Delivering maintenance value and excellence to mining operations

Effective management of a maintenance department is critical to any mining operation's long-term success.

It is a long held industry view that strong asset management practices provide a critical advantage to the bottom line, particularly given mining equipment maintenance can consume up to 50% of the overall budget. Without a clear understanding of the life cycle position of an asset, optimising and maximising value of any maintenance strategy remains difficult.

With mining companies struggling to extract the true life cycle costs of running equipment from their ERP systems, effectively managing maintenance costs, and/or proactively driving a continuous improvement asset management ethos, is far more difficult than it appears. Furthermore, Reliability Centred Maintenance (RCM) and Condition Based Maintenance (CBM) are not the only solutions. The ability to define and track the life cycle cost of assets, which adds critical and necessary context to RCM and CBM-based decisions, is the missing piece.

A whole of life view of an asset ratifies:

- Identification of lifecycle risks and opportunities;
- Control and reduction of maintenance spend;
- An end user's proactive decision-making.

Why every maintenance strategy needs Life Cycle Costing

Life Cycle Costing (LCC) predicts total costs, resources, utilisation and productivity for an asset over its entire life cycle. It allows management to take a holistic view of physical assets, considering their full impact and requirements in the operating environment. The LCC model can also be easily extended to evaluate, not only the cost of operating and maintaining equipment, but also materials, labour and other resource requirements and expected equipment performance.

Life cycle management works alongside an organisation's ERP to deliver strategic asset management capability. A common drawback of life cycle models is that they are static, i.e. they are not updated automatically based on the real-time decisions and events occurring on site (e.g. utilisation changes, parts price changes, maintenance plan changes, condition monitoring alerts, premature component change outs, corrective maintenance, unplanned downtime, etc.).

Would it not be more advantageous if all relevant maintenance and production data automatically updated the LCC projection in real-time? This would provide a real-time, dynamic life cycle cost model. It would enable asset managers to see and understand the impact of their decisions on the life cycle cost of the asset, and determine an asset's optimal economic life. It would also allow:

- Maintenance managers to see future risks and opportunities and simulate, optimise and evaluate alternate maintenance strategies;
- Inventory to see the forecast of components and parts;
- Production to understand forecast availability and utilisation in real-time;
- Finance to understand— in real-time— a Zero-Based maintenance budget for the next month, year, five years and beyond.

Zero-Based Budgeting (ZBB) gives managers an entirely new way to understand their business, with better cost management resulting in improved performance management. According to professional consulting firm KPMG, ZBB can improve margins and enables organisations to allocate resources strategically.

Solving complex maintenance challenges with Dynamic Life Cycle Costing

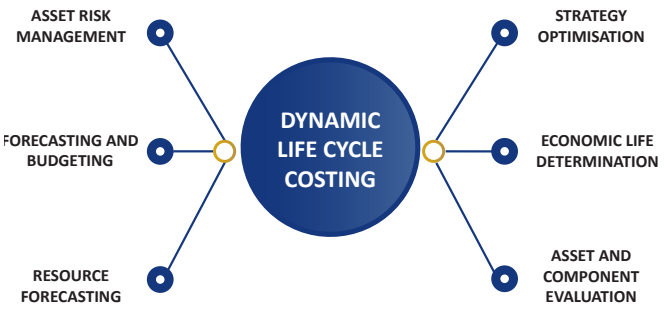
Solving complex maintenance challenges with Dynamic Life Cycle Costing (DLCC) is where a connected and integrated solution comes into focus. A powerful asset management solution should have a unique Dynamic Life Cycle Costing engine at its core – an inbuilt intelligence engine which enables mining organisations to

be proactive about asset management. This includes the ability to identify asset life cycle risks and opportunities, control and curtail maintenance costs, reduce unplanned downtime, and report and analyse critical engineering, maintenance process, application and operational drivers of asset performance. Leveraging any major ERP, DLCC takes inputs in real-time from various asset management processes and systems such as on-board monitoring systems, fleet management systems and the mine plan. This allows automatic reforecasts of future usage, availability, productivity, maintenance costs, resource requirements, risks, opportunities and value. It can be done for every piece of equipment and every component for the entire life of each asset in real-time. Seeing the future, from multiple angles, enables smarter proactive decision making today.

The advantages of DLCC

Without a forward looking view, it is not possible to adopt a comprehensive proactive approach to asset management. Harnessing a DLCC engine, companies can obtain a forward looking maintenance picture through the following capabilities:

- Risk management - Identify high risk and highopportunity components relative to the asset's life cycle that result in higher productivity, and lower capital, and maintenance costs.
- Strategy optimisation- The life cycle maintenance strategy is continually reviewed to provide the lowest cost per tonne, or hour, for assets. Managers can simulate and evaluate multiplealternate maintenance strategies and immediately see the impact this strategy change could bring.
- Long-term planning- Effectively visualise the long-term component plan to identify future labour and component bottlenecks as well as optimise the plan's resources, downtime and cost.
- Economic life optimisation- A proactive economic life optimisation forecasts the aggregated value in components for each piece of equipment to get a life cycle view. The DLCC processes information to identify the optimal equipmentreplacement points based on the users' strategy for higher productivity, lower capital expenditure and lower maintenance costs.
- Real-time maintenance budgeting- A live LCC projection for an asset, which accounts for all futureo planned and unplanned events, and is dynamically and automatically adjusted based on the inputs discussed earlier, is in fact a live budget – a live life-cycle budget. Creating a financial budget/reforecast is simply taking a slice-in-time of the asset's life cycle budget for the desired budgeting period. By harnessing a DLCC engine, an accurate, on-demand budget is produced, and the weeks, sometimes months required to "build a budget" disappears.



Dynamic Life Cycle Costing provides powerful forecasting capabilities.

Achieving value with asset management software

When trying to solve complex maintenance issues, improve the end-to-end performance of assets and achieve measurable return on investment (ROI), RPMGlobal's innovative and remote-enabled asset management software (AMT) delivers. It does this in a number of ways, as illustrated below. Mining companies, contractors, dealers, as well as major OEMs around the world have deployed AMT to help measure and manage their continuous improvement journey.

1. Downtime

- Lost production due to asset downtime.

Problem: If the asset is not reaching its targeted hours per month, the required production is not being achieved.

Solution: AMT tracks and reports downtime causes—linked to work orders—to help identify the main drivers for downtime. These drivers may be technical items (specific component or system) or process related (not enough electricians, or parts not organized in advance of planned and scheduled maintenance).

A coal mining company in South America was able to prevent 440 unplanned stoppages per month due to mechanics using incorrect or outdated service sheets. When investigated, it was determined that not only were there errors in the service sheets, but they were also out of date. AMT is able to capture and report not only the causes of unplanned stoppages, but also how unplanned stoppages can be prevented in the future.

- Consistent report functionality

Problem: Reporting that is inconsistent or inaccurate consumes significant time; the resources that check and consume these reports are generally high cost engineering, technical and managerial resources. Maintenance departments also often struggle to extract the true costs of running equipment from their ERP systems. Their time is therefore taken away from focusing on analysing results and problem-solving which adds value to an organisation.

Solution: AMT contains many industry standard reports straight out of the box that are available in real-time. Examples include mean time to repair (MTTR), mean time between repair (MTBR), utilisation, mean time to first stoppage after PM (MTFS After PM), downtime, PCV, ACI, RVIC, costs, budget vs actual, forecast cost variance, Cost per Unit of Measure (historic, future, total life-cycle).

In less than 6 months' post AMT go-live, a gold mining company in Australia increased their mean time between failures (MTBF) by 100%. The same company also reduced its budgeting timeframe from 3 months to 1 week. Prior to AMT, the company was using cumbersome and manual spreadsheets for budgeting. With AMT, users were able to identify high frequency unplanned tasks. Once identified, MTTF for these components could be analyzed, allowing them to be included in PMs along with other planned work, reducing the unplanned work between services to allow for an increase in MTBF.

- Reporting on drivers, not just outcomes

Problem: Maintenance departments struggle to measure and analyse the drivers of asset performance (lead indicators). They are limited to reporting the outcomes (lag indicators) such as availability, reliability and actual vs budget. Measuring, and then improving asset performance drivers, will result in better outcomes.

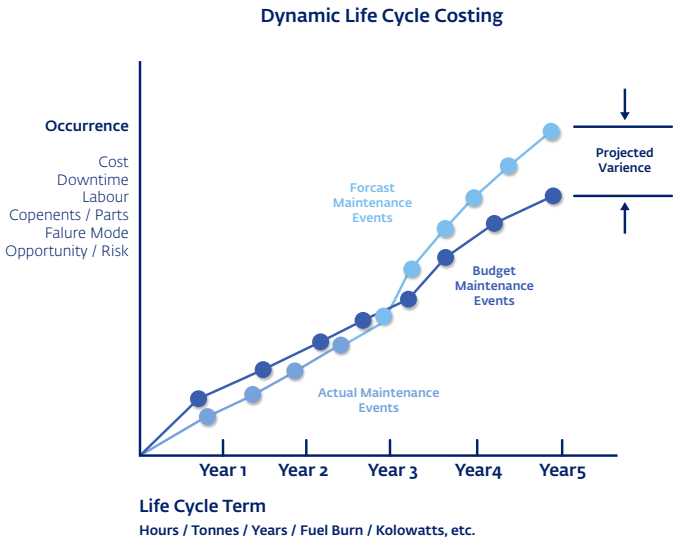
Solution: AMT reports on asset management strategies and processes, not just the asset itself. This encompasses metrics such as the percentage of components changed out after failure, overdue maintenance plans, standard job coverage, workscope coverage, service accuracy, maintenance compliance, backlog ageing, MTFS After PM, redo/rework, top 10 causes of downtime, top 10 repetitive failures, projected cost variance (PCV), annualised cost impact (ACI), cost per hour, cost per tonne, etc.

A large mining company used AMT to incorporate drivers, along with outputs, into monthly site maintenance reports in order to raise management awareness, and drive broader continuous improvement projects that were previously limited to focusing on engineering problems and solutions.

- Identify high impact issues affecting cost and availability
  Problem: Often engineers lack clear visibility on pressing issues that have the biggest impact on asset costs and availability.

Solution: AMT harnesses its DLCC engine to highlight and prioritise items that have the biggest impact on asset cost and performance. By focusing engineering resources and efforts on these problems, more efficient use of resources and lower cost per production unit is achieved.

An Indian coal mining company with two mines; one mine with a mobile mining truck fleet was achieving low availability using its own maintenance teams. The adjacent mine had double the amount of mobile mining trucks that were being maintained by an OEM under a MARC. The OEM operating the MARC used AMT and was achieving 20% higher availability. They had a rigorous set of maintenance strategies which CAT dealer management updated based on AMT's optimisation recommendations.



AMT provides visibility on the projected cost variance between budget and forecast maintenance events.

2. Maintenance Cost Control

- Change components prior to failure

Problem: Changing a major component after it has failed incurs a 25-50% higher cost compared to the cost pre-failure.

Solution: AMT helps engineering teams optimise the maintenance strategy by understanding realistic performance drivers. This enables identification of components that need to be removed and is best used in conjunction with AMT's CBM module and other existing reliability analysis tools if available.

- Understanding real-world performance of components at the mine site

Problem: Cost forecasts are often based on theoretical OEM estimates of component life and repair costs without modifying for their real-world use.

Solution: AMT holds both the theoretical OEM estimates as well as the real-world component cost and life numbers that are critical to developing realistic strategies, forecasts and budgets. AMT tracks and reports actual component cost and life, symptoms and causes of failure, failure modes, parts which failed, etc. AMT enables reliability engineers and analysts to have access to quality data from which to base decisions for optimising the maintenance strategy. In addition, it allows maintenance and supply chain departments the ability to take these differences and the cost impact back to the OEM's when product problems occur to either renegotiate supply contracts, focus OEM engineers on addressing known failure modes, or ask for relief.

Using AMT, a South American mining company was able to analyse and compare the quality of rebuilds from different rebuild centres. AMT enabled the company to graphically display the component life distribution over time, thereby ensuring the easy identification of the different lives achieved from each rebuild centre. The subsequent change to the optimal rebuild partner, resulted in an annual saving of US$4 million.

- Predicting and controlling unplanned as well as planned maintenance costs

Problem: Actuals costs always exceeding budget, unplanned costs significantly greater than planned maintenance, unable to accuracy predict and justify budget for future unplanned maintenance spend, unreliable/inaccurate/incomplete master data used in forecasts.

Solution: AMT's DLCC captures and forecasts in real-time all planned and unplanned maintenance, providing complete visibility.

Sophisticated tools within AMT enable you to:

- Identify, quantify the impact of, and prioritise the improvement of inaccurate master data.
- Analyse historic and future drivers and causes of cost overruns.
- Identify future risks.
- Identify future opportunities to reduce future costs.

It does all of this for planned and unplanned work. For example, the value of identifying high dollar unassigned cost items and moving them to Planned or Non-Planned strategy tasks can have a big impact. It moves it from being an unplanned cost to a planned cost which can be anywhere from 1.5-5 times cheaper (if planned). AMT also provides recommendations which can be tested and evaluated against the maintenance department's and the company's targets.

Using AMT, contractors and dealers globally have been able to model upfront from a zero-base planned and unplanned costs of, and successfully manage to a fixed (i.e. locked) five to 10-year budget, total repair and maintenance contracts; while still achieving availability, reliability and BCM targets.

3. Inventory

- Inventory forecasting & emergency freight

Problem: Inventory departments often struggle with poor visibility over the future demand for high-value, slow moving, long-lead time parts such as major components. This results in either excess holdings, or no availability of expensive component parts when required. No availability can lead to prolonged asset downtime (waiting parts), high emergency freight costs, and/or paying a premium for the parts. Excess holdings of components causes high inventory holding costs and can significantly inflate working capital.

Solution: AMT provides an accurate, full life cycle forecast of component demand which is automatically and dynamically updated in real-time. The result is an accurate forecast, enabling inventory teams to optimise component, and associate piece part inventory. With a life cycle forecast, AMT provides a more accurate forward looking component forecast that informs Procurement and Stores of their purchasing and holding requirements. This results in a stronger negotiating position during the purchase process and better inventory holding practices.

4. Financial

- Develop an accurate budget

Problem: Developing an accurate maintenance budget is often time consuming and prone to error.

Solution: AMT streamlines the maintenance budgeting process which frees finance and engineering personnel to work on more value-adding activities. Those responsible for the budget can spend more time analysing, developing and refining alternate maintenance strategy scenarios that optimise the maintenance strategy, and thus, the maintenance budget.

When developing their first AMT budget, an Australian gold miner successfully created their first cut of a budget in two days, down from the six-week exercise before the implementation of AMT. This significant time saving allowed the team to focus their time on developing new scenarios, identifying opportunities to reduce maintenance costs, and simulate the impact of different mine planning scenarios.

- Incorporating future asset costs into a budget

Problem: Identifying which asset(s) to retire and when, and with which asset to replace it with (if any) and when and the ongoing cost to maintenance that asset; are very time consuming exercises, and the in particular the future maintenance cost estimate is very high-level / based on outdated assumptions.

Solution: AMT has a suite of benchmarking reports, and reports which forecast the future condition of assets, all of which can be compared to asset book-values to determine the optimal asset replacement point. New asset purchases can be modelled and compared in AMT (CAPEX and OPEX) and included in AMT's budget, without the assets existing in the ERP.

A large diversified global miner used AMT to budget a 20-40-year expansion of an existing mining operation, which included the forecast delivery of 150+ new mobile equipment over a three-year period. The process involved modeling, comparing and budgeting offerings from different OEMs, to determine the optimal fleet mix from both CAPEX and OPEX standpoints, for life of mine.

- Cost forecast accuracy

Problem: Maintenance contributes a large portion to mine operating costs, and maintenance costs are not fixed but vary from year-to-year.

Solution: AMT has a first principles approach to maintenance budgeting based upon the asset's maintenance strategy, and accounts for future unplanned events. It allows for more accurate forecasting of costs and resources so the money gets budgeted within the month the repair is actually projected to occur.

- Better working capital management

Problem: Excess component inventory results in increased inventory holding costs and higher working capital.

Solution: AMT has a first principles approach to long term component forecasting that is based upon a whole of life approach to the maintenance strategy for that asset. This allows for more accurate forecasting of costs and resources and a more accurate component replacement forecast. This component forecast drives a better understanding of inventory holding, working capital needs and improved financial KPIs.

Conclusion:

Without a dynamic life cycle approach to asset management, value-adding functions such as maintenance budgeting, strategy optimisation, risk analysis, long-term resource planning and economic life optimisation are not possible. A successful asset management solution like AMT adds value to any existing enterprise system by providing DLCC methodology to assets. It actively identifies risks within the thousands of equipment items and components under management and highlights those risks. By understanding the future impact of these risks, managers can make decisions that have a positive impact on the asset's life cycle and cost, thereby saving mining operations time and money.

To learn more about how AMT can add value to your mining operation, contact RPMGlobal.

Please contact us on: **info@rpmglobal.com**

References:

- *Zero based budgeting- Enabling finance to drive better decisions on portfolio and cost management. KPMG, 2019.*

ABOUT US

RPMGlobal Holdings Limited (ASX: RUL) [RPM®] was listed on the Australian Securities Exchange on 27 May 2008 and is a global leader in the provision and development of mining software solutions, advisory services and professional development to the mining industry.

With history stretching back to 1968, RPM has been trusted by mining companies of all sizes and commodities to support their growth. Our global expertise has been achieved over the past 50 years through our work in over 125 countries and our approach to the business of mining being strongly grounded in economic principles.