment's productivity by improving the quality of its lubrication. For its new machines, the company also needed to change to an API CI-4 lubricant to meet equipment manufacturers' guidelines.

The Solution

Shell Lubricants technical experts suggested that the company should switch from a non-Shell engine oil to Shell Rimula R4 X 15W-40. To help identify whether the oil-drain interval could safely be extended, they also offered Shell LubeAdvisor technical support and Shell LubeAnalyst oil and equipment condition monitoring services.

The Results

Changing to Shell Rimula R4 X and taking advantage of the Shell Lubricants services enabled the company to extend the oil drain intervals of its heavy equipment. This helped:

- Increase equipment availability and productivity
- Extend component life
- Reduce maintenance downtime
- Cut lubricant and spare-part consumption
- Reported annual savings totalled **USD $172,000**

9 Savings/benefits were reported by one customer. Actual savings/benefits will vary. More details available on request

10 Shell Lubricants documented customer savings 2011-2015

OIL DRAIN INTERVALS EXTENDED BY UP TO 180% RESULTING IN SAVINGS OF USD $1,247,758[9]

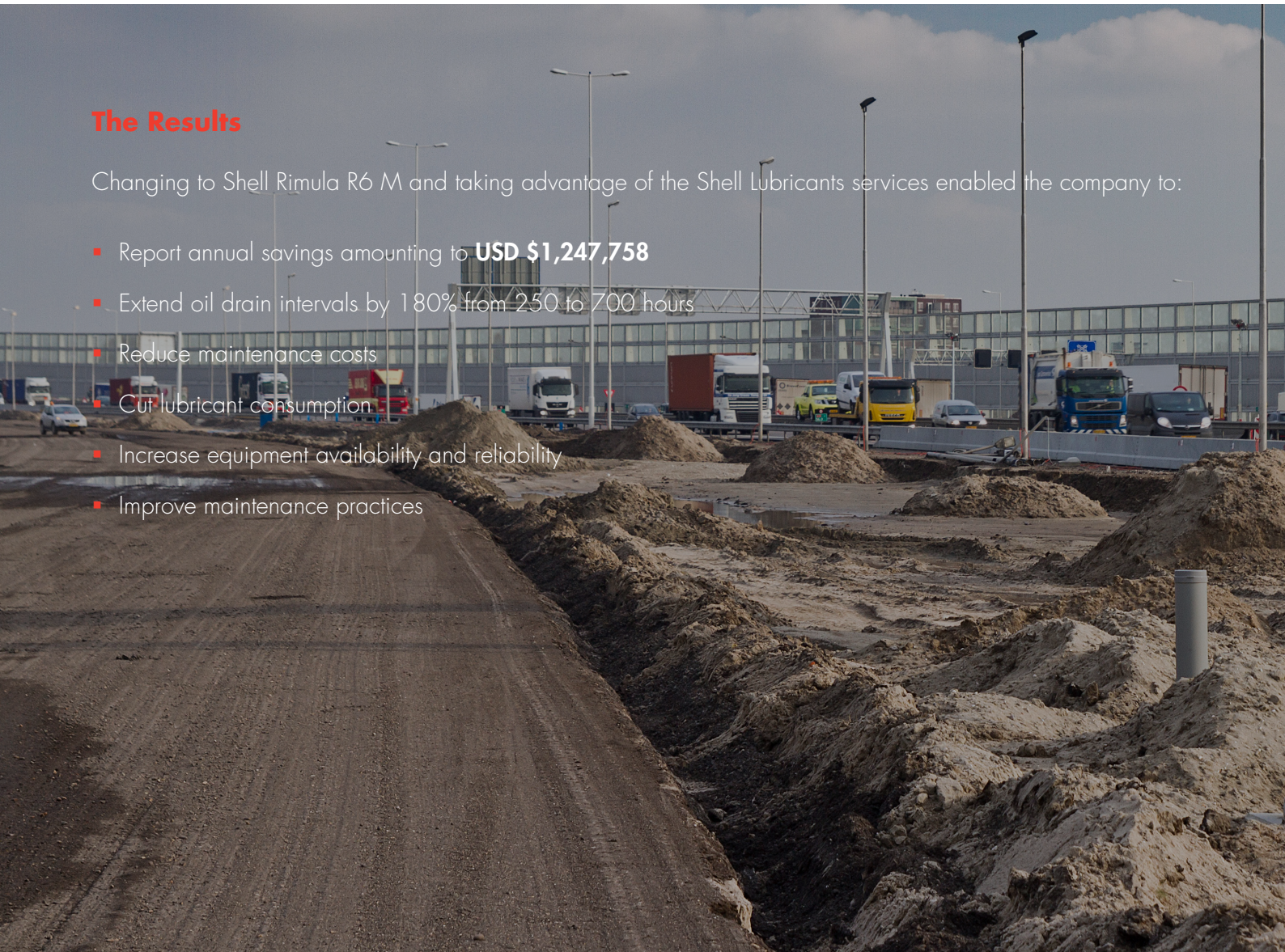
The Challenge

Internationally renowned construction engineering and services company, Dragasur C.A. based in Venezuela, operates a specialist highway construction and maintenance division. The company wanted to reduce the operating costs of its heavy-duty equipment, including trucks and cutter-suction dredgers by improving maintenance practices.

The Solution

Shell Lubricants technical experts recommended an upgrade to Shell Rimula R6 M. This heavy duty diesel engine oil is designed to deliver excellent protection against wear and deposits in a wide variety of modern, high-powered engine types.

The Shell Lubricants offer also included the Shell LubeCoach service - staff training focused on upgrading maintenance practices, to help reduce operational costs and increase the profitability of the business.



The Results

Changing to Shell Rimula R6 M and taking advantage of the Shell Lubricants services enabled the company to:

- Report annual savings amounting to **USD $1,247,758**
- Extend oil drain intervals by 180% from 250 to 700 hours
- Reduce maintenance costs
- Cut lubricant consumption
- Increase equipment availability and reliability
- Improve maintenance practices

SHELL LUBEVIDEOCHECK REDUCES GREASE CONSUMPTION SAVING TURKISH COMPANY USD $50,000[11]

The Challenge

A leading Turkish construction company involved in motorway, bridge, tunnel, airport, subway, railway, power plant and energy work was experiencing significant bucket pin wear in its excavators that required large amounts of grease. The company was applying a lithium based grease to lubricate the excavators' bucket pins but wear levels were very high, as was grease consumption at 24 tonnes per year. With greasing required up to four times a day, equipment downtime was excessive. High costs and interrupted productivity prompted the company to seek advice.

The Solution

Shell Lubricants technical experts performed an oil analysis using Shell LubeVideoCheck. Based on this, they recommended that the company should change to Shell Gadus S2 V220AD 2 as an effective alternative to the lithium-based grease. Shell Gadus S2 V220AD 2 is a high performance grease designed for shock-loaded heavy-duty bearings working in damp, hostile conditions.

The Results

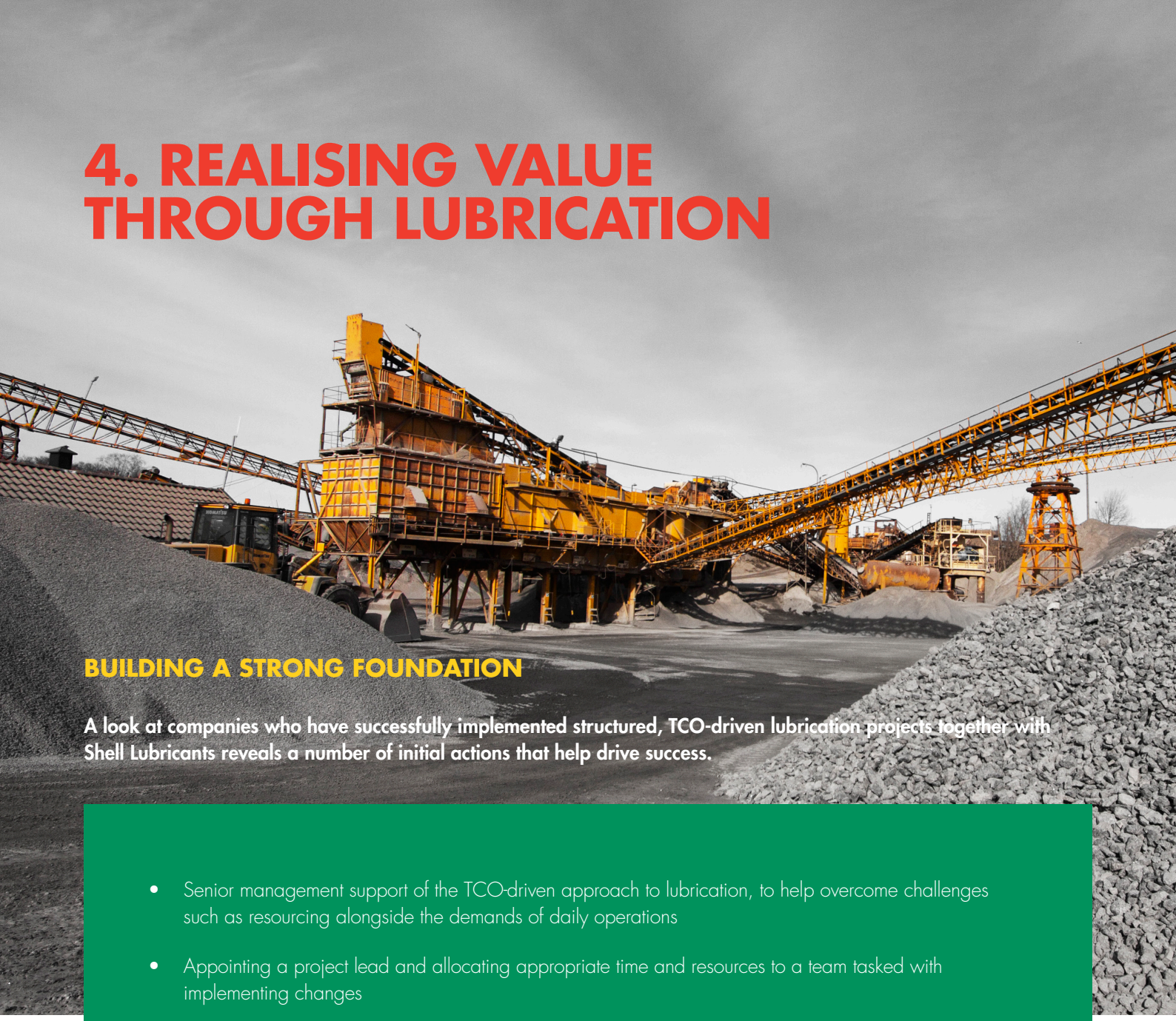
By changing to Shell Gadus S2 V220AD 2, the company benefited from:

- Significantly decreased grease consumption from 24 to 3 tonnes per year
- Reported annual cost savings amounting to USD $50,000
- Reduced service costs and reduced downtime due to less frequent lubrication

In addition, ongoing support from Shell Lubricants technical experts and the early detection of any future issues, provides peace of mind to the company's management team.

11 The savings indicated are specific to the calculation date and mentioned site. These calculations may vary from site to site and from time to time, depending on, for example, the application, the operating conditions, the current products being used, the condition of the equipment and the maintenance practices

4. REALISING VALUE THROUGH LUBRICATION



BUILDING A STRONG FOUNDATION

A look at companies who have successfully implemented structured, TCO-driven lubrication projects together with Shell Lubricants reveals a number of initial actions that help drive success.

- Senior management support of the TCO-driven approach to lubrication, to help overcome challenges such as resourcing alongside the demands of daily operations
- Appointing a project lead and allocating appropriate time and resources to a team tasked with implementing changes
- A good relationship with the lubricant supplier, whose technical teams play a key role in identifying and delivering value
- A comprehensive analysis to identify, quantify and prioritise TCO-related projects. Importantly, aligning on how value is measured enables savings to be recorded accurately. For example:
    - What is the hourly cost of maintenance and time required for repairs?
    - What is the cost of replacement parts?
    - What is the benchmark failure frequency?
    - What is the monetary value of downtime for each piece of equipment, in terms of lost production?
- Setting measurable targets to ensure that progress can be tracked

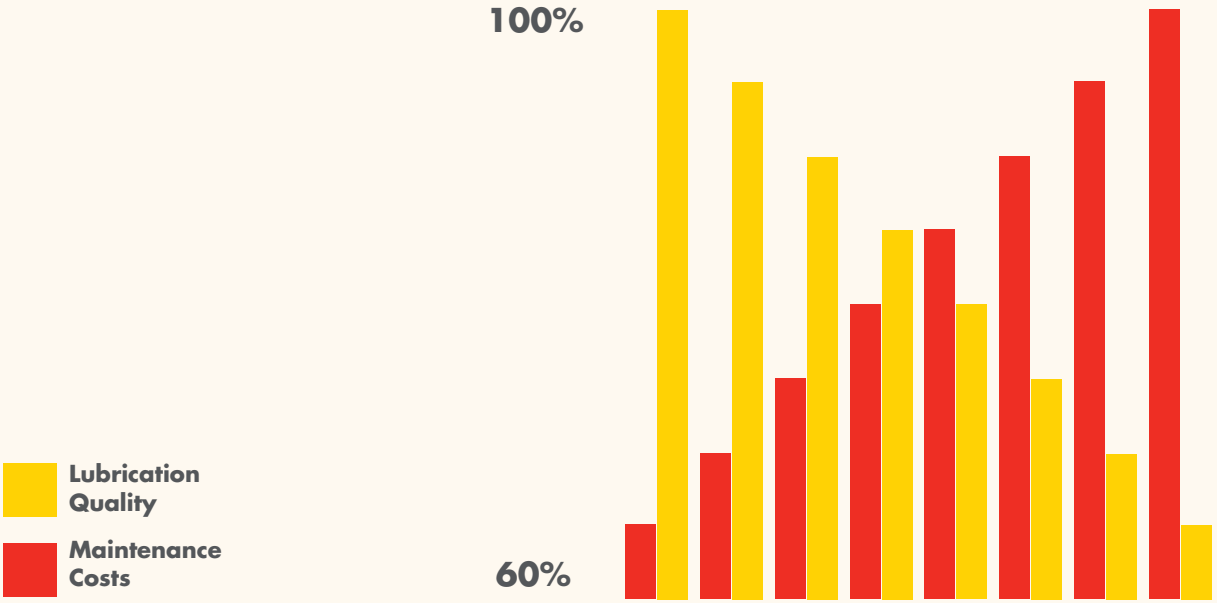
These steps will help companies form a strong foundation from which to successfully incorporate a TCO-driven approach to lubrication into daily operations, carry out lubrication improvement projects, and realise the associated cost savings and productivity benefits.

As equipment and lubrication technology continue to evolve, regular review of the approach will help companies continue to focus effort and resources on projects that deliver greatest value.

Driving down maintenance costs

There are many factors impacting maintenance expenditure, but a direct correlation can be seen, where all other factors remaining equal, higher quality lubrication leads to lower maintenance costs.

Achieving excellence in lubrication (product selection and management) can result in far more significant reductions to total maintenance costs than purchasing lubricants based primarily on product price.



5. WHAT'S NEXT?

Looking beyond the present day, Shell Lubricants is always working to consider the future challenges that the next generation of products and services will help companies to overcome.

Looking at current industry trends, some issues Shell Lubricants is already addressing include:

Changing equipment portfolio

The emergence of new OEMs from Asia is introducing a broader variety of construction equipment to the industry, all with slightly different lubrication requirements. In addition, in regions like North America, many construction companies are starting to move into quarrying and cement manufacturing. This is diversifying their portfolio of equipment, and means that the lubricant must be able to perform in even more challenging operating conditions.

Real-time monitoring

Applying sensor technology and telemetrics to analyse lubricant and equipment performance in real time will play an increasingly important role, especially as companies look to lengthen ODIs, improve efficiency, and further extend equipment life.

Tightening regulation

Emissions performance standards worldwide are increasingly stringent. For example, the CK-4 and FA-4 specifications for engine oils also include tighter emission requirements. In Europe, OEMs and Shell Lubricants are preparing for the introduction of new Stage V emission legislation, scheduled for 2019.

Alternative fuels

Although the exact nature of environmental targets vary from region to region, the impact on fuels is being felt around the world. Some countries are already introducing high biodiesel blends for construction engines, while we also expect increasing adoption of LNG fuels. Engines designed to run on alternative fuels place different requirements on the lubricant, for example hotter operating temperatures.

Technical innovation

Gas-to-liquid (GTL) technology is one of the most exciting recent innovations in lubrication and one example of how product performance can be enhanced in the future.

DID YOU KNOW?

The latest synthetic base oils from Shell are produced from natural gas using a revolutionary, proprietary gas-to-liquids (GTL) process. With no sulphur* and very low aromatic and unsaturates contents, these GTL base fluids typically have higher flash points, lower densities and more effective thermal properties than conventional mineral oils. They enable the development of lubricants that offer superior performance compared to those based on traditional, crude-derived base oils.

*Below the detection limits according to ISO 14596/ASTM D2622

6. APPENDIX

LUBRICANTS TECHNOLOGY - KEY FACTS

Each key function plays a different role in helping cut TCO. The aim is to achieve the best balance of the four, to maximise the impact of the lubricant or grease on TCO and equipment productivity.

REDUCE FRICTION
Lubricants form a fluid barrier between moving surfaces to reduce friction between them, helping maintain smooth running and limit wear.

CLEAN
Lubricants flush away contaminants, removing dirt and wear particles from vital areas for removal via filtration. Many also contain active detergents for more powerful cleaning.

PROTECT
Lubricants and greases form a protective barrier between moving surfaces, preventing metal-to-metal contact and wear. They also contain additives that neutralize harmful acids such as combustion by-products that can impact equipment life. Enhanced protection helps limit wear and extend the life of components, helping to reduce spend on spare parts.

COOL
Lubricants absorb excess heat from high friction zones and transfer it away for cooling. This allows the equipment to function efficiently. (Not a critical function of greases).

LUBRICANT FORMULATION

A lubricant's precise blend of base oil and additive package helps ensure that it is able to deliver optimum performance for the longest possible time in a cost effective manner.

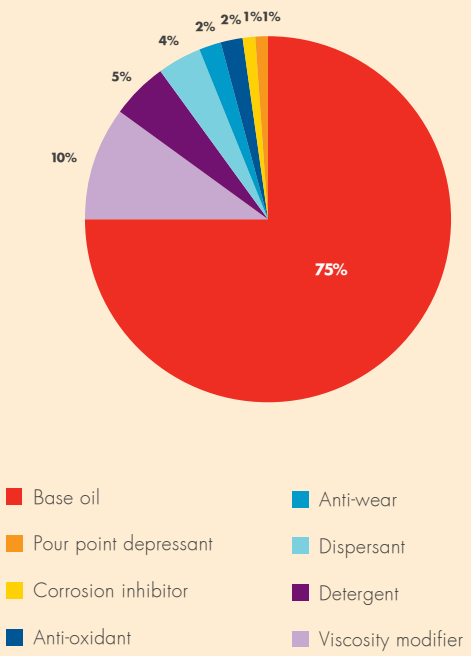
The process of creating a new lubricant or grease – from selecting components, to rigorously testing the formulation and conducting field trials – is highly complex and can take several years. In some cases lubricants evolve over decades, with developments in chemistry, and technology innovations.

BASE OILS AND ADDITIVE PACKAGES

Base oils typically make up 75% to 95% of the finished product and influence many of its key characteristics. They are key to determining factors like viscosity and lubricity.

The additive package comprises up to 25% of a lubricant's composition and works to enhance key performance aspects of the base oil, to achieve optimum performance of the finished product.

Typical composition of base oil and additive package for a heavy duty diesel engine oil



SHELL LUBRICANTS
TOGETHER ANYTHING IS POSSIBLE

DID YOU KNOW?

For decades, Shell Lubricants has led the way in advancing lubricants technology for the benefit of customers.

1933

Shell develops the four-ball load and wear test. Now a standard lubricants industry test, this assesses wear prevention in highly loaded contacts like rolling element bearings and open gears.

1936

The first oil company to invent lithium greases. An important shift for the industry, lithium greases now represent >80% of all greases used worldwide.

1957

Introduces the first ever range of Atomic Power Lubricants: radiation-resistant lubricants used in the world's first full-scale nuclear power station.

1990s

First to market with a 'low SAPS' engine oil. Lower levels of sulphated ash, phosphorous and sulphur help reduce diesel exhaust emissions by protecting after-treatment devices.

2014

First to introduce lubricants formulated from natural gas, with Shell patented gas-to-liquid technology.

2016

Shell introduces Shell LubeAnalyst Sensors, designed for real-time oil condition monitoring