

Chapter 9

Know Your Assets

Familiarity breeds

Abstract The aim of this chapter is to draw attention to the need for asset managers to be familiar with their assets in a technical, business, and operational context. The role of the asset manager involves being well informed across the application of the assets, although this does not mean that the asset manager will be the ultimate expert on any one functional aspect. The asset manager will have an integrated view of the assets as a whole and will understand the relationships, interdependence, and degree of criticality among the deployed assets and be aware of asset condition. *Outcomes* After reading this chapter you will be aware of the importance of understanding the range of assets which are used in the business, their roles, the technologies involved, and the relative criticality of particular assets. You will be aware of the value of expert teams which have in-depth asset knowledge of particular asset types. You will be aware of the significance of bottlenecks that can occur particularly in flow process businesses and of possible backlogs of work and of asset condition. These are factors which may require an adjustment of resources.

9.1 Awareness of Key Assets¹

Successful asset management is dependent on managers having a clear understanding of the assets that are required to physically sustain the business and to keep it profitable. There is value in having a *register of key assets* of the organization which includes information on their leading specifications and age. Having a high standard of awareness of the key assets promotes good asset management. In particular, it focuses the attention of employees at all levels on the role and significance of the assets on which the organization depends. It is also valuable to

¹ ISO 55001 Clause 4.3: “The organization shall determine the boundaries of the asset management system...”.

promote an awareness of the range of assets and their interrelationship in providing essential capabilities.

Key aspects of asset knowledge can be summarized as:

- Awareness of key assets
- Block diagrams of major product flows, systems, etc.
- Criticality of assets from technical and business viewpoints
- Awareness of expert individuals or teams who have fully detailed knowledge of particular asset types
- Asset utilization
- Bottlenecks
- Backlogs
- Asset condition

Asset management information systems contain a vast amount of detailed information. In order to see the wood for the trees, the register of key assets, which is essentially a report generated from the full asset register, lists the main items at a senior management decision level. The register of key assets is a useful document in capability development planning and capital budgeting. This document will incorporate information such as:

- Asset/capability title
- Brief configuration detail
- Location
- Age
- Asset condition
- Estimated remaining life
- Book value
- Replacement cost
- Recent history, e.g., last overhaul or upgrade date
- Known issues
- Known plans

There is also value in having maps, plans, satellite images, photographs, and surveillance images at various levels of detail, making it as simple as possible to understand the location and nature of assets and their current condition.

9.1.1 Examples

An indication of the range and complexity of industrial assets is given by Fig. 9.1, which shows the assets at a mine site. The actual mining operation is not in the picture, and requires a further range of assets in the form of mining machinery and supporting services. Most industrial complexes involve a wide range of types of assets.

A statement of the quantity of assets under management, of the budget involved and of the work carried out annually is valuable as an indicator to staff, to

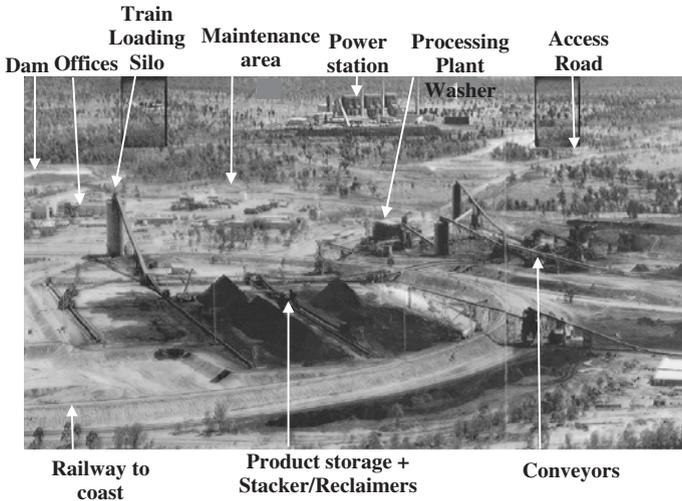


Fig. 9.1 Mine site assets

Asset	Quantity
Track	1800 kilometers
Electrification system	1600 kilometers
Turnouts	4715
Signals	3683
Train services per day	2500
Customer journeys per day	2.7 million
Annual capital budget	\$1billion
Annual maintenance budget	\$1 billion
Annual track reconstruction	42 kilometers
Annual rerailing	74 kilometers
Annual overhead wiring rebuild	16 kilometers
Turnout renewals	60
Track circuit renewals	155
Source: RailCorp New South Wales Asset Management Group	

Fig. 9.2 A railway asset summary

senior management, and to the public of the scale of the asset management task. Figure 9.2 gives an example.

At an electricity transmission company the CEO arranged for video screens in the head office to display, on a real-time basis, the electricity throughput of each of the company’s major transmission lines. This drew the attention to the fact that the important action was happening out there in the field, and that the activities of the office staff were essentially in support of the physical transmission process.

9.2 Acquisition of Asset Knowledge

The acquisition of asset knowledge requires a formal effort. Asset managers should always take the trouble to learn about the assets under their jurisdiction. A good approach to this is to assign young engineers the task of documenting areas of plant and explaining their workings in a descriptive document. Staff generally can then be made aware of the contents of the descriptive documents and they can be used in induction and training programs.

9.3 Block Diagrams

System block diagrams help in understanding the role and criticality of assets. A very simplified block diagram based on a power station is shown in Fig. 9.3.

The following are some rules for creating block diagrams:

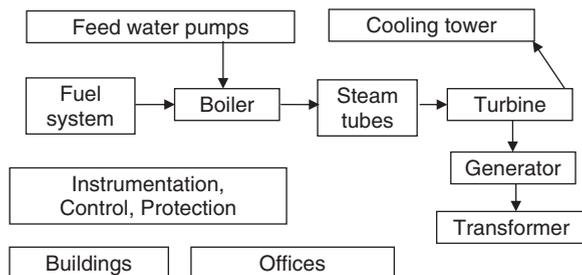
1. The *function* of each component or block should be identified.
2. Each block should be *physically* identifiable.
3. The blocks should be mutually independent (as far as reasonably possible).
4. Links, e.g., pipes, wiring, couplings should be assigned to specific blocks, or form their own block where justified.
5. Each block should preferably focus on one main technology, e.g., mechanical, electrical, hydraulic, PLC.

9.3.1 Information Required Per Block

The following points give an indication of the type of information required in relation to each block:

- Function of block and basic operating principles
- Inputs
- Outputs

Fig. 9.3 Power station block diagram



- Structure, e.g., assemblies, components, and functions and operation of these
- Operating norms, e.g.,
 - Production or flow rate
 - Yield
 - Pressure
 - Temperature
 - Other gauge settings.

9.3.2 Drawings

To fully understand the detail of a system it may be necessary to study the engineering drawings or piping and instrumentation diagram. This can be a worthwhile exercise. As my father used to say (probably quoting the Duke of Wellington), “time spent in reconnaissance is seldom wasted.”

9.4 Criticality

For asset planning we need to understand the *criticality* of the various items. This will be in terms of potential production losses if they fail, and also reflect safety and environmental issues. Criticality analysis helps us to prioritize maintenance work and also provides a basis for designing-in redundancy and making contingency plans. There are many examples where the loss of a production unit has caused major disruption on a statewide basis, such as the Varanus Island gas terminal in Western Australia, where a failure cut off one-third of the state’s gas supply. A similar example is the Longford gas plant in Victoria where a failure cut off the gas supply to Melbourne for several weeks. In the aftermath to this latter event, other sources of gas supply were expanded so that risk was reduced.

9.4.1 Example—Chemical Plant

In the example in Fig. 9.4 which is from a chemical plant, the heat exchangers were identified as the most critical assets as they are not duplicated and can only be repaired off-line, a time-consuming process involving extensive delays for cooling and start-up. To offset the criticality we need to prioritize these items and ensure that they meet fitness-for-service criteria at a standard sufficient to sustain them over a defined planning and inter-inspection period.

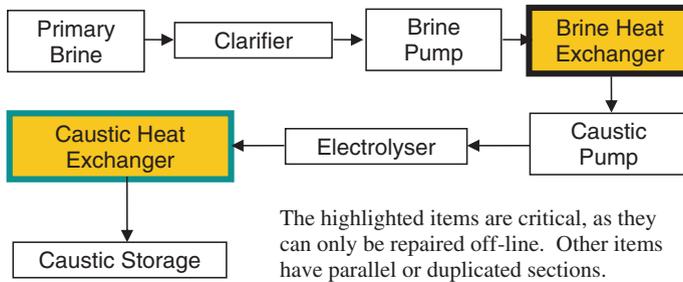


Fig. 9.4 Block diagram and criticality—chemical plant

9.4.2 Example—Mining Site

In the example shown in Fig. 9.5 from a mining site, criticality is based qualitatively on the following factors:

- Failure Category (Unlikely, Adequate warning, Sudden)
- Failure Impact (Low, Medium, High)
- Ease of Repair (No shutdown, Shutdown area, Shutdown plant)
- Mean downtime (Low, Medium, High)
- Cost of Breakdown (Repair cost only, Minor production loss, Major production loss)

	A	B	C	D	E	F	G	H	I
	Equipment Name	Number off	Failure rate off 1=Low 2=Medium 3=High	Safety-Enviro impact. 1=Low. 2=Medium. 3=High.	Ease of repair. 1=No shutdown reqd. 2=Shutdown of area. 3=Shutdown of plant	Mean Down Time 1=Low. 2=Medium. 3=High	Cost of Breakdown. 1=Repair cost only. 2=Minor production loss. 3=Major production loss	Criticality = 3* C*(D+E+F +G)	Comment
1	Drilling rigs	2	3	2	1	2	1	54	Can lease if critical
2									
3	Dragline	1	2	1	2	2	1	36	
4	Coal loaders	8	2	1	1	2	2	36	6 out of 8 reqd.
5	Dump trucks	14	2	1	1	1	1	24	10 out of 14 reqd
6	Transport	12	1	1	1	1	1	12	
7	Main conveyors	2	2	3	3	3	3	72	
8	Subsidiary conveyors	12	2	2	2	2	2	48	
9	Stacker-reclaimer	1	2	1	2	2	2	42	
10	Blender	1	2	1	2	2	2	42	
11	Coal washer	1	1	3	2	2	2	27	
12	Loading silo	2	1	1	2	2	2	21	Old silo retained as standby
13	Rail track	1	1	3	2	2	3	30	Contractor
14	Rail system	1	1	3	2	1	2	24	
15	Rail locos	6	1	1	2	2	2	21	Contractor
16	Rail wagons	248	2	2	2	2	2	48	More redundancy reqd
17	Unloading bay	1	1	1	2	2	3	24	
18	Port stacker-reclaimer	1	1	3	2	3	3	33	
19	Dozers	1	1	3	2	3	3	33	
20	Port conveyer	1	2	1	2	2	3	48	
21	Ship loader	1	2	1	2	2	3	48	

Fig. 9.5 Criticality analysis of mining assets

9.5 Expert Teams

An expert team is a group of people with specialized knowledge of the working of a particular functional area or of a particular type of plant. Figure 9.6 shows an example of the type of membership of a team. The technical nature of the equipment and the processes makes it essential to have people who understand the plant in order to make sound decisions. Forming expert teams give plant personnel status and motivation. They take their expertise seriously and it is taken seriously by management.

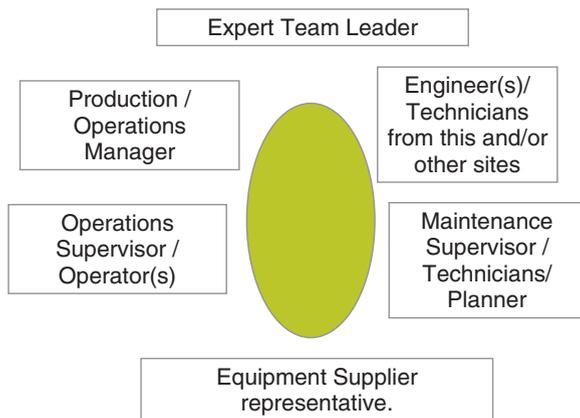
In some cases the expert team may be formed by linking experts across sites. For example, a mining company may have an expert team with knowledge of a particular type of process or machine, such as draglines. Technical problems relating to draglines, such as root cause analysis of failures, would draw on the knowledge of this group.

However, it is important to keep focussed on the objectives of the organization and not get side tracked into displacement activities.

9.6 Bottlenecks

A bottleneck is a part of a process which has limited capacity, and therefore constrains the throughput of the system as a whole. In systems involving simple flow processes, effective improvements can only occur at bottlenecks. However, bottlenecks are not always constant, but may depend on the production or product mix. For example, in a production facility, we received a large order for product requiring heat treatment. This made our heat treatment plant into a bottleneck at that time, whereas with a normal mix of orders, we had plenty of heat treatment capacity. We should therefore consider how demand on machines varies with the product mix before focusing on a current bottleneck. Also, if we act to remove

Fig. 9.6 Expert team



an existing bottleneck, the effect may be limited by causing a new bottleneck to appear in a different part of the process.

De-bottlenecking involves making investments that are cost-effective in increasing product flow or reducing costs by relieving bottlenecks. As part of our asset knowledge we should be aware of existing and potential bottlenecks, if any, and seek to relieve bottlenecks where this can provide the most cost-effective improvements. The following steps are recommended for this purpose:

1. Flowchart the process, identifying operations, queues, storages.
2. Identify demand drivers (e.g., customer pull), demand rates, and translate into average required throughput rates for each part of the process. Take account of average and peak loads.
3. Identify capacity constraint areas—potential bottlenecks.
4. Calculate maximum throughput rate of areas, using averages, then allow 25 % extra for queueing effects. Take maintenance into account.
5. Recognize areas as (a) complete bottlenecks, (b) occasional bottlenecks, (c) excess capacity.
6. Consider variability in service times. A high degree of variability (as opposed to consistent, even performance) leads to longer queues and/or larger stockpiles.
7. Treat bottlenecks by adjusting capacity, reducing variability, or prioritizing flows.

9.7 Backlogs

The buildup of backlogs of work in particular areas is relatively easy to identify, but is often ignored by management. Backlogs are an indicator of lack of resources in particular areas, whereas lack of a backlog indicates adequate resources. Watch out in case there is some deliberate attempt to distort the picture. Management should respond to the buildup of backlogs by checking the reason and taking steps to reduce the backlog, or to contain it to reasonable levels.

9.8 Asset Condition²

Asset condition will usually deteriorate over useful life. Normal depreciation reflects this loss of condition in a general sense. If the condition of an asset is such that it can no longer serve its functional purpose, then corrective action should be taken to restore the functionality. Considerations are:

- Asset condition in regard to primary functionality and safety.

² International Infrastructure Management Manual. Association of Local Government Engineering NZ Inc. P.O. Box 118, Thames, New Zealand. www.ingenium.org.nz. Section 2.5.

- Asset condition in regard to expected level of service, particularly for those which deteriorate gradually and where the condition can then be restored, such as roads and buildings.

An approach is to assess condition on a specified scale. This may be a 1–5 scale such as:

- 1 = very good
- 2 = good
- 3 = moderate
- 4 = poor
- 5 = very poor.

For comparison purposes it is important to have agreed systems for assessing asset condition.

The response to deteriorating asset condition can involve a timescale over which corrective action needs to be taken, such as:

- Immediate,
- Within 1 month,
- Within 3 months,
- Within 1 year,
- Monitor at next inspection.

For any given equipment type, the details can be spelled out in an inspection or condition monitoring procedure. The key point is to be aware of asset condition and to respond in time to sustain the functionality and safety.

9.9 Plant Criticality Exercise

The senior management of a process plant wants to increase production. They are considering adding another product line and have a cost estimate of \$750,000. You are a plant engineer and are asked to comment on the proposal. You know that the standard of reliability of the equipment is not high and that down time is significant, particularly for the furnace and blower.

The plant produces intermediate plastic products. Raw material is fed from any of three hoppers into either of two feeder lines. The feeder lines pump material via a flow controller, through a furnace, and then into a blower where it is formed into continuous sheet. There is a pump for each feeder line. From the blower, the material can be fed to any of five existing product lines. Give answers in dot point form to the following questions.

- Draw a block diagram of the process.
- Which stages of the process are critical from an operational point of view?
- What do you suggest to management?
- How would you back up your recommendations?

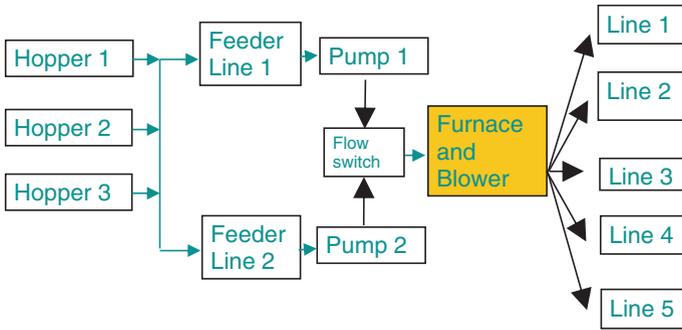


Fig. 9.7 Plant criticality block diagram

9.10 Plant Criticality Exercise Solution

The furnace and blower are critical. Increasing their availability through better maintenance planning, maintenance resource provision, and maintenance execution are recommended. In practice, this solution enabled increased production targets to be met without installing a new product line (Fig. 9.7).

Figure 9.8 illustrates the relative cost-effectiveness of the solution options.

9.11 Look Back in Embarrassment

“You’re such a wiz at asset management—I wonder if you ever did anything wrong?” said Veronica as she met Jock at the water cooler.

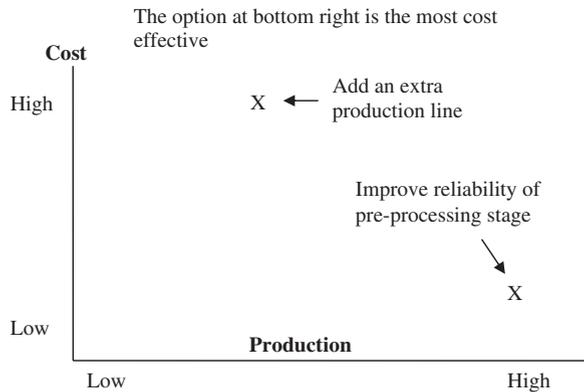
“There was one thing,” said Jock.

“Only one?”

“Only one I remember.”

“Tell me.”

Fig. 9.8 Cost-effectiveness of de-bottlenecking—example



Okay, “said Jock,” I’ll own up to it. It was in my early days out of college. I was in charge of a repair workshop, way up-country. Most of the focus of my life at the time was on sport and running a dance band and all I really took note of in the workshop was keeping up the stocks for the vending machines. There was a heap of complaints if they ran out of anything.

It was a couple of years later, after I had moved on, that I realized some of the things that I should have been doing and looked back in embarrassment.

There was a bottleneck in our production—I’m sure now that people were trying to tell me about it at the time. It was in textile work—not a big technical focus but there was a lot of it. We only had one textile worker and she was always flat out and holding things up. I could have easily recruited another textile worker when one of the staff from another area left, but my mind just wasn’t into gear on that sort of thing. It’s definitely not covered in an engineering degree.”

“It doesn’t seem such a big deal,” said Veronica.

“Maybe not, but I still feel stupid about it,” said Jock.

“I’ve been thinking about ways of getting it wrong,” said Veronica sometime later.

“Yeah?” said Jock, “like what?”

“Well, first you can have a senior management that is completely out of touch.”

“That’s quite common,” said Jock.

“I was reading about the high priests of the Incas sacrificing virgins to stop the advance of the Spanish conquistadores,” said Veronica.

“That’s a good example, but be careful, the Incas might sue you for defamation,” said Jock.

“Then there is not reacting to known issues, like ignoring obvious worn out stuff. And then just not being aware if issues that you—or someone—should be aware of, such fatigue failure or insulation degradation,” said Veronica.

“And then there’s just bad luck,” said Jock.

“Yeah,” said Veronica. “I think I’ll buy a Lotto ticket.”