Strategic Asset Management

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Summary: This paper presents various methodologies and issues associated with a total asset management process that embraces the use of capital and maintenance expenditure to ensure assets meet the full spectrum of operational requirements, including safety, performance and return on investment. Pervading the entire process is a risk management process that is a function of the condition of the asset base and the responsiveness to identified needs. The tangibles of the asset management plan are physical documents and systems that make up the individual elements within the framework. In this case, they are the outward signs of a business process, which is comprised of many business rules. A mixture of Oracle, intranet and Office-based documents will be described, including how these are interleaved.

Output from the asset management plan described in the paper includes distribution of costs across systems and areas, efficiency of the expenditure (including reactive versus proactive maintenance plus anecdotal notes on known problems), and effectiveness of the expenditure – management of the reliability and capability of the systems, where capability represents ability of an asset to provide its intended function with expected levels of flexibility, efficiency and quality. In conclusion this work has achieved interpretation of the broad overall business targets in terms of operational requirements for specific assets and groups of assets, planning ahead to check likelihood of asset capability being able to meet operational requirements, and gap analysis between operational requirements and operational performance.

1.0 INTRODUCTION

The Asset Management Plan for an organisation links the business requirements of the asset base with various necessary business functions associated with the management of risk and cost, [1]. These include capital management, a register of risk issues, long range maintenance strategy and budget management. The tangibles of the Asset Management Plan are physical documents and systems that make up the individual elements within the framework. In this case, they are the outward signs of a business process, which is comprised of many business rules. The business rules are defined in policy and then enforced through the information system, work procedures and the responsibilities listed in position descriptions.

The Asset Management Plan has three objectives relevant to delivery of tangibles. The first is the creation and definition of a sequence of products and systems that are to be used in accordance with the responsibilities of a position and within the context of a team to ensure the defined business processes are enacted efficiently and with minimum risk. Secondly it is necessary to provide physical substance to a strategy that allows people involved in the implementation of that strategy some simple goals and tools to assist in its achievement. The final objective of the Asset Management Plan is to enforce the business rules that make up the strategy, no matter how intricate, interlinking or complex these rules are required to be since the simple use of the tangibles will ensure that they will be followed.

A facility should be analysed wherever possible (pending data, time and access for interview constraints) for the following:

1. Top cost areas (i.e. opportunities for savings subject to further detailed analysis in these areas), [2]
2. Work types and possible work efficiency
3. Reliability data in the form of defect trends
4. Responsiveness to backlog and rectification of defects
5. Risk management – as indicated by integrity considerations and responsiveness of maintenance providers
6. Budget analysis

7. Anecdotal notes of relevance regarding asset management of the facility

In seeking to recommend on possible cost optimisation of the asset management approach, an analysis should focus on determining specific high spend areas that would warrant a detailed engineering investigation in the future, and on aspects of the asset management highlighted by both data and interviews that should be reviewed as to effectiveness in terms of methodology, systems and resources, [3].

Essentially the Asset Management Plan is the means by which we identify the intended future performance of the equipment base as well as the engineering means by which we will achieve this performance, [4]. The Asset Management Plan is more than maintenance engineering, although maintenance is a very important component. The Plan is an agreement between operations, Production engineering, principal engineering and maintenance providers and covers:

1. Equipment operational requirements – opportunities for improvement, limitations to be addressed, operational considerations such as access for maintenance
2. Risk management – issues to be addressed, priorities for work to be done
3. Technology plan – solution strategy to achieve operational goals, improve the state of the equipment base, strategy for asset management as decommissioning is approached, integration of site-wide programs such as corrosion management
4. Capital plan – stay-in-business capital projects, prioritisation of projects, impact analysis of budget reduction
5. Maintenance plan – major maintenance or ad hoc work, prioritisation of projects, impact analysis of budget reduction, routine maintenance budgeting
6. Equipment analysis – maintenance and equipment condition improvement opportunities, investigations
7. Performance analysis – backlog analysis, work efficiency and maintenance strategy analysis, budget analysis

This paper considers aspects of a strategic asset management approach, the exploration of maintenance improvement and concepts in effective measurement of maintenance work performance.

2.0 ASSET MANAGEMENT PLAN

The simple framework of the Asset Management Plan is shown in Figure 1. The Framework describes all of the elements that make up the Plan. An element is a business process or set of tasks that a group of people are expected to undertake as part of their normal duties, [5]. The Long Range Maintenance Plan is a sub-element of the element Maintenance Plan. We use the word sub-element just to indicate that the Long Range Maintenance Plan is related to some other business processes, all of which contribute to the activity of maintenance planning.

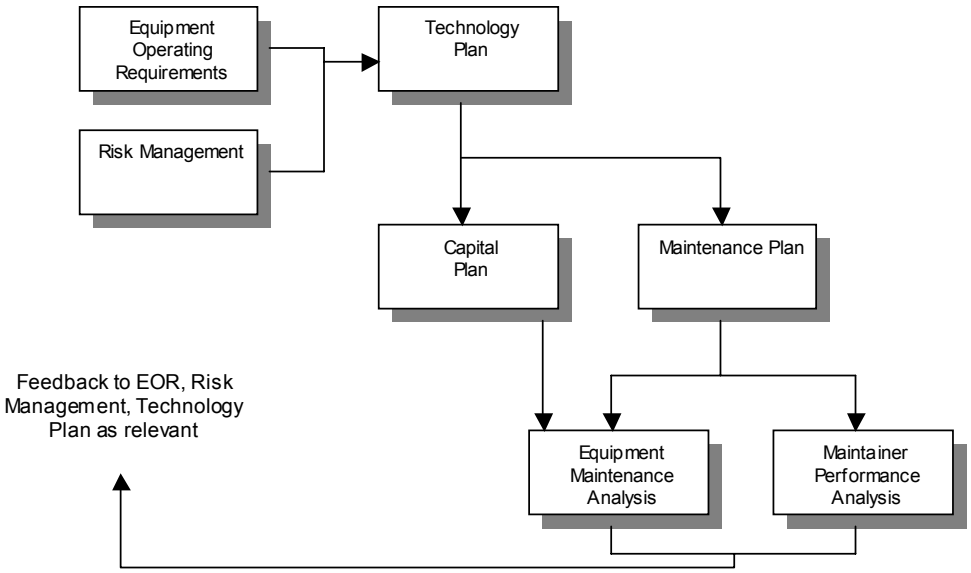

Figure 2.1 Simple framework of the Asset Management Plan

Equipment operating requirements (EORs) covers opportunities for improvement, limitations in the asset base to be resolved, and operational issues to consider when planning work. The risk management addresses risk issues, OH&S audits, environmental audits and operational loss control audits. The Technology Plan is a pivotal element at which decisions are reached regarding expenditure and commitment to performance targets, forward issues and major projects, impact of capital on maintenance, the Impact of maintenance on equipment life, impact of site-wide programs (eg corrosion program) and makes recommendations for work. The Capital Plan covers projects, refurbishment projects, the risk profile of the included work, and provides an annual capital budget within the context of say a five-year plan. The Maintenance Plan manages major maintenance work, refurbishment projects, the routine maintenance budget and uses a risk profile of work to finalise an annual maintenance budget, again within the context of say a five-year plan. The feedback elements include equipment analysis, which is concerned with maintenance work type analysis, condition monitoring alerts, NDT reports and general inspection results. The maintainer performance analysis addresses backlog analysis and rework.

The linking between the EORs and the Technology Plans is a relatively one to one relationship:

1. Opportunities for improvement in the EORs links directly with issues with the plant listed in the Technology Plan
2. Operational requirements such as plant performance requirements and limitations (either in throughput or in flexibility of operation) assist with identifying both causes of concern and considerations associated with issues in the Technology Plan – both fields within the Technology Plan act as further explanation to an issue
3. Maintenance considerations in the EORs affect both the maintenance history (or strategy) listed in the Technology Plan (and which will impact on recommended maintenance projects) and routine maintenance considerations, which are picked up in the Maintenance Plan

The priorities of issues within the Technology Plan should be governed by considerations listed in the EORS such as criticality of assets and their performance requirements.

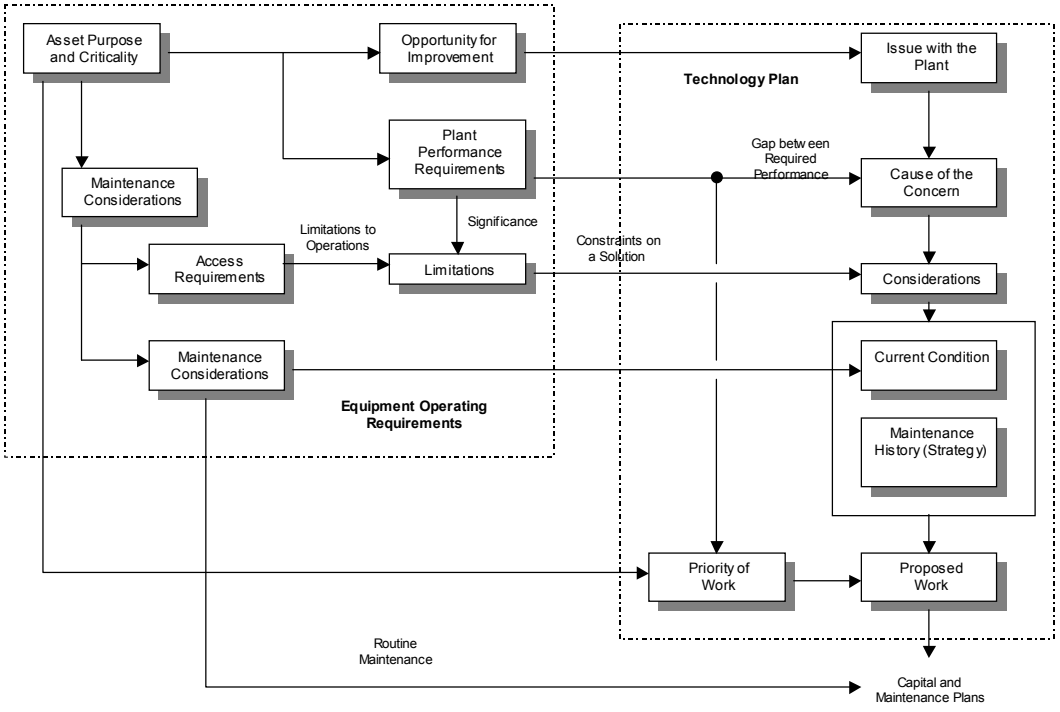

Figure 2.2 Linking between EORs and Technology Plan

The linking between the Technology Plan and items referred from it to the Long Range Maintenance Plan are even tighter. Virtually issues in the Technology Plan will drop into the Maintenance Plan as ad hoc or non-routine work items, provided they are approved to proceed from the Technology Plan into the Maintenance Plan. The diagram on the Long Range Maintenance Plan shows two streams of work: the upper steam on the diagram refers to non-routine work, which is typically major maintenance, ad hoc maintenance greater than 20K in value and other forms on work not scheduled as time-based in the Maintenance Plan. To form the Long Range Maintenance Plan routine costs, historical data is extracted from the works management system and compiled. Analysis of the data set distinguishes between high periods of cost during which it is assumed that non-routine major refurbishment has been carried out.

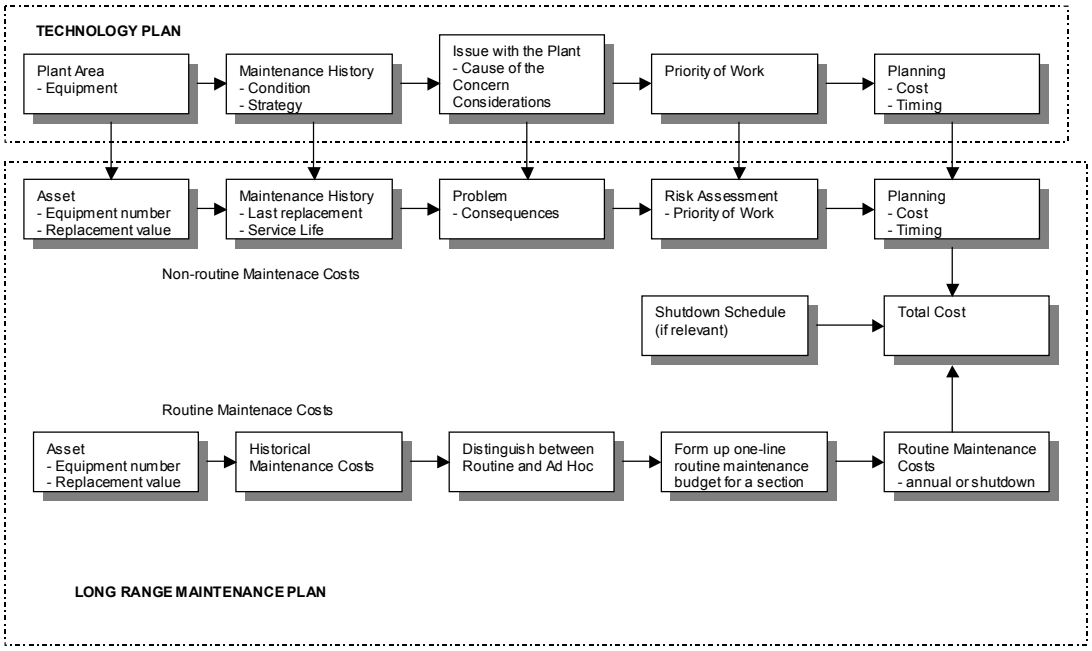

Figure 2.3 Linking between Technology Plan and Long Range Maintenance Plan

3.0 LONG RANGE MAINTENANCE AND CAPITAL MANAGEMENT

The approach adopted in the management of non-routine major maintenance or refurbishment work is a project-based approach. This aspect of the Maintenance Plan is therefore treated in a similar way to the management of the Capital Plan, so that processes described here will match what is necessary to integrate the Capital Plan into the overall Asset Management Plan.

3.1 Criticality considerations

The elements in the LRMP need to be sorted according to criticality considerations, such as those tabulated below:

Options	Priority	Consequences	Maintenance/ Capital Spend
		S - Safety	
M - Must do	1 – High - Must do within twelve months	P - Production Capacity	
L - Long Term (Item will probably be viable in the long term, but open for consideration)	2 – Medium - Must do within three years	Q - Process Efficiency	M - Maintenance
O - Optional (Do not do if item is not viable in long term	3 – Low - Should be considered within the next three years	C - Maintenance Cost	C - Capital

Table 3.1 Criteria for planning of work

Often capital issues considered under the Capital Plan are included within the LRMP. This is because the timing of the tasks will coincide with periods of major maintenance, and there is some advantage in determining lump sum monetary requirements for a given year or month.

3.2 Exhibit of a LRMP

An extract from a working LRMP is tabulated below. It can be seen that there are three kinds of work that need to be covered:

1. Ad hoc major tasks
2. Repetitive tasks, particularly inspections and overhauls
3. Tasks that can be anticipated at some time in the life cycle management – typically replacement or complete refurbishments driven by results from the inspection program

Kiln	Item	Equipment	Equipment Details	Equipment Number	Replacement Value $,000 per item	History		
						Last Replacement	Life (Yrs)	Last Replacement
Hydrate Feed System								
1	A1	Feed Bin		T661-11				
1	A2	Apron Feeder		AF661-101	50			48K refurbishment 9/00
1	A3	Spillage Conveyor		C661-101				
1	A4	Belt Weigher		BW661-102				
1	A5	Screw Feeder Drive, Screw and Tube	Liner	SF661-103	40			
			Screw Tube		35			Changed in 2000
1	A6	Feed End Hydrate Lifters	Elevator Pot	ELV661-346				
1	A7	Structural/platforms						
		Major maintenance						
		Routine maintenance						

Risk					Scope					Budget $,000				
Problem	Consequence	Risk Type (E,S,B)	Likelihood	Rating	Proposed Work	Expenditure Type	Cost ($,000)		Priority	2002	2003	2004	2005	2006
Hydrate slowly wears lining	Hydrate lost to environment	E	4	2										
					Refurbish	M	x	2004				x		

Screw feeder alignment is difficult	Screw feeder breaks	B	4	4	Change out tube liners every 3 years	M	x	2004				x		
Screw feeder alignment is difficult	Screw feeder breaks	B	4	4	Change out screw tube every 10 years	M	x	2010						
						M	x	R		x		x	x	

Table 3.2 Exhibit of a Long Range Maintenance Plan (LRMP)

The exhibit demonstrates how clearly the ad hoc work stands out within a tightly specified asset base, plus some of the information collated to justify the long range expenditure.

The development of the costs for the repetitive major maintenance work is accumulated from historical spend profiles, [6]. This spending is allocated across each of the equipment areas contained within this scope of work. Instead of a top-down approach, which is based on what, did we spend last year plus considering known problems, the LRMP provides a bottom-up approach or zero base where the costings are built up for each item of equipment. There is an element of "what did we spend last time" in the budget for routine maintenance since this is based on the rolling average of the last five to six years, or for however long data is available.

The process of compiling the LRMP is shown below.

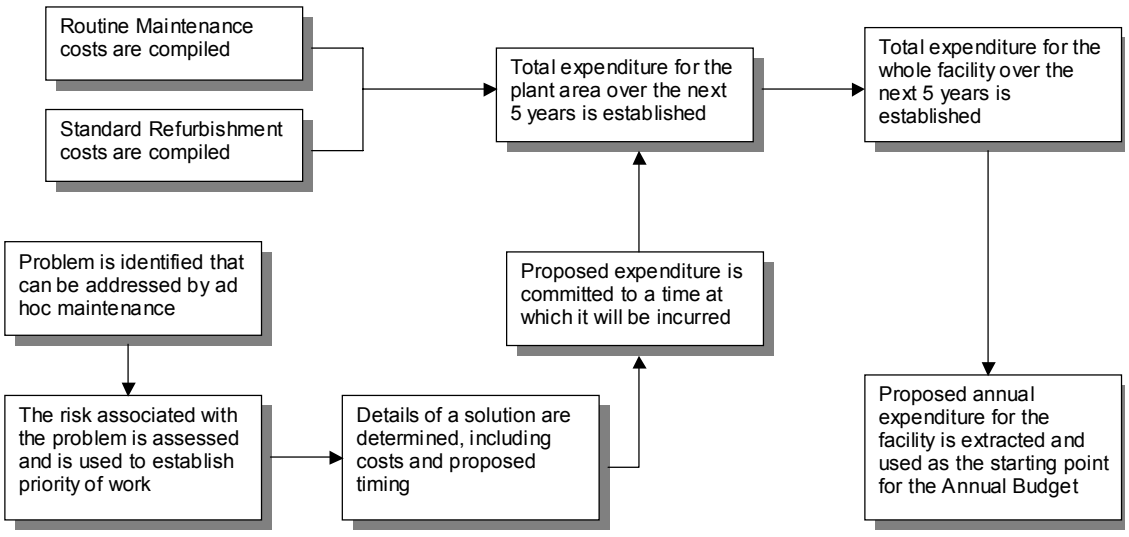

Figure 3.4 Compiling the Long Range Maintenance Plan

4. FEEDBACK

This section describes the analysis of maintainer performance such as backlog analysis and equipment condition using work type analysis, which the feedback loops within the Asset Management Plan. These elements are made up of a number of standard forms of analysis, which will be added to over time as the service providers mature their service delivery.

4.1 Backlog Management

Backlog analysis is a Key Performance Indicator (KPI) can show the risk outstanding with planned but incomplete maintenance work. The backlog report is a tool to distinguish between acceptable and high-risk responsiveness to work requests. The report will also show the specific tasks that are threats to the assets or may need their criticality changed over time. The backlog report may also verify the tasks that are completed but are still open in the works management system database. A procedure has been developed to generate an automated backlog report such as shown below.

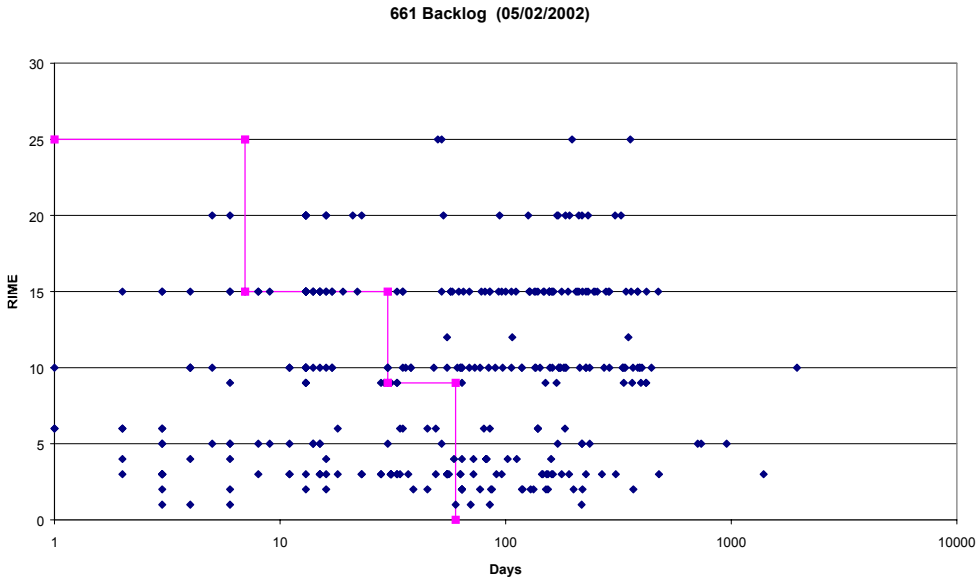

Figure 4.1 Backlog report

Each point on the plot is a work order, and the x-axis refers to the days outstanding between when the task was raised and the date of the analysis. The y-axis is a measure of the risk of the work order, with 25 representing maximum possible exposure. The area to the left side of the staggered line is the acceptable performance area, where the time in backlog is considered acceptable given the criticality of the task. But the other side of the policy line identifies tasks that are risks to the assets or need their criticality to be reviewed over time.

The backlog spreadsheet that is produced with the plot shown above also provides considerable information as to the nature of each work order in backlog, including the current tasks within the work order that are outstanding. Hence queries as to the nature of the backlog can be answered by referring to this spreadsheet

4.2 Work Type Analysis

Three dominant types of work are typically used:

1. Corrective Actions
2. Breakdown Maintenance
3. Preventative Maintenance (PM)

Corrective actions are predominantly driven by inspection work and operator feedback. We are concerned with the following issues: time spent in various types of work – is maintenance proactive or reactive, and the proportion of Breakdown work and Corrective work to PM work for different types of equipment.

The analysis is based on cumulative labour hours expended per type of equipment. Equipment types are identified by a unique two character alphanumeric within the equipment number associated with a work order. The results contained in the work type analysis plots are the sum of man hours within the designated period for a specific work type and type of equipment.

A sample analysis from another site is provided to illustrate the technique. Three plots show cumulative man hours per year within the three work types defined above, and grouped for distinctive equipment types labelled along the x axis.

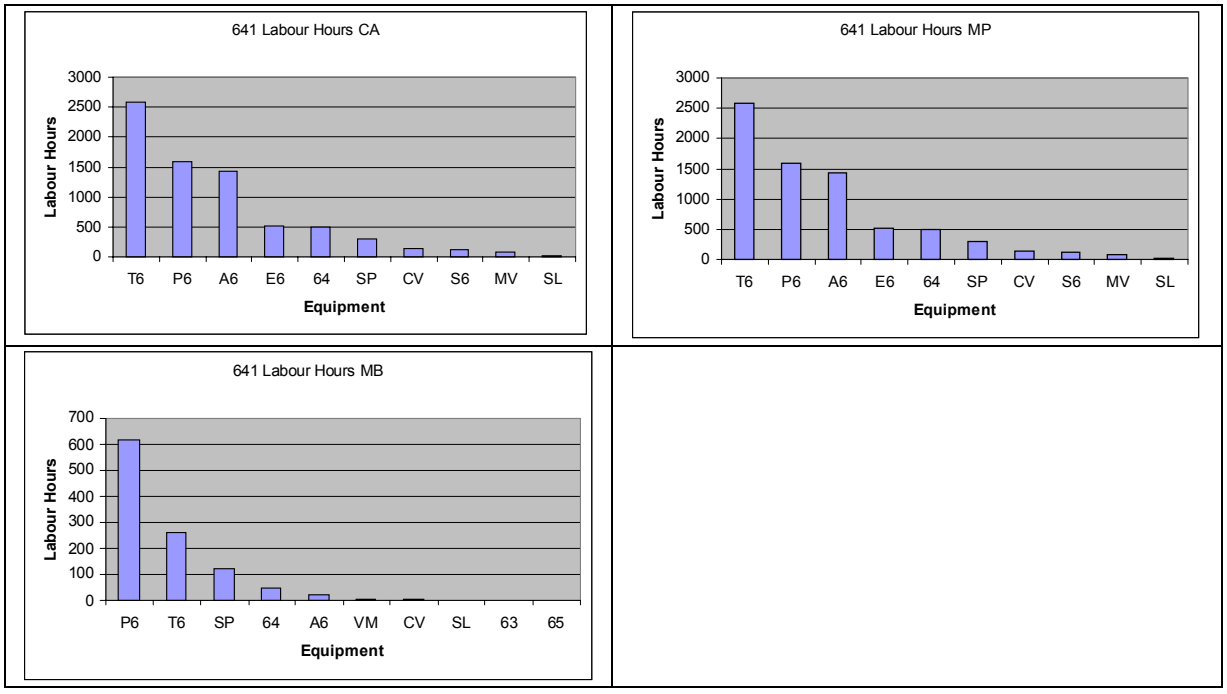

Figure 4.2 Sample work type reports

The commentary on these results is:

- High corrective and PM action on tanks
- Pumps in this area receive more PM support than others, yet still have high breakdown (MB) and significant corrective action
- Agitators also receive considerable amount of attention – is the PM strategy right?

5. CONCLUSION

The challenge for asset management is to provide a credible statement on a strategy that will ensure the organisation can sustain their asset base and its business mission in a long term cost effective manner. An

imperative for this issue is the need to reduce overall expenditure to meet gaps between the sum of individual budget submissions from all areas across a facility and the total organisation maintenance and logistics budget guidance figures.

To achieve this the conduct of the asset management plan has to be guided with feedback on the distribution of costs across systems and areas, efficiency of the expenditure (reactive versus proactive maintenance plus anecdotal notes on known problems), and effectiveness of the expenditure. Effectiveness refers to management of the reliability and capability of the systems, where capability represents ability of an asset to provide its intended function with expected levels of flexibility, efficiency and quality.

Long-range maintenance strategy can reflect a plan that at a minimum forecasts out to 5 years hence and includes the following:

- Plant condition assessment and life assessment
- Identification of major maintenance improvements, where major maintenance normally refers to overhauls or shutdowns
- Investigations and management of long term risk
- Planning of major maintenance periods
- Review of the cyclic planned work lists, which may be called the Maintenance Plan, although this Plan may also include major maintenance improvements
- 5-year budgets

Normally the management of the long range maintenance is integrated with management of the Capital Plan of an asset base, since periods of major maintenance normally offer times of access for capital upgrades and configuration changes. There are also links between capital and major maintenance as capital change-out may address long-standing maintenance problems and capital refurbishment or change should lead to modification of the Maintenance Plan, [7].

Short-term maintenance control is normally expected to have a twelve-month focus and is concerned with:

- Scheduling of work from the Maintenance Plan, outstanding requests for corrective maintenance and any non-urgent breakdown work into planned maintenance periods
- Response to equipment inspections and condition monitoring that identify items requiring immediate rectification
- Urgent attention of breakdowns that cause immediate loss of currently required capability
- Management of urgent risk issues that need attention within the next twelve months
- Certification, approval and logging of configuration changes
- Budget management and tracking of expenditures
- Development of budget for the following twelve month period
- Scheduling of the work packages and management of major maintenance periods that fall within the twelve month period, including resource management, expenditure and supply of materials and purchased services
- Developing detailed scopes and resource plans for major maintenance periods that are imminent

External to this set of work, but included within the overall business of asset management are:

- Interpretation of the broad overall business targets in terms of operational requirements for specific assets and groups of assets
- Planning ahead to check likelihood of asset capability being able to meet operational requirements
- Gap analysis between operational requirements and operational performance
- Risk identification including hazards to capital, mission, safety, health and environment
- Capital planning to improve the capacity, efficiency or cost impact of using the assets to achieve operational targets

- Engineering support including establishing standards to be met and design out of intractable problems or operational limitations

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