3 PROCESS

3.1 STRATEGY

Business strategy is simply a set of objectives and a plan to achieve them. It is definitely a process. For large mobile equipment, the objective should always be to achieve the lowest unit production cost for the life of the vehicle by thoroughly preparing for major overhauls and ensuring that routine preventive maintenance is performed to optimize equipment safety, availability, and integrity.

Strategy begins with equipment selection. Does the application favor electric shovels, trucks, and drills, or are mechanical machines a better choice? How are the units matched? Is the mine standardizing around brand and models? All these variables have a profound effect on the resulting maintenance strategy.

Once the fleet is defined, decisions have to be made. The most important include:

- what the expected life is for each machine and how to configure the maintenance strategy to achieve that life;
- what major services (welding, machining, mechanical, electrical) will be delivered on-site and who will do the work;
- if equipment is being rebuilt off-site (a common practice with support equipment and large structures), transportation considerations need to be determined;
- what is the source of supply for major components;
- where the components will be stored and when ownership of those components will be transferred to the mine;
- what are the stocking levels for components;
- what are the stocking levels for consumable parts;
- what is the logistical plan for emergency orders;
- how are key commodities being provided and what is the replenishment cycle;
- are the facilities adequate to host the volume of work that is required to maintain the fleet as it ages and grows; and
- for new mines, the strategy needs to be determined at least a year prior to first production, and the people responsible for running the maintenance operation (especially the maintenance superintendent) should be in place on that timeline.

These concerns are the same at mines around the world but the answers are always site-specific, depending on the availability of support resources and the operating circumstances at the mine. In my experience, problems arise when decisions are made too late or on an ad hoc basis with no reference to the long-term ownership strategy for the machinery.

Management often decides to take the entire maintenance process off the table by contracting the process to equipment suppliers. Known as maintenance and repair contracts (MARCs), such agreements may make sense if the supplier can provide superior services due to better access to the resources needed to maintain its fleet. MARCs have their place, particularly for greenfield mines or if the machines are new to

the market with no track record; however, MARCs are very expensive and the contracts themselves are a significant drain on mine management. MARCs and other forms of product support contracts are covered in a separate section of this document.

3.2 PLANNING AND SCHEDULING

3.2.1 Baseline Plan

There has to be a starting point when designing the maintenance plan. It includes the known events intended to keep the machinery running through its expected life, as well as both routine preventive maintenance (PM) and major events such as large component changes.

While there's a trend towards performing maintenance on a condition basis, the overall strategy is usually described according to specific tasks performed at predictable frequencies. Suppliers favor machine run hours, or SMU (service meter units), to establish benchmarks for component change-outs. For example, they might recommend a 20,000 SMU benchmark to replace the engine on a haul truck. Mines are likely to consider net operating hours (NOH) as the time measure by which they define benchmarks because NOH excludes time idling on standby when components undergo less stress.

There's an assumed NOH/SMU ratio at most sites. For example, if the ratio is 90% for haul trucks then the 20,000 SMU engine becomes an 18,000 NOH event. This causes problems if the NOH/SMU ratio can't be reliably verified but, in any case, the baseline plan itself should comprise a comprehensive list of events that are known to occur at regular intervals, be it NOH or SMU.

The benchmarks are a guide; they can be modified as the machine proceeds through its life and according to actual equipment condition. The important thing is to modify the benchmarks logically based on strong verifiable evidence rather than speculation. Setting benchmarks involves the calibration of events to meet circumstances; very dusty sites may require lower PM intervals on electric shovels, while severe haul profiles will affect the benchmarks for major component change-outs on trucks. It's a combination of considering equipment manufacturers' recommendations and applying local knowledge and experience to create the final baseline plan.

The baseline plan can include tasks, frequency, work category, estimated costs, labor hours, and downtime for each event. The level of detail is up to the maintenance planning group, but the more detailed it is the more useful it becomes in creating detailed plans, supporting the budget process, and negotiating with suppliers.

A typical baseline plan is presented in Table 3: Baseline Plan — 320T Electric Drive Haul Truck.

Table 3: Baseline Plan — 320T Electric Drive Haul Truck

System	Description	Frequency (SMU)
PM	Field – Minor Repairs	50
TIRE SERVICE	Inspection/Minor Repairs	100
PM	250 Hour PM	250
ENGINE	Electric Service	500
HYDRAULICS	Hose Replacement (as required)	500
LUBE	Lube – Grease	500
LUBE	Lube – Crankcase	500
PM	500 Hour PM	500
PM	Scheduled Fluid Sampling	500
PM	Wash	500
AUXILIARY SYSTEMS	VIMS, GPS Dispatch	1,000
AUXILIARY SYSTEMS	Fire Suppression	1,000
AUXILIARY SYSTEMS	Miscellaneous 24V Repairs	1,000
ENGINE	Air Filter/Cleaner (4) Inner	1,000
FRAME/STRUCTURES	Frame – Minor Cracks	1,000
FRAME/STRUCTURES	Cab – Repairs	1,000
PM	1,000 Hour PM	1,000
PM	Auto Lube System Service	1,000
PM	Brake Inspection/Adjustment	1,000
ENGINE	Air Filter/Cleaner (4) Outer	2,000
LUBE	Lube – Wheel Motor Gearboxes	2,000
LUBE	Lube – Steering Tank	2,000
LUBE	Lube – Brake/Hydraulic Tank	2,000
PM	Cab – HVAC SERVICE	2,000
AUXILIARY SYSTEMS	Grease System	5,000
BRAKES/STEERING	Front Brakes (2) – Minor	5,000

System	Description	Frequency (SMU)
BRAKES/STEERING	Rear Brakes (2) – Minor	5,000
ENGINE	Switches and Hoses	5,000
ENGINE	Batteries (4)	5,000
IMPLEMENTS	Body Repairs	5,000
LUBE	Coolant – extender	5,000
PM	Payload Monitoring Service	5,000
POWER TRANSFER	Resistor Grid – Service	5,000
TIRE SERVICE	Position 1Change/Move	5,000
TIRE SERVICE	Position 2Change/Move	5,000
TIRE SERVICE	Position 3Change/Move	5,000
TIRE SERVICE	Position 4Change/Move	5,000
TIRE SERVICE	Position 5Change/Move	5,000
TIRE SERVICE	Position 6Change/Move	5,000
BRAKES/STEERING	Front Brakes (2) – Major	10,000
ENGINE	Engine – Mid-life Adjustments	10,000
ENGINE	Water Pumps	10,000
ENGINE	Alternator 24V	10,000
ENGINE	Pre-Lube Pump	10,000
ENGINE	Fuel Injection Pump	10,000
ENGINE	Fuel Transfer Pump	10,000
ENGINE	Injectors	10,000
FRAME/STRUCTURES	Frame – Major Repairs	10,000
TIRE CHANGE/MOVE	Rims Replacement (6)	10,000
BRAKES/STEERING	Accumulator (3)	15,000
BRAKES/STEERING	Steering Pump	15,000
BRAKES/STEERING	Steering Control Valve	15,000
HYDRAULICS	Hose Replacement (OH)	15,000
AUXILIARY SYSTEMS	Computer, Radio	20,000

System	Description	Frequency (SMU)
BRAKES/STEERING	Slack Adjusters (front & rear)	20,000
BRAKES/STEERING	Brake Oil Cooler	20,000
BRAKES/STEERING	Front Wheel Hub Group (2)	20,000
BRAKES/STEERING	Park Brake Release Pump	20,000
BRAKES/STEERING	Steering Cylinders	20,000
BRAKES/STEERING	Linkage	20,000
ENGINE	Turbocharger Repair (4)	20,000
ENGINE	Air Compressor	20,000
ENGINE	Air Starter Motor	20,000
ENGINE	Engine – Replace	20,000
ENGINE	Fan Drive (Pump & motor)	20,000
ENGINE	Radiator	20,000
ENGINE	Install Additions, Mounts, Harness	20,000
FRAME/STRUCTURES	Cab – Overhaul, Seat replacement	20,000
FRAME/STRUCTURES	Front Suspension Cylinder (2)	20,000
FRAME/STRUCTURES	Rear Suspension Cylinder (2)	20,000
HYDRAULICS	Hoist Pump	20,000
HYDRAULICS	Hoist Cylinder (2)	20,000
HYDRAULICS	Main Control Valve	20,000
POWER TRANSFER	Alternator/Blower – Minor	20,000
POWER TRANSFER	Control Cabinet – Major Overhaul	20,000
POWER TRANSFER	Blower Service	20,000
POWER TRANSFER	Blower Motor Replacement	20,000
POWER TRANSFER	Contacts – Minor Service	20,000
POWER TRANSFER	Contacts – Major Service	20,000
POWER TRANSFER	Resistor Grid - Overhaul	20,000
POWER TRANSFER	Wheel Motors & Planetaries (2) – 1st	20,000
IMPLEMENTS	Body – Midlife Overhaul (Liners, etc.)	40,000

System	Description	Frequency (SMU)
IMPLEMENTS	Body – Major Overhaul	40,000
POWER TRANSFER	Alternator/Blower – Major	40,000
POWER TRANSFER	Wheel Motors & Planetaries (2) – 2nd	40,000
FRAME/STRUCTURES	Frame – Major Repairs/Replacement	80,000