Asset value

Asset managers need a framework to assist them to optimise the lifecycle value of their organisations assets, writes *Allen S.B. Tam* and *John W.H. Price*.

Asset database*

Decision Dimension Relevance		Data
Operation		Production/operation rate
		Required availability
		Operational data (vibration, pressure, temperature, noise)
		Profit per unit time or per unit production
		Maintenance manual
Assurance		OEM suggested maintenance intervals
		Human resource (Skills level and training)
		Historical asset data
Economic	Maintenance costing	Human resource costs
	Maintenance costing	Spare part unit cost
	Maintenance costing	Spare part holding cost
	Maintenance costing	Spare part lead time
	Maintenance costing	Turn around time (for repairable)
		Equipment and facility availability

Understanding the cost of maintenance is critical, especially when operating complex assets such as aircrafts and chemical plants. However, the return on maintenance investment is not easily quantifiable in a monetary sense and thus is often not valued as a return on investment. If invested in and performed properly, maintenance can effectively reduce operational risks and potential losses (costs) through unwanted breakdowns.

What is needed is an asset management framework for optimising maintenance investment decisions to align them with enterprise business objectives. Capital intensive complex assets often consist of various systems and components manufactured by different Original Equipments Manufacturers (OEMs) and vendors. Since it is undesirable to stop operation for maintenance, asset operators plan maintenance to minimise disruption to normal operation and at the same time seek not to jeopardise the overall asset's safety, reliability and operational risk.

How frequently maintenance is carried out is normally governed by the maintenance intervals which are determined by the OEMs during the design stage. Since the physical operating conditions and design specifications of each piece of equipment are diverse, deterioration due to usage and operating incidents will be different. As a result, the maintenance specification as well as maintenance intervals of each system may not be the same. For industries that have strict regulations on safety, the respective maintenance requirements are even tighter. Adding on to the complexity, the maintenance function requires support of other resources such as facilities, equipment, human resources and spare parts.

This research proposes an integrated and generalised framework (Figure 1) which aims to optimise the maintenance program at any period within the asset's life-cycle. The proposed framework can assist in formulating models for optimising the operation and maintenance of the asset.

The three decision dimensions for asset management considered here are defined as follows:

1. **Operation dimension** is achieving organisation output objectives for the asset.
2. **Assurance dimension** is achieving compliance with regulations, safety and company quality requirements.
3. **Economic dimension** is achieving most return without exceeding enterprise monetary allocation.

Since the decision dimensions have direct or indirect relationships to one another, the tradeoffs

*** Key: The IT systems have been given generic names; MRP (Materials and Resource Planning); CMMS (Computerised Maintenance); OEM (Original Equipments Manufacturers).**

The asset database provides the basic reference of physical properties and asset functions so that strategic decisions can be made at senior managerial level. In this table, the data is categorised into decision dimension relevance, then the uses and importance of each data source is discussed and in the final column, a priority ranking is given. Detailed planning of outages is not regarded as an enterprise significant factor, but total cost of an outage is enterprise significant. This table was developed with information sourced from interviews, workshops and internal reports from a wide range of industries including defence, aviation, power, manufacturing and research.

Uses	Importance	Priority	Where it is captured?
Calculate deterioration rate	To determine when component is due for maintenance	A	MRP system Individual system
Calculate permitted shutdown time	To determine if there is enough time for maintenance	A	Management strategy
Condition monitoring	To monitor systems condition to determine maintenance intervals	B	Control room in hardcopy, CMMS
Calculate outages cost	Parameter to quantify breakdowns	A	Management strategy
Specify maintenance tasks and schedule	Detailed day to day operation	B	OEM and operators manuals
Schedule maintenance and shutdown	The basic guide to formulate maintenance program	A	MMS or hardcopy
Ensure personnel are qualified and trained for a given job	Maintenance work quality assurance	C	Human resource system
Evaluate asset performance and the asset response to maintenance program	Maintenance program effectiveness, Evaluation of costs and life expectancy	B	CMMS/hardcopy
Budgeting	To quantify maintenance cost	A	Management accounting system
Budgeting	To quantify maintenance cost		
Budgeting	To quantify parts holding cost		
Determine stock level/ordering point	To justify amount of parts in stock (for non-repairable)		
Determine stock level and maintenance schedule	To justify amount of parts in stock (for repairable)		
Planning of heavy maintenance	To determine the outage schedule	B	MRP system

between these dimensions are to be analysed such that the enterprise return on investment is optimised. This research takes the view that each decision dimensions consists of a family of parameters which can eventually be quantified to monetary values. Through quantifying these decision dimensions, models can be formulated and optimisation can be carried out simultaneously using a consistent unit which we term the 'value per unit time' approach.

Allen S.B. Tam is a PhD candidate in the Department of Mechanical Engineering, Monash University. He received his BE in Aerospace Engineering with 1st class honours from the University of NSW.

Professor John W.H. Price is in the Department of Mechanical Engineering, Monash University. Before joining the university, he was a senior engineer in the electricity industry.

MBR subscribers: To view full academic paper email mbr@buseco.monash.edu.au

Public access: www.mbr.monash.edu/previous_issues.php (six month embargo applies)

Figure 1: Optimisation framework