ASSET MANAGEMENT COUNCIL

Asset Management Council
PO Box 245
Surrey Hills Victoria 3127
Australia

# AMFAQ3: Influencing Lifecycle Cost Though Continuous Improvement

## Question

Somebody once told me that 95% of the lifecycle cost of asset ownership is predetermined at the end of the design phase. What impact does this have on the continuous improvement of asset management during the operations phase? Why should I bother if I can only influence 5% of the life cycle cost?

## Analysis of the Question

The design of the asset has been produced to meet the requirements provided to the designer. The outcome is a piece of equipment or system which is intended to deliver the required functionality to the business, and which will have failure modes (with associated risks) not able to be economically designed out.

These risks (failure modes) will be managed by operator or maintenance staff intervention during the operational phase of the lifecycle either as part of a planned maintenance programme or a reactive intervention after a breakdown.

These future (risks) constraints exist even before the system is manufactured, and are certainly 'locked in' to the equipment/system even though the costs may not yet be incurred. This does not mean you cannot influence these (risks) costs in the future by 'continuous improvement' redesign of process or the equipment/system itself.

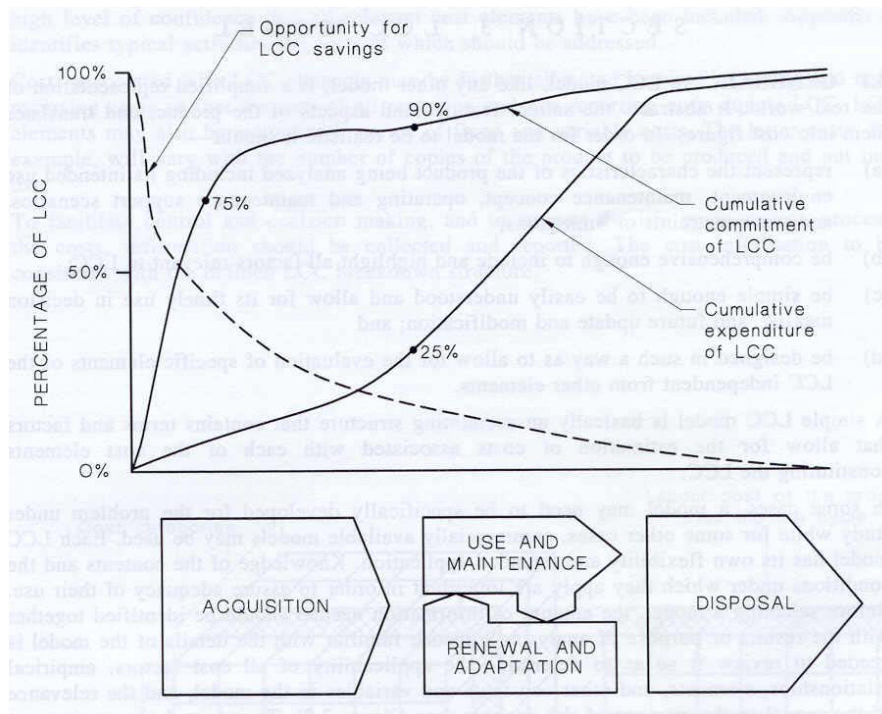


*Figure 1: Life Cycle Cost Commitment (Source – AS 4360)*

The 95% sounds high, typical estimates quoted are more around the 75% mark. Refer to Figure 1.

## Summary of Response

- Most importantly, businesses exists not as a result of costs, but because of the profit potential, and the impact of this influence on cost (as one risk) can have a very drastic result on profit (10% cost influence with 60% improved profit) as can be seen from the data in Table 1. This difference can make one company excel against it lesser productive competitors. The major contributor here is the fixed cost component influencing the Profit
- Another significant factor here is the $ value that can be influenced by % posed. For example (refer to Figure 1), a 5% and up to 25% influence still results in significant costs.

 

- Further, consider the maturity of the enterprise with regard to the application of Asset Management "Best Practices". The more immature the approach is, the higher the influence % will be and vice versa. Considering the overall Asset Management maturity (against an absolute industry scale) of most mining / manufacturing companies are between 30% and 55%, this implies that this influencing % can be quite high.
- Operational Context and Economical Environment is extremely volatile and the original statement does not really address the influence of continuous improvement (nor the effect of a changing acceptable risk profile) also as a result of changes imposed on the enterprise. (See "Further Items for Consideration" later)

***Table 1: Profit Impact Example (Source – Sandy Dunn)***

- **10% increase in uptime (10% more sales), leads to 60% increase in profits**
- **10% decrease in Costs, leads to 140% increase in Profit.**

| Values | Reference Base $'000 | Improve Productivity (10%) $'000 | Reduced Costs (10%) $'000 |
|---|---|---|---|
| Sales | $100 | $110 | 100 |
| Cost of sales | $70 | $77 | $63.0 |
| Gross Profit | $30 | $33 | $37 |
| Fixed Costs | $25 | $25 | 25 |
| Net Profit | $5 | $8 | $12 |
| Improvement % from Base | | 60% | 140% |

Refer to "Some more on Maintenance Contribution" for further discussion

***Table 2: Cost Contribution Example (Source – The Mining Valuation Handbook)***

| Mining Total Cost Components Example (Victor Rodenno) | | | | | |
|---|---|---|---|---|---|
| **Cost Component** | **Capacity T=[mtpa]** | **Open Cut** | **Underground** | **Treatment Plant** |
| Capital Cost [US$] | 1 | $23,500,000 | $86,760,000 | $37,610,000 |
| Total Operating [Cost/t] | 1 | $9 | $37 | $11 |
| Total Operating (Cost over 15 Year Life) | 1 | $136,800,000 | $553,050,000 | $162,750,000 |
| **Total Cost (15 Year Life)** | 1 | **$160,300,000** | **$639,810,000** | **$200,360,000** |
| Capital Cost as % of Total Cost | 1 | **15%** | **14%** | **19%** |
| Operational Cost as % of Total Cost | 1 | **85%** | **86%** | **81%** |
| Value if only 5% of Total Cost can be influenced | 1 | **$8,015,000** | **$31,990,500** | **$10,018,000** |
| Value if say 25% of Total Cost can be influenced | 1 | **$40,075,000** | **$159,952,500** | **$50,090,000** |
| Value if only 5% of Total Operational Cost can be influence | 1 | **$6,840,000** | **$27,652,500** | **$8,137,500** |
| Value if say 25% of Total Operational Cost can be influenc | 1 | **$34,200,000** | **$138,262,500** | **$40,687,500** |

The estimates provided above in Table 2 are based on results from some 95 mining development projects located in 33 countries around the world. The trend calculations provided were applied to a 1mtpa mining operations over a 15 year life span to illustrate the concepts. Also refer to Figure 2 for an illustration.

From the estimates, and assuming two scenarios for a 5% and 25% influence on Total Cost and Total Operating Costs, it is evident that these values are very significant from a business perspective as can be illustrated by Table 2 where this % can have a much more significant impact on company profit due to the influence of the Fixed Cost component.

## Some more on Maintenance Contribution

Note Extrapolate to reflect on Production Contribution (see Table 2) (Source – The Cost of a Reacting Maintenance Culture in the Mining Industry, Prospect)

 

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- One of the major costs in mining is direct maintenance. It ranges from 20% to 50% of total costs, the highest ratio of all industries. International and Australian research indicates that one-third of maintenance time is not used effectively and is basically wasted. This means that somewhere between 7% to 15% of total costs are wasted through the ineffective use of maintenance.
- Case studies have shown that up to 15% yearly reduction in total maintenance expenditure is realistically achievable (where maintenance is say 40% to 50% of the Operational budget by investing in more pro-active maintenance.

## Further Items for Consideration

- Cost Elements Contribution over time such as changes in energy, labour, fuel.
- The accuracy of estimation of Capital Costs and Operating Costs as result of the quality of the technical assessment and the impact of the operational environment.
- Impact on Equipment and Asset Life as result of the maturity of Asset Management Practices applied.
- Production Impact, utilisation, sales contribution.
- Changing acceptable risk profiles (Production, Safety, Environment and Cost) as a result of changing business circumstances

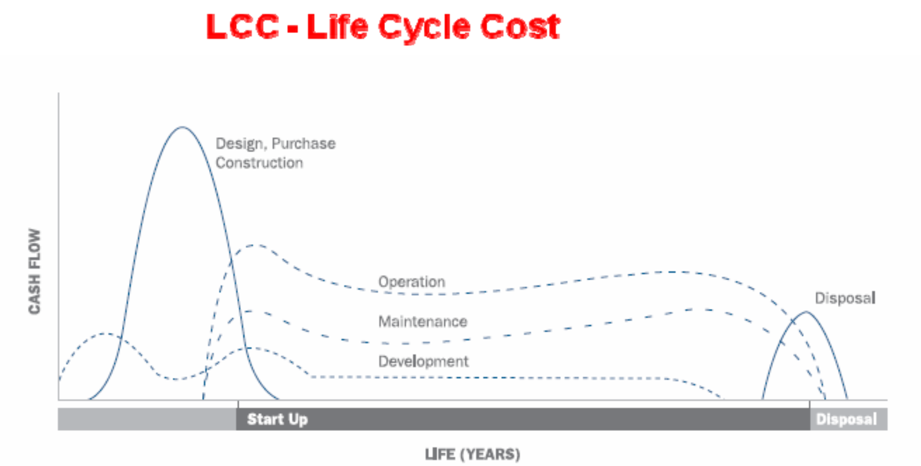


***Figure 2: Life Cycle Cost Elements (Source – Life Cycle Costing – Better Practice Guide)***

LCC = Capital Cost
+ life-time Operating Costs
+ life-time maintenance costs
+ Disposal Cost
- Residual Value.

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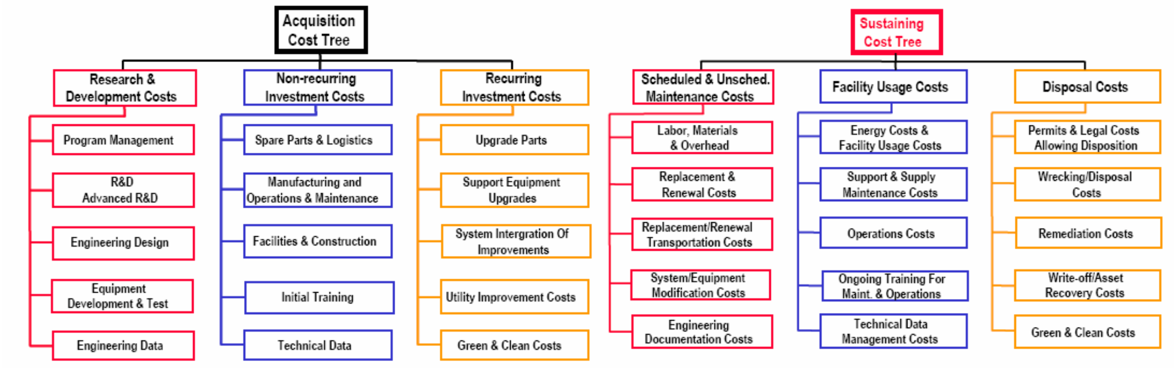


***Cost Contribution, Figure 3 (Source – A Life Cycle Cost Summary, H. Paul Barringer, P.E., Barringer & Associates, Inc.)***

## Why continuous improvement?

- Upon delivery and commissioning of the system or equipment the subsequent operation and maintenance actions can further degrade the operational reliability of the equipment, particularly where 'past practice' maintenance is applied by either the designer of the maintenance plan, or the asset owner.
- The result is a system or equipment achieved reliability/availability which may be less that the inherent or as designed reliability/availability. This will result in incurring unnecessary costs that will adversely impact profitability.
- The continuous improvement process can take a number of forms.
- Process improvement can identify where the existing support processes are falling short of what is required, due to various site operational inefficiencies that may have occurred since the system/equipment was commissioned.
  - One example is poor task effectiveness / human error issues which result in a sub-optimal level of performance, eg low MTBF, high MTTR, even fails shortly after routine maintenance.
  - Addressing these can issues via maintenance analysis reviews, training, improved manuals/ spares have the potential to return the system back closer to the required levels of availability/reliability saving significant costs.
- Another form of continuous improvement is to identify modifications which can be made to the equipment design or support plan design to improve the reliability/availability.
  - This is a re-design task, and as such the actions taken will determine future reliability/ availability and support costs. The redesign task may be to address a change arising from a change in the functional requirements, or to address a design defect not evident during the initial design reviews and approvals process.
  - This modification of the design is itself a 'design phase' undertaken in the 'use & maintain phase' which can also have a range of outcomes. It may improve, make no change, or in some cases actually further degrade the system/equipment performance. The key aspect here is that the future reliability / availability and support costs into the future are again re-established as a result of this new design and it's associated modifications, whether it be to the physical design or the design of the maintenance/support plan.

 

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- Note the term design is not just the initial design performed prior to acquisition and commissioning. Design can occur again at several points in the 'use & maintain phase' of the lifecycle if required and where justifiable via cost/benefit analysis.

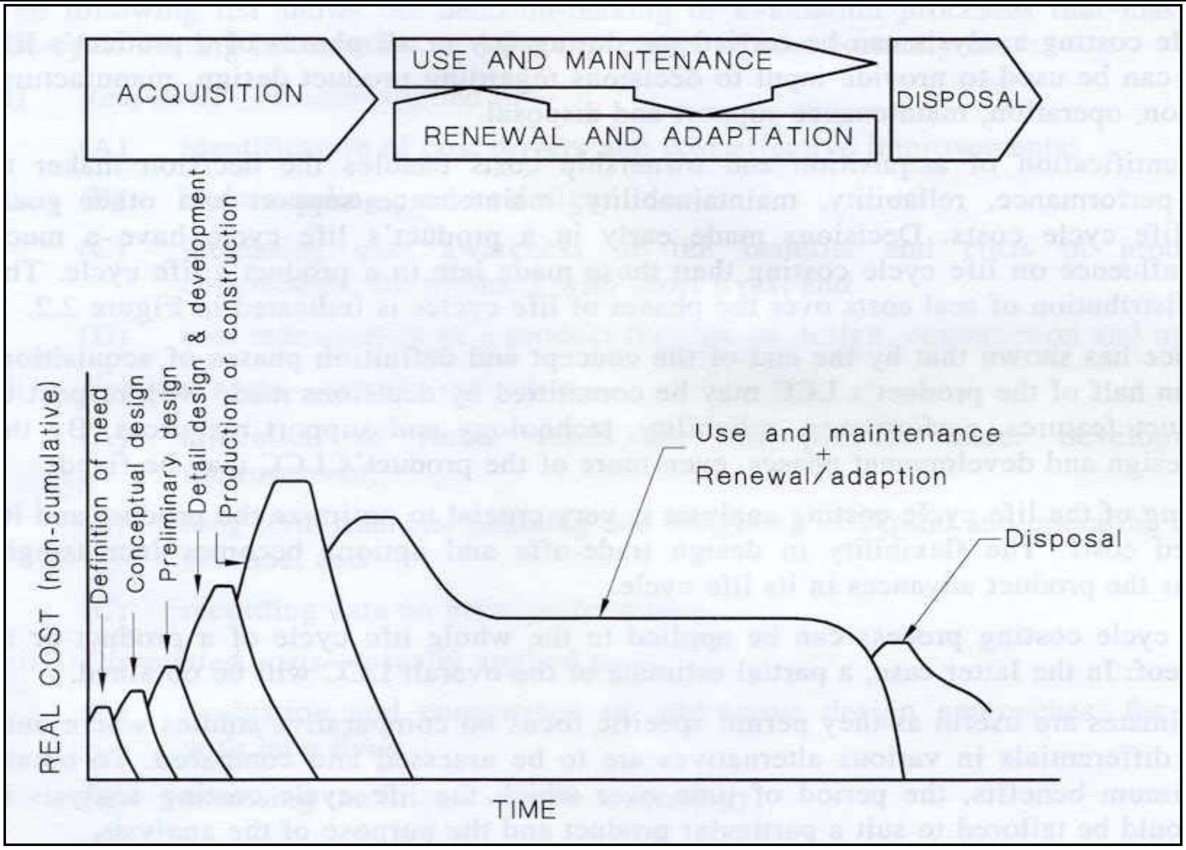


***Figure 4 Life Cycle Cost Elements (Source – AS 4360)***

## Conclusion

- Yes, you must bother because:
  - The focus is on profit (not cost) which is very sensitive for small % changes to costs and very significant values are at stake here; and
  - Risk profiles change (the Board/CEO will want to change the required risk profiles as the business circumstances change), as the role of Boards/CEOs is to provide the required balance between acceptable risk and costs.
- Even just looking at the cost component that can be influenced, we are still talking significant values and this can mean the difference between the survival of the company in a competitive environment or going under.

## References

### Text Books:

- The Mining Valuation Handbook, Dr. Victor Rodenno

 

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- SME Mining Engineering Handbook, Howard L. Hartman, Seeley W. Mudd (Memorial Fund of AIME., Society for Mining, Metallurgy, and Exploration (U.S.))


**Web Sites:**

www.umsgroup.com

http://www.barringer1.com/lcc.htm

**Standards:**


- AS/NZS 4536: Life Cycle Costing - An application Guide
- NORSOK O-CR-001: Life Cycle Cost for Systems and Equipment


**Other:**


- Life Cycle Costing – Better Practice Guide, Australian National Audit Office
- A Life Cycle Cost Summary, H. Paul Barringer, P.E., Barringer & Associates, Inc.
- The Cost of a Reacting Maintenance Culture in the Mining Industry, Prospect


 