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Maximizing Asset Management – From Work Plan to Financial Performance

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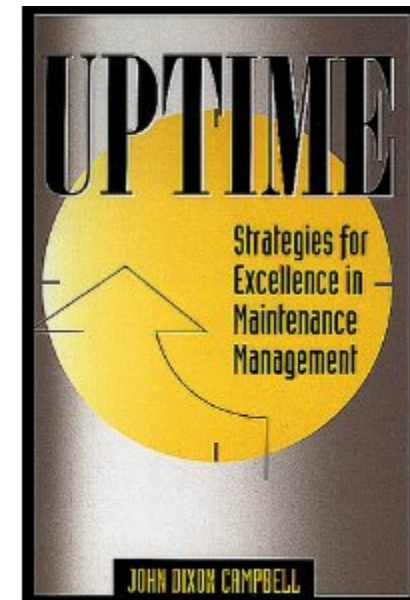
Presentation Summary

- Maximizing mining assets is often seen as a trade-off between maintenance and operations, with few links to financial performance.
- Asset management is a key aspect of a mine's financial performance.
- Maintenance performance is a function of maintenance efficiency and maintenance effectiveness.
- High performing maintenance departments are able to forecast a work plan for an asset and predict the cost of executing the work plan.
- Reducing maintenance costs while increasing operational output requires skill, planning, precision and effective financial forecasting and control.

Maintenance is often the single highest expense in a Mining organization

Sector	Percentage
Mining	20 to 50
Primary Metal	15 to 25
Manufacturing	5 to 15
Processing	3 to 15
Fabrication and Assembly	3 to 5

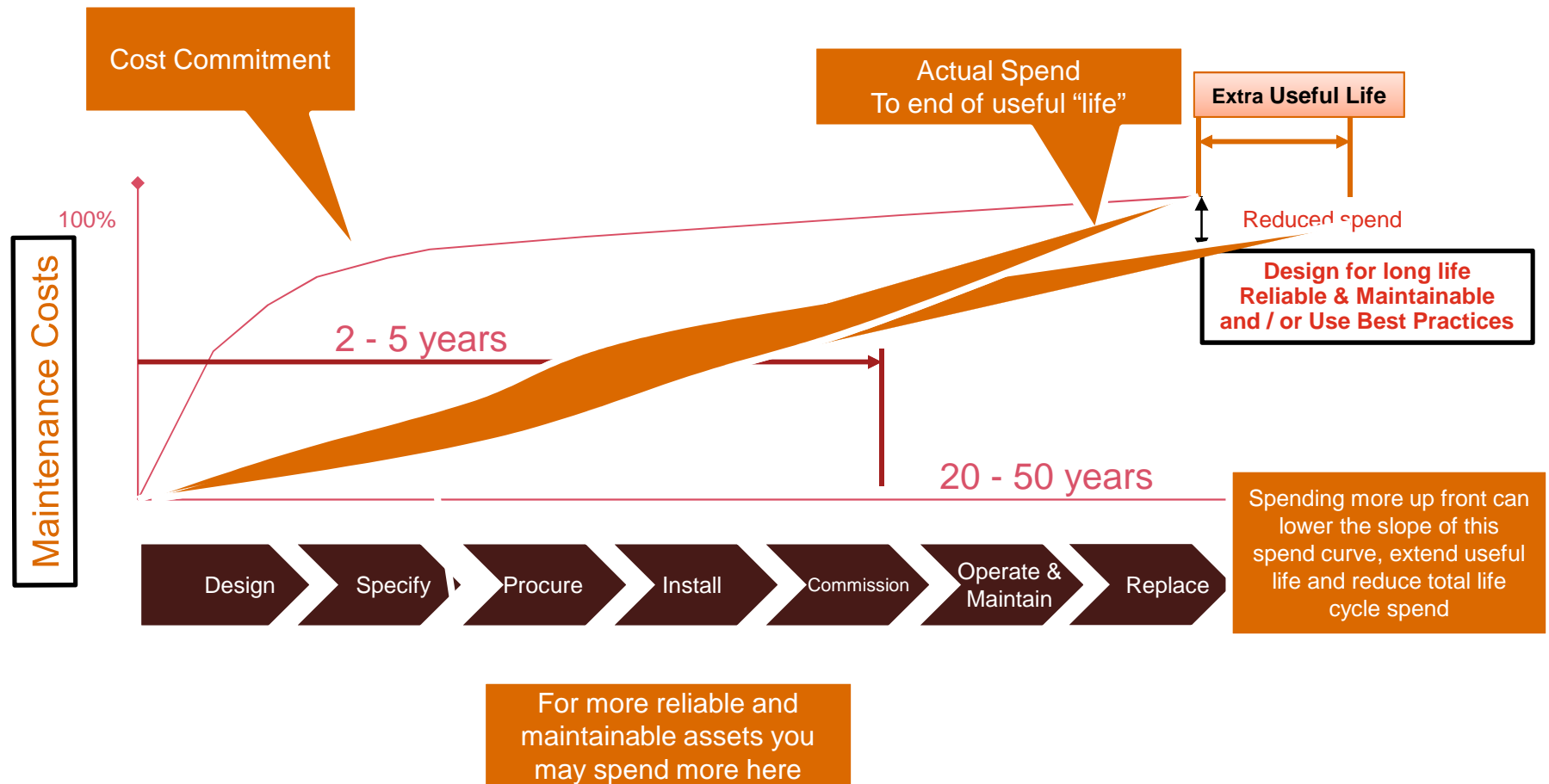
But maintenance costs are discretionary, and under **your control**. So how to spend wisely?



John Dixon Campbell, 1995

Uptime: Strategies for Excellent in Maintenance Management

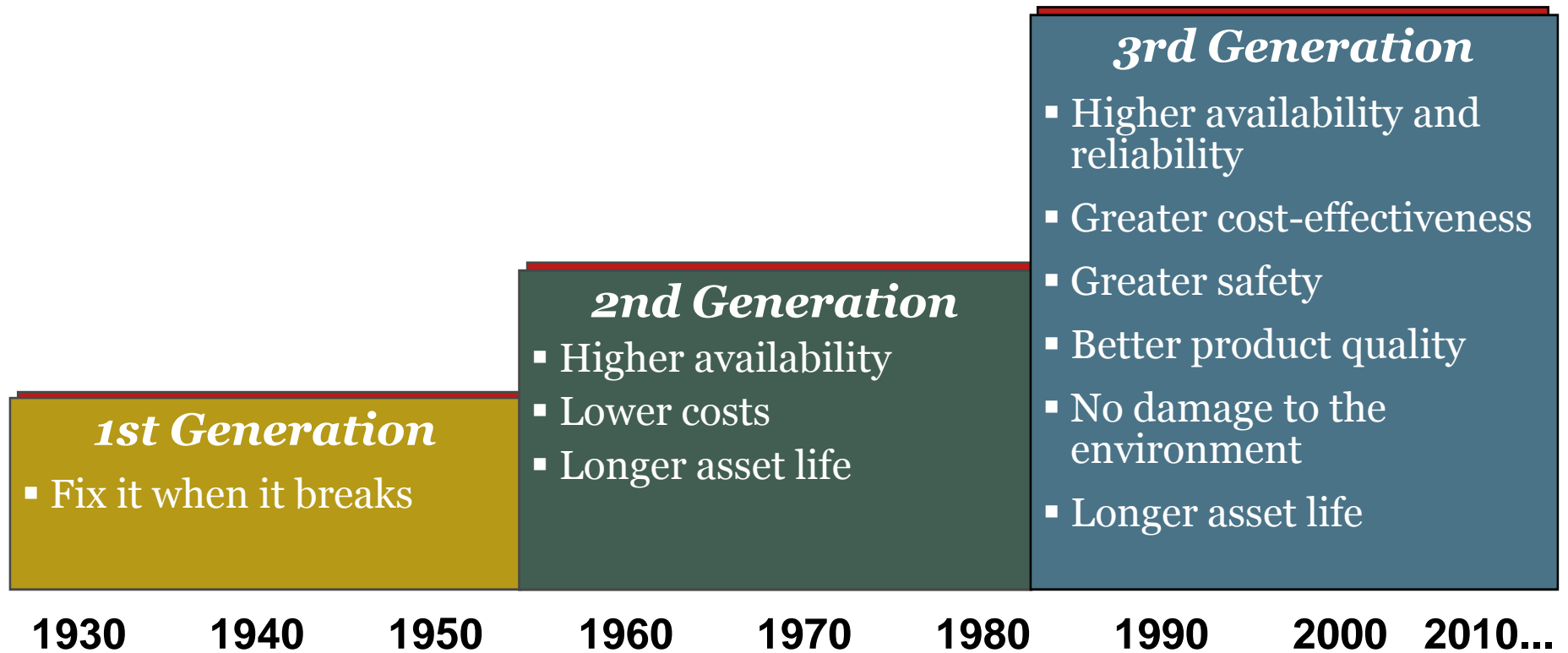
Asset Management should strike the optimal balance between asset productivity and Total Cost of Ownership (TCO)



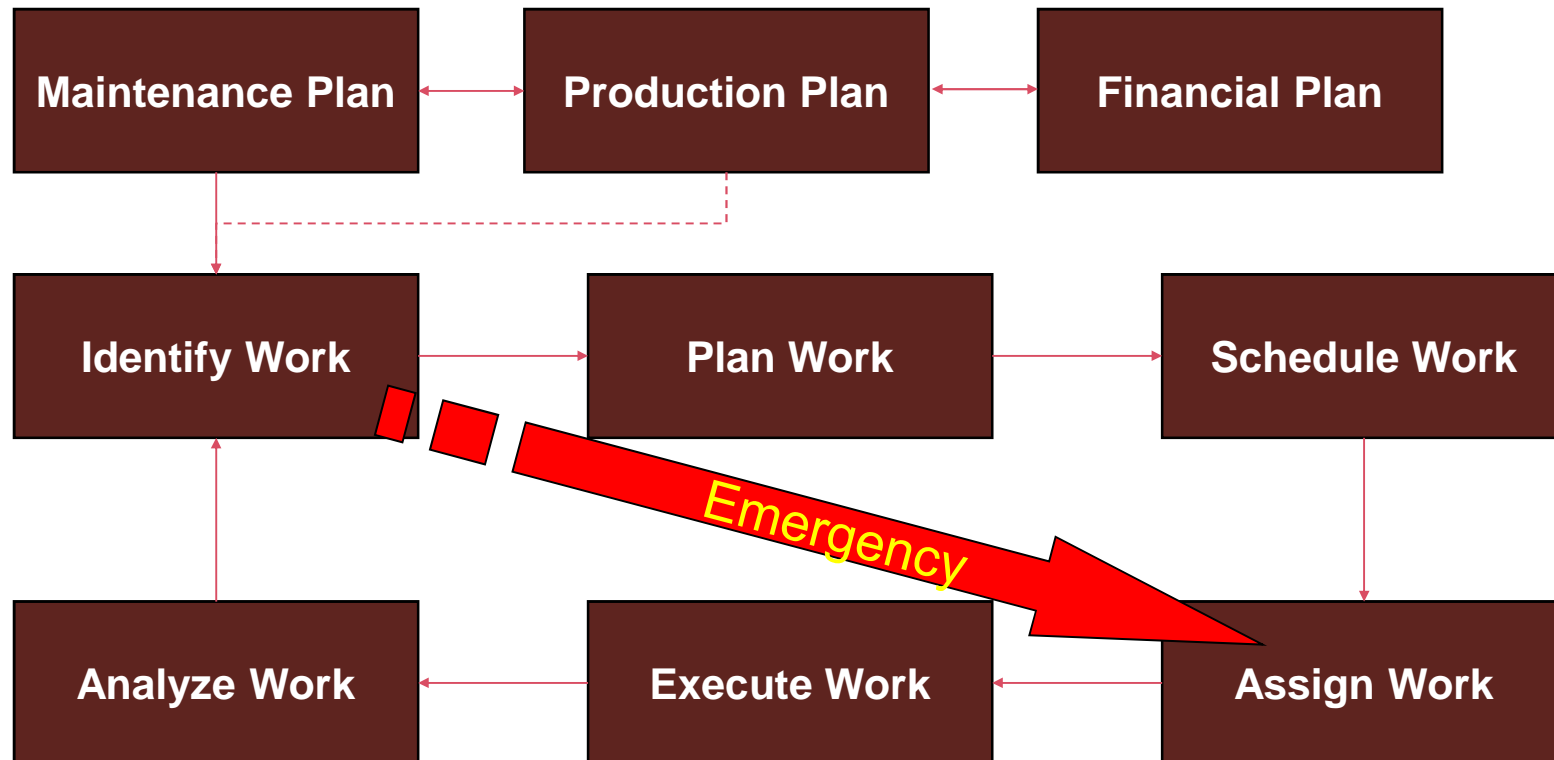
Enterprise Asset Management (EAM) in Mining

- Mining companies are looking to transform their operations through maintenance software implementation or benefits realization
 - Achieve cost reduction – both in \$ value and % of operating costs
 - Manage safety and environmental risk more effectively through better maintenance practices
 - Incorporate maintenance into Capital projects to achieve the lowest total cost of ownership
 - Capture the value from their corporate maintenance group

Maintenance expectations are increasing



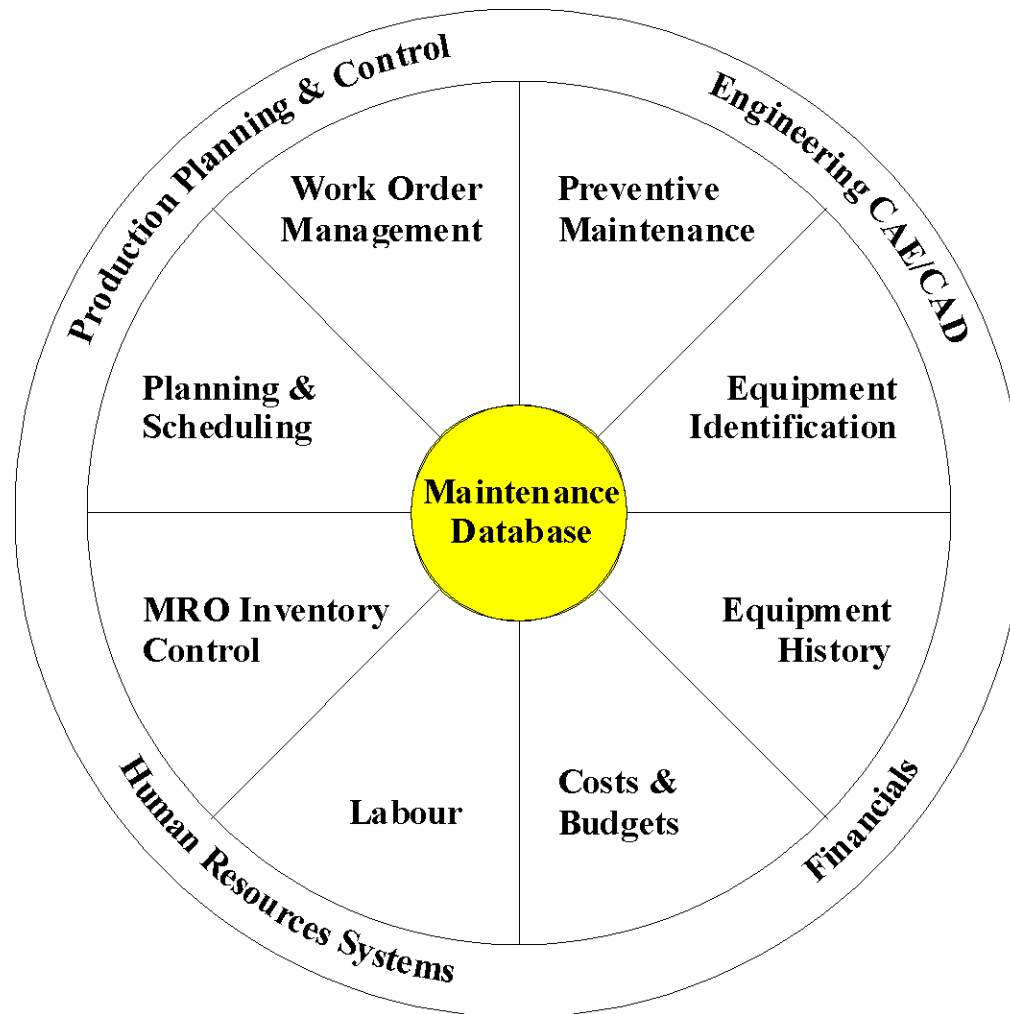
Maintenance Efficiency is driven by the maintenance business process



Emergency Maintenance is 3-9 times the cost of planned maintenance.

EAM Software often drives efficiency improvements

SAP-PM
Oracle EAM
Maximo
Mincom



EAM software improves the productivity of planners and tradespeople.

Trends related to Maintenance Efficiency

- ERP functionality is quickly catching up to best of breed CMMS systems
- On-line condition data monitoring systems measuring equipment health
- Sophisticated real-time work scheduling systems bolted to maintenance work order systems
- ERP integration between maintenance assets and fixed assets
- Data warehouse technology is unlocking the information buried in maintenance systems

Maintenance Effectiveness is doing the right thing

Maintenance Effectiveness problems stem from:

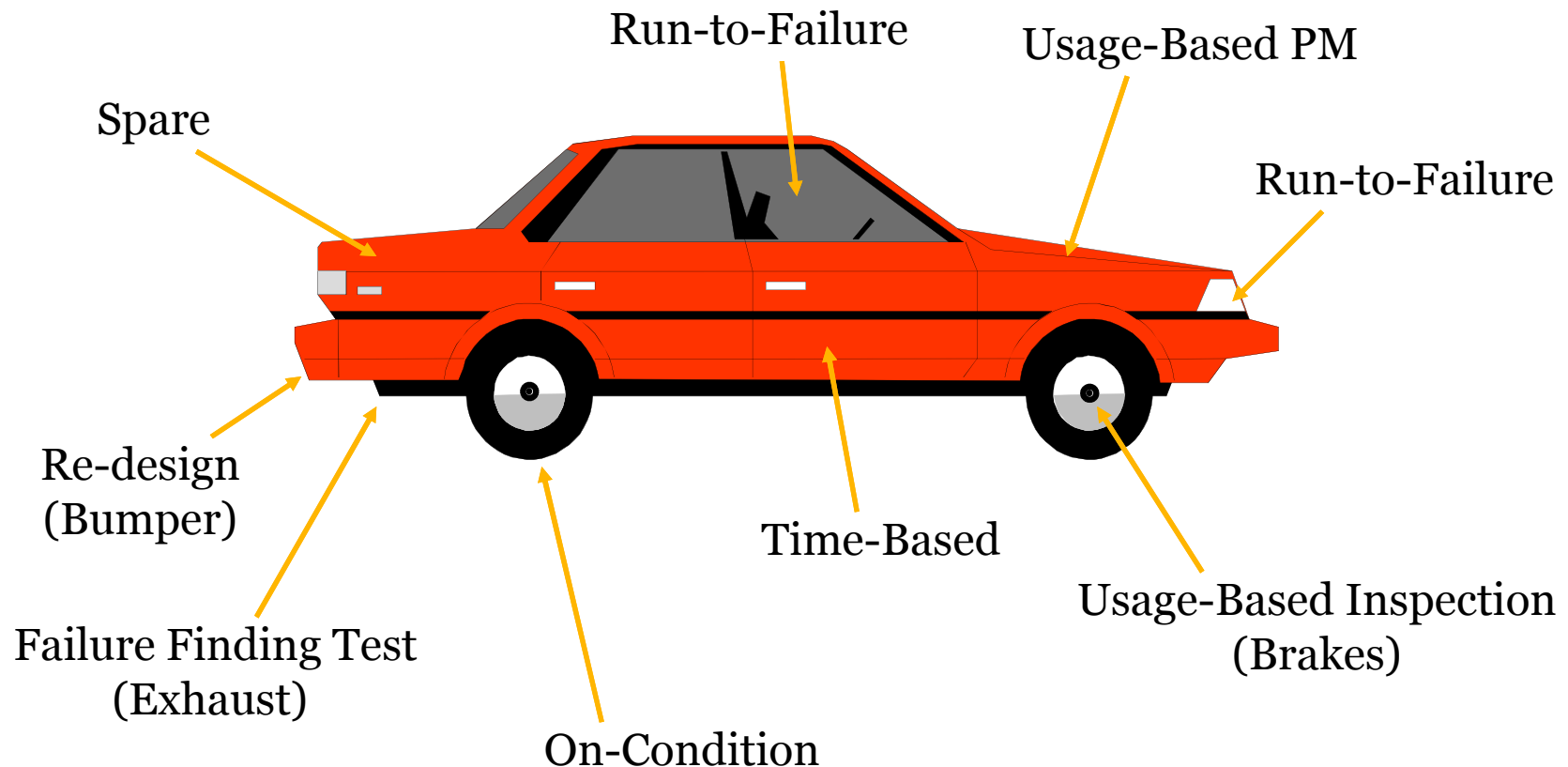
- Doing too little maintenance
- Doing too much maintenance
- Doing the wrong maintenance

But what is the most effective maintenance work plan?

Maintenance Tactics

The Maintenance organization must be able to perform the tactics required. This requires both technology and trained resources.

Maintenance tactics include:



The Six Failure Patterns



Pattern A: The "Bathtub Curve"

High infant mortality, then a low level of random failure, then a wear-out zone



Pattern B: "The Traditional View"

Random failure then a wear-out zone



Pattern C:

Steady increase in the probability of failure



Pattern D:

A sharp increase in the probability of failure settling down to random failure



Pattern E: Random Failure

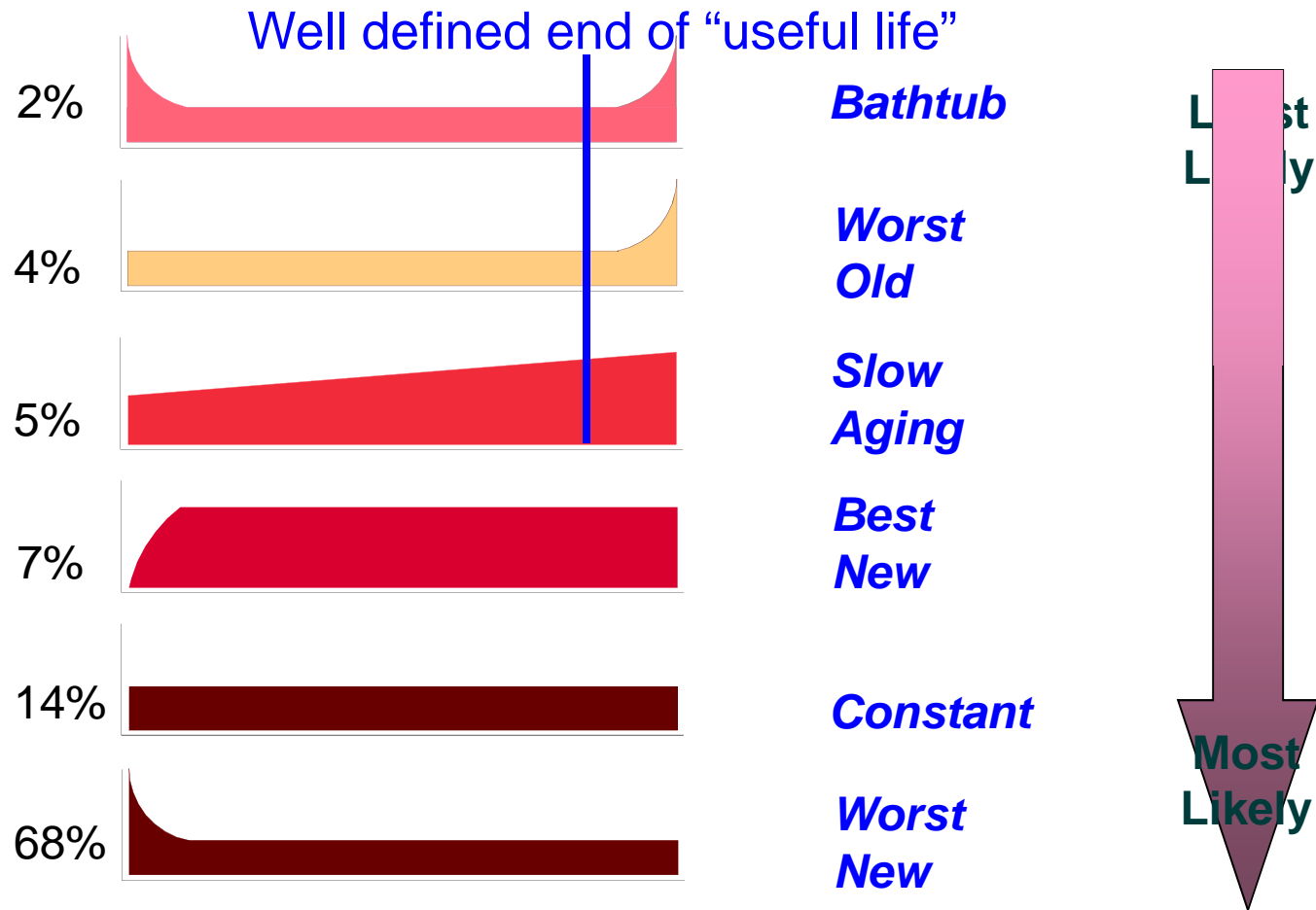
No relationship at all between how old it is and how likely it is to fail



Pattern F: The "Reversed J" Curve

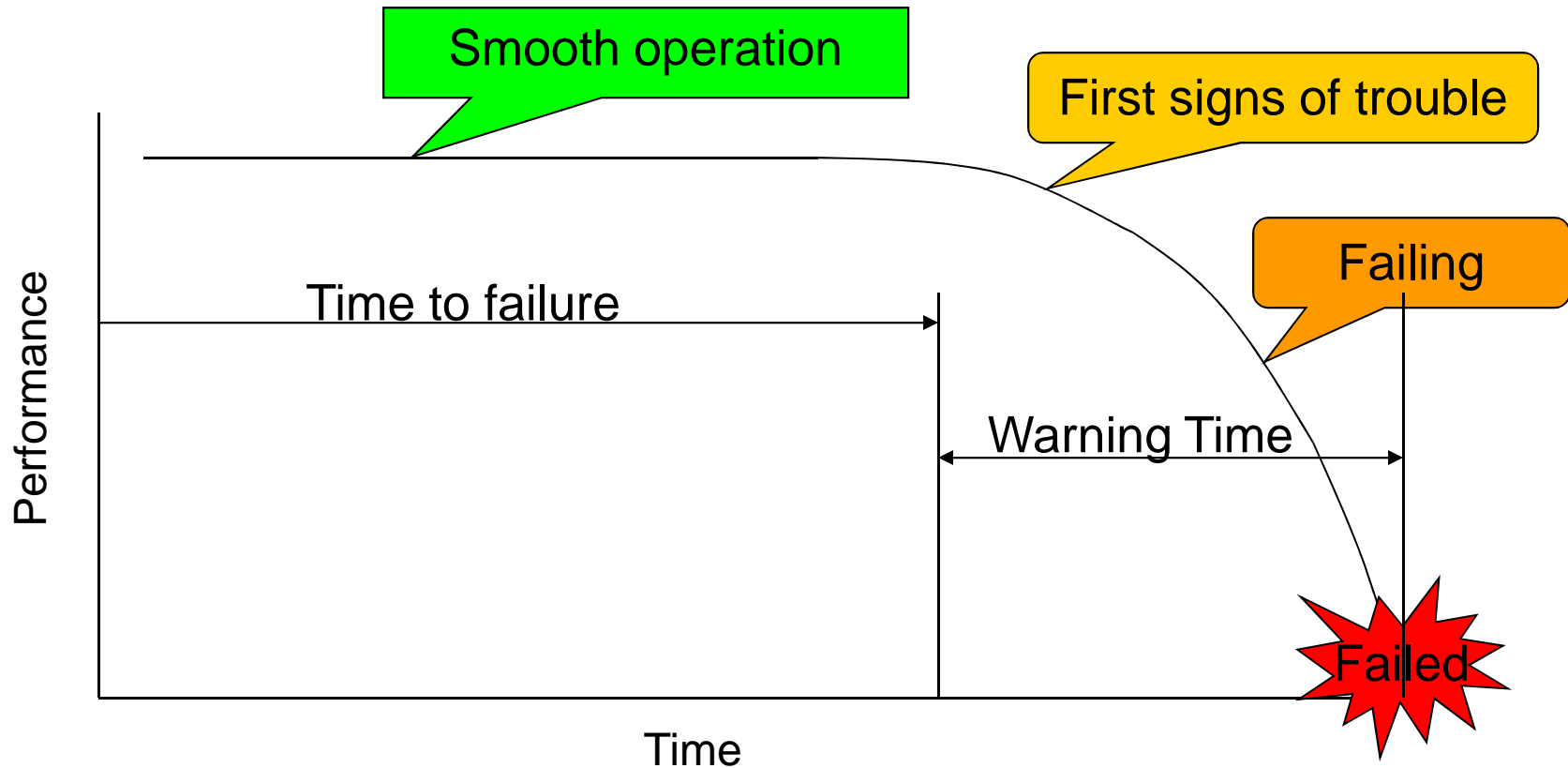
High infant mortality then random failure

Match tactics to failure modes...



Graphs of conditional probability of failure over time. From Nowlan and Heap.

Warning time drives the appropriate tactic



Applying the RCM2 Process

To successfully apply RCM2 requires the participation of competent people who best know the equipment to develop a work plan.

The 7 Steps:

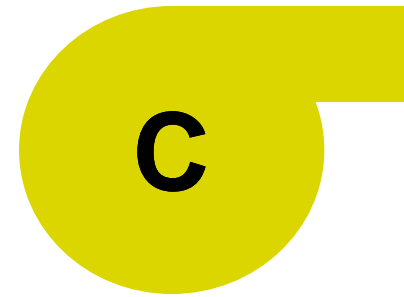
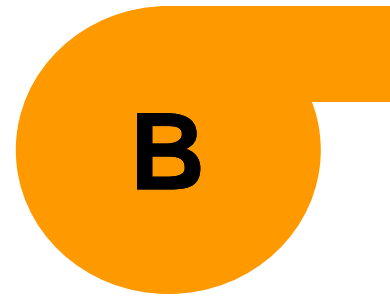
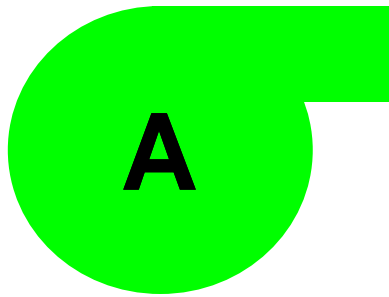
1. What are the functions of the equipment?
2. In what ways can it fail?
3. What causes it to fail?
4. What happens when it fails?
5. Does it matter if it fails?
6. Can anything be done to predict or prevent the failure?
7. What do we do if we cannot predict or prevent the failure?

RCM2 provides maintenance and operations people (and others) with a common set of values and a common language so that they can answer these questions together.

These questions can only be answered sensibly by maintenance and operations people working together.

When needed the review group should also include safety, environmental, quality and human resource personnel.

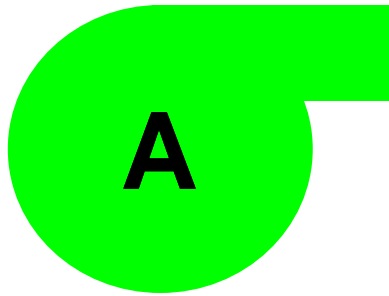
Generic maintenance policies can be developed for most types of physical assets



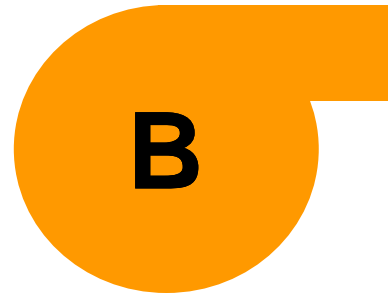
**Traditional thinking suggests:
All should be maintained the same way**

Generic maintenance policies can be developed for most types of physical assets

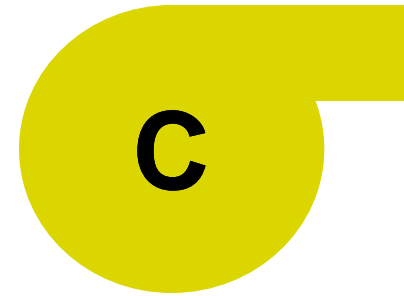
STAND ALONE



DUTY



STAND-BY



Replace bearing every 24 months

Three identical pumps, three totally different maintenance policies!

STAND ALONE

A

- Function : To pump 300 l/min of water
- Functional Failure : Unable to pump at all
- Failure Mode : Bearing seized
- Failure Effect : Downstream production stops
- Consequence: Failure affects operations

Predict / Prevent Failure

DUTY

B

- Function : To pump 300 l/min of water
- Functional Failure : Unable to pump at all
- Failure Mode : Bearing seized
- Failure Effect : If B fails

Run to Failure

STAND-BY

C

- Function : To pump 300 l/min of water
- Functional Failure : Unable to pump at all
- Failure Mode : Bearing seized
- Failure Effect : Failure not evident to operators if is still working
- Consequence: Failure not relevant if B is still working

Testing

Manufacturer's Recommendation:

Replace bearing every 24 months

Wrong

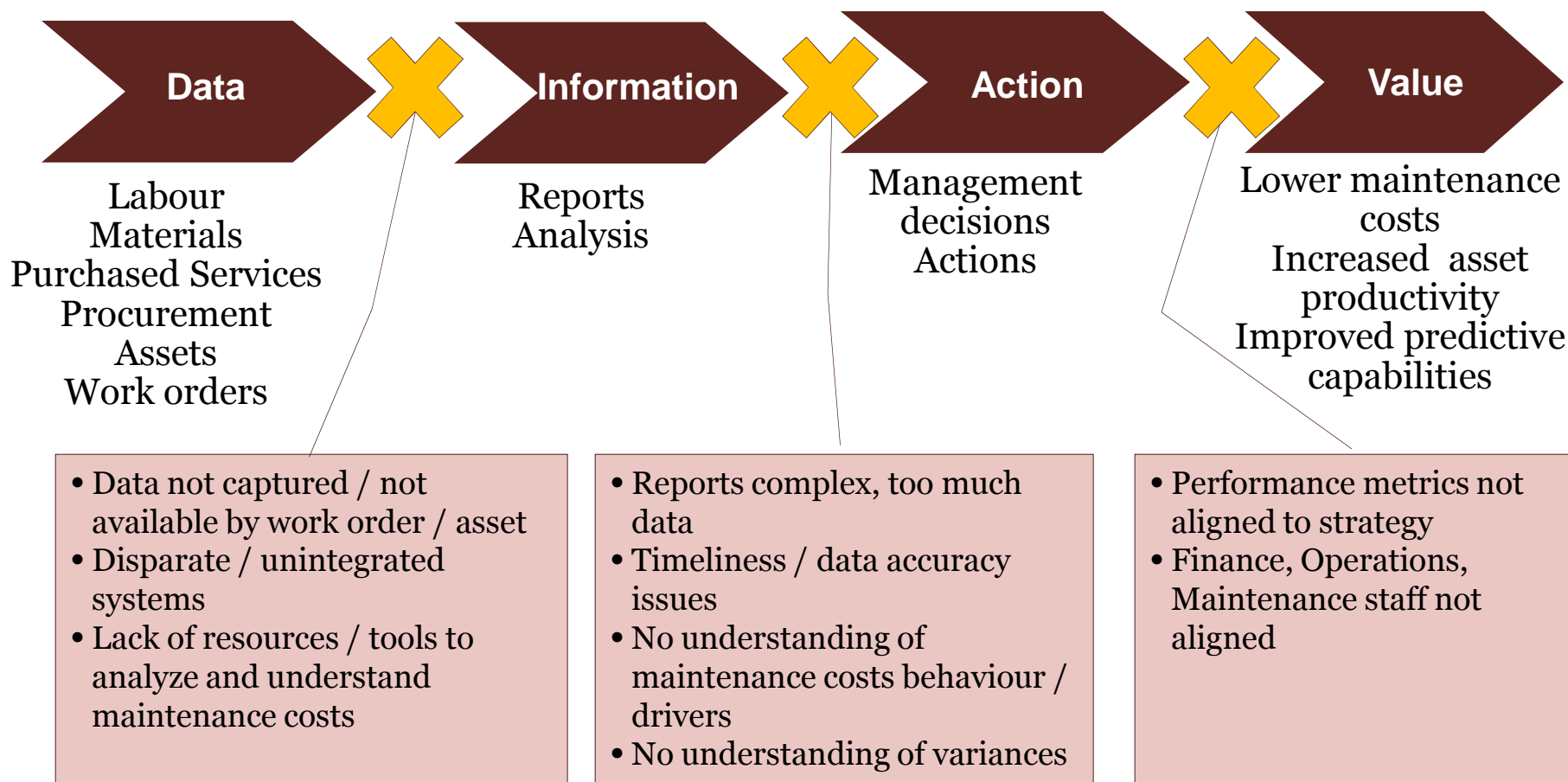
***Maintenance Performance =
Maintenance Efficiency x Maintenance Effectiveness***

- Maintenance Efficiency creates business processes to do define how the will be performed (Emergency, Planned, or Unplanned).
- Maintenance Effectiveness matches maintenance tactics to failure modes so that the right work is done (Time Based, Condition Based, Redesign, etc).
- High performing maintenance departments are able to provide a detailed forecast of their work plan for an asset, and are able to accurately estimate the cost of executing that work plan over a given time period.

What does Asset Management have to do with Financial Performance?

- Mining companies need to effectively balance competing priorities – reductions in operating costs, reduction in capex requirements, revenue growth and increased asset utilization
- Capital for both investments and operational purposes is becoming harder to come by
 - Reduced capital expenditure budgets meaning existing assets have to become more productive
 - Need to manage investments in working capital
- Financial evaluation is crucial in order to provide information and analysis to determine whether it is more cost-effective to continue to maintain, overhaul or replace a failing asset
- Need to reduce maintenance costs as part of an overall approach to improving profitability while maintaining asset availability / productivity

Many Mining companies lack the ability to identify the actions required to drive more value from their assets



Asset Management & Financial Performance- the Business Case for Asset Management

- Reduced maintenance spend from more efficient and effective use of maintenance resources
- Increased output/ capacity through increased equipment availability & utilization
- Improvements in working capital
- Reduction in business risk and improved safety / environmental compliance
- Improved access to maintenance and spend data
- Enhanced Fixed Assets tracking

Reduced maintenance spend from more efficient and effective use of maintenance resources

- Optimize plant maintenance SLAs and reduce reactive work orders
- Ensure all materials in place to support planned maintenance prior to commencing the work, improving productivity of maintenance employees
- Better understanding of maintenance costs (more planned, less reactive) gives more predictability to costs – results in better plans (Operational & Financial)
 - Better able to anticipate and quantify impacts of changes to planned maintenance activities (predictability of results)
 - Allow trade-off between asset availability and investment in maintenance
- Unplanned maintenance is 1.5x-3x more costly than planned maintenance – moving to more planned maintenance will reduce overall maintenance spend

Increased output/ capacity through increased equipment availability & utilization

- Smooth coordination of production and maintenance schedules, which increases production and reduce operating costs
- Decreased duration of plant shutdowns and turnarounds
- Decreased probability of unscheduled plant stoppages due to unplanned maintenance and/or equipment failure
- Industry studies show that unscheduled downtime can fall from 18% (typical) to 2% (best in class) with an effective asset management approach

Improvements in Working Capital

- Improved ability to manage maintenance inventories (spare parts, consumables)
- Finance needs to bring their skills to bear in terms of:
 - Establishment of min / max reorder points to establish optimal inventory levels and to determine economic order quantities
 - Understanding of inventory turns
 - Obsolete / slow moving inventory – identification and management
 - Identify and evaluate need for unique spares
- EAM tools provide potential for advanced inventory management techniques (VMI, consignment, shared stores)

Reduction in business risk and improved safety / environmental compliance

- EAM solutions provide C-suite with visibility to risks that relate to asset management and to understand how these risks impact corporate performance
 - Establish standardized processes to identify, quantify, and prioritize risks of asset failure including asset downtime, regulatory compliance, environmental or safety concerns
 - Establish controls and mitigation strategies to reduce the impact of these risks through effective maintenance plans
- Key to managing asset risk is having a strategy in place to either prevent from occurring or to reduce / contain the losses in the event they do occur through preventive maintenance on key assets

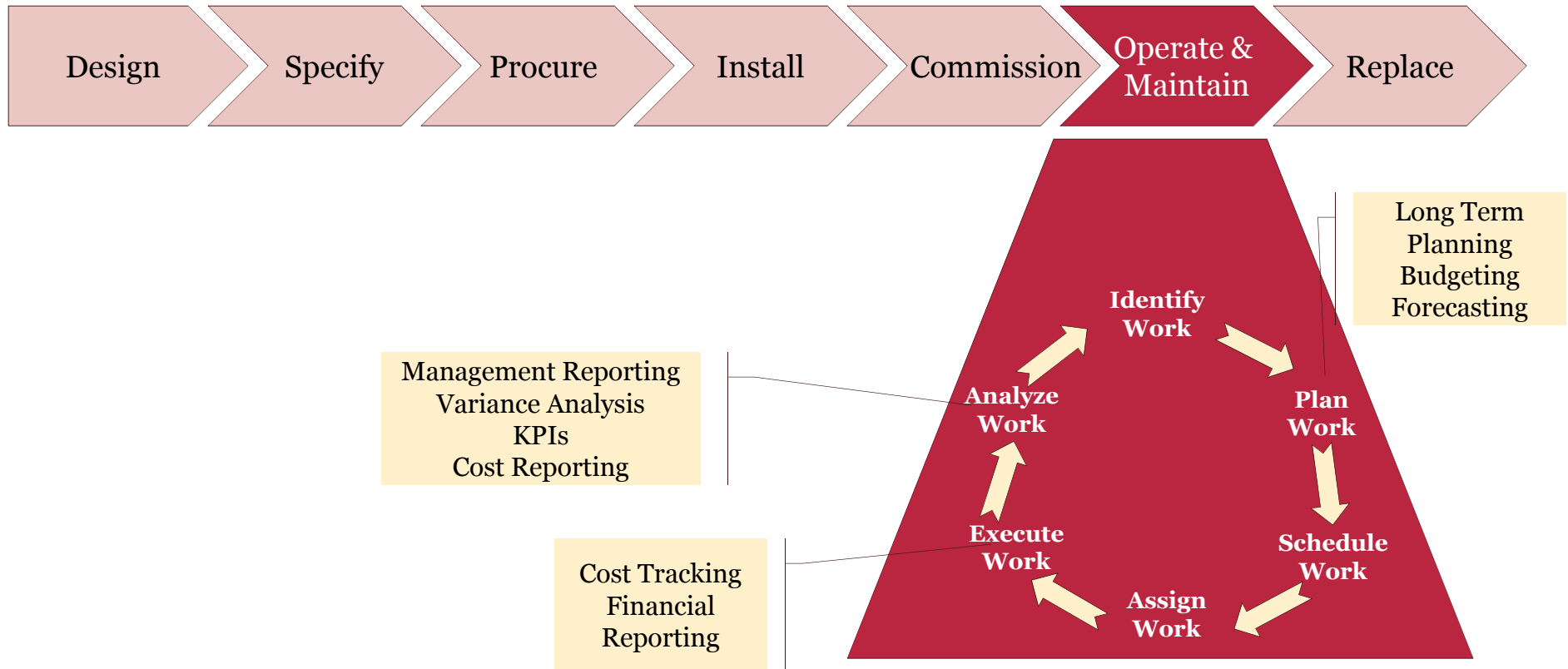
Improved access to maintenance and spend data

- Improved understanding of what is being procured, where (site), from which vendors, at what price
- Facilitates vendor sourcing / spend analysis as part of a strategy to reduce procurement costs
- Ability to benchmark costs / contracts between sites, and to consolidate spend to improve negotiating power
- Typical savings of 5%-10 % of purchased materials / services for sourced commodities

Enhanced Fixed Assets Tracking

- Financial fixed asset sub ledgers are often focused to meet financial, rather than operational, reporting requirements
- Equipment records within an EAM solution provide ability to track assets through the full installation – failure – repair – reinstall lifecycle
- More accurate / detailed database for asset verification
- Typically provides enhanced tracking of asset additions / moves / disposals, including enhanced accountability
- Improved ability to provide better information for tax purposes

Asset Management must be integrated to Performance Management processes



Zero Based Budgeting for Maintenance

- Budgeting starts with a “clean sheet of paper each year”
- Creates a maintenance budget for an asset from first principles. It is a bottom up method based on the asset work plan.
- Maintenance tasks are identified with frequencies and last completed data, or with probabilities where the task is random in nature, and costs.
- Asset usage, or availability, is forecast for the time period, and used as a driver to determine the expected maintenance cost.
- Projects and other one-time spend are added to the forecast.

Advantages

- Ties work plan to budget
- Easy to do ‘what if’ scenarios
- Increase visibility reduces spend
- Test for Total Cost of Ownership
- Budget by asset and not GL account

Complications

- Often work plan is not available
- Requires reliable asset data
- Time to prepare the model – software?
- People may forget the Pareto principle

What should you do to capture these benefits

- Improve collaboration between Maintenance, Operations & Finance
 - Need to align goals and performance measures of these teams, based on common corporate objectives
- Align financial and operational metrics to link asset performance to overall corporate objectives
- Provide visibility into all aspects of the asset lifecycle in addition to having real-time information about asset conditions
 - Invest in analytics and dashboards to provide role based visibility to the workforce for effective decision making
 - Provide historical and real time asset performance data to employees for efficient decision making
- Integrate plant floor and business systems
 - Connect EAM with business applications to increase responsiveness and provide ability to make quick and intelligent business decisions

Key Messages

- EAM represents a significant opportunity for mining companies to drive operational and financial performance
- Match maintenance tactics based on the probability and impact of failure
- Asset management allows companies to determine the right balance of reductions in operating costs, reduction in capex requirements, revenue growth and increased asset utilization
- Significant benefits are possible from moving to a more robust asset management approach
- Capturing these benefits requires a company to:
 - Improve collaboration between Maintenance, Operations & Finance
 - Align financial and operational metrics to link asset performance to overall corporate objectives
 - Provide visibility into all aspects of the asset lifecycle in addition to having real-time information about asset conditions
 - Integrate plant floor and business systems

Questions & Discussion

