A Simple Spreadsheet Technique for Removing Future Operating Risk and Costs During Feasibility and Design

ICOMS 2007 Conference

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Lifetime Reliability Solutions

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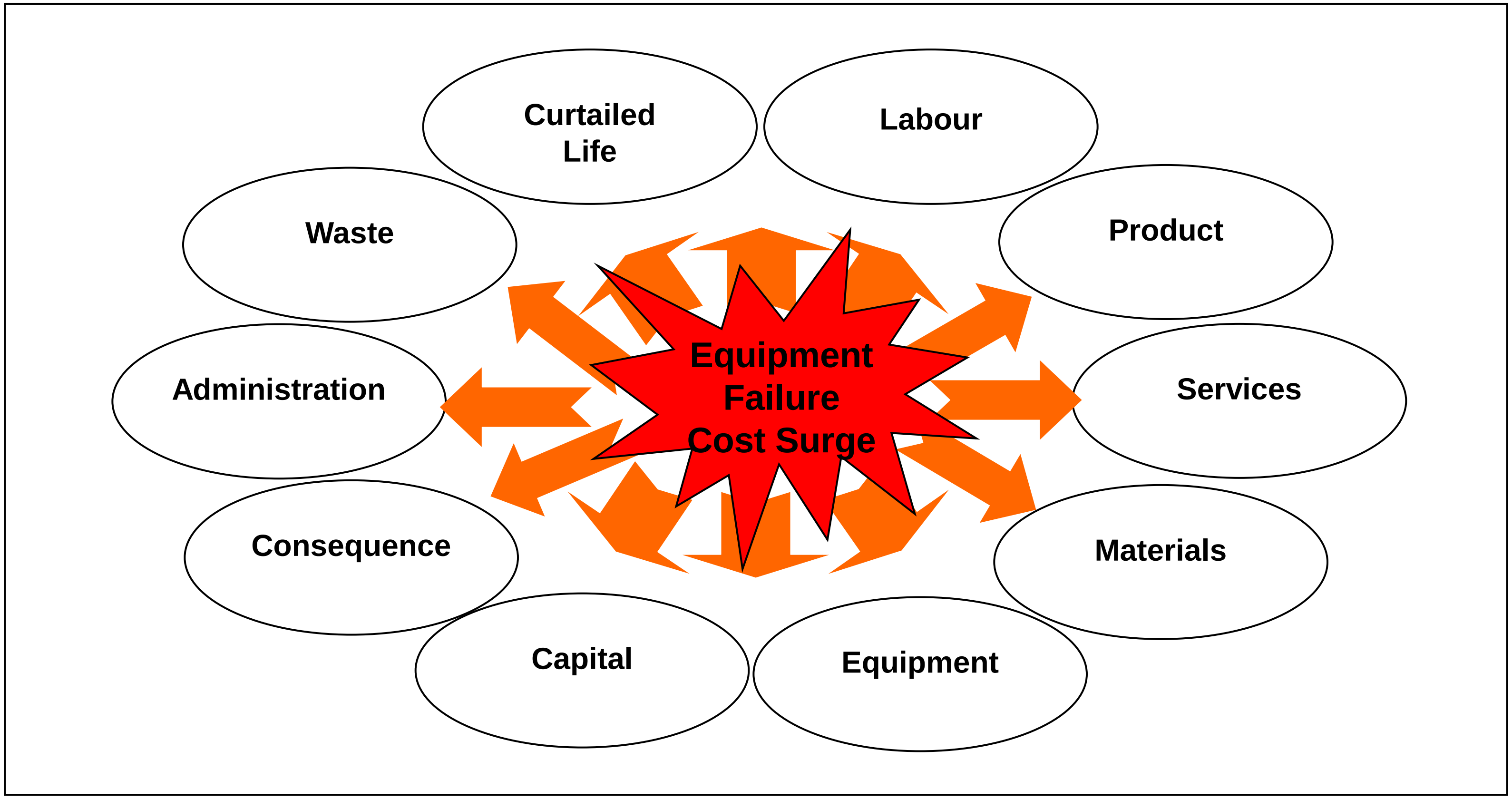
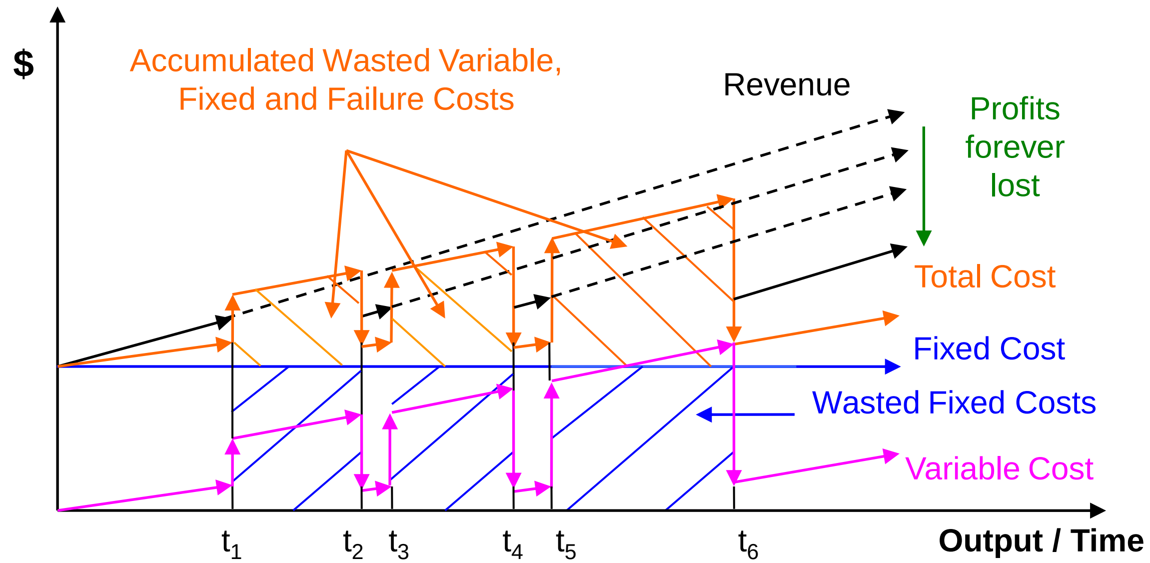
Failure Costs Surge thru the Company

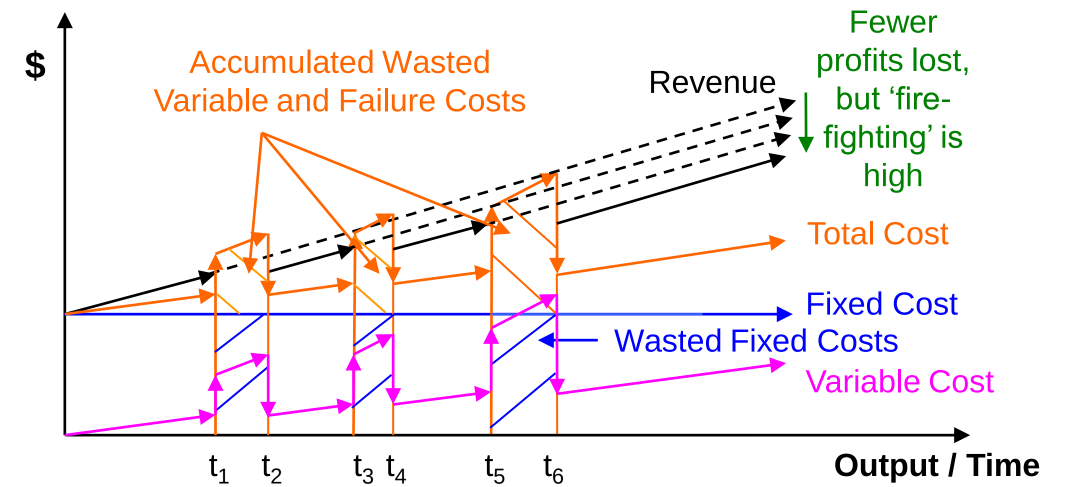


Clearly, repeated plant and equipment failures and stoppages destroy the profitability of an operation.



Effects on Profitability of Repeated Failure Incidents

Benefits of Reducing Operating Risk

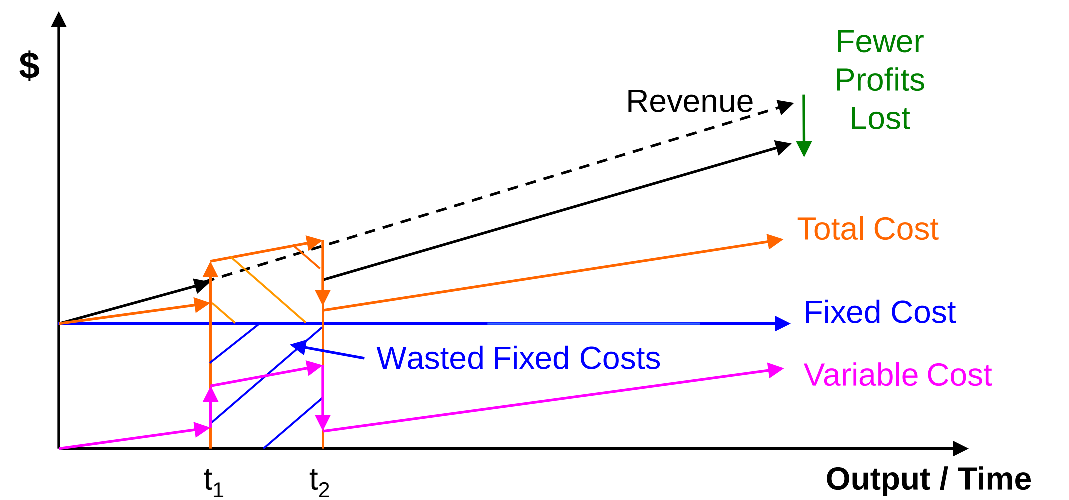


Effects on Profitability of **Reducing Consequence** Only

Risk ($/yr) =

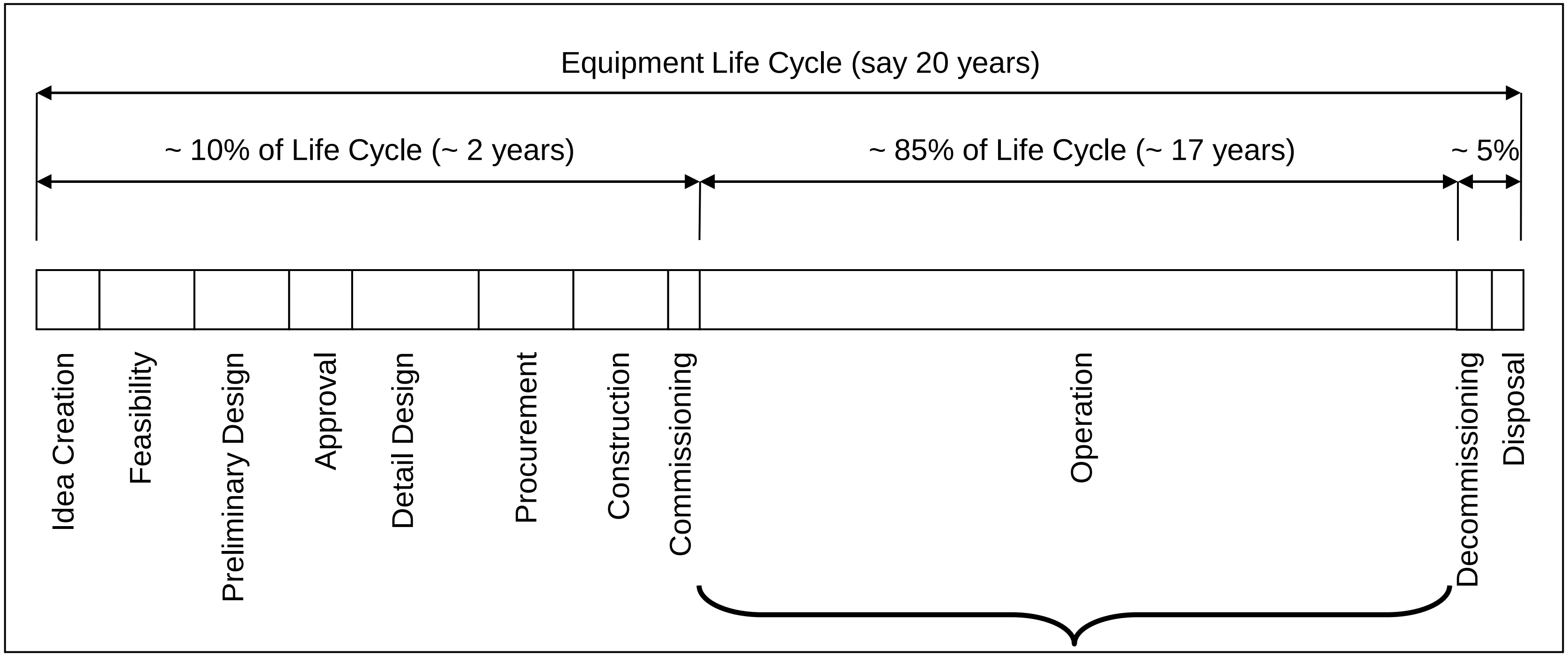
Frequency (/yr) x

Consequence ($)



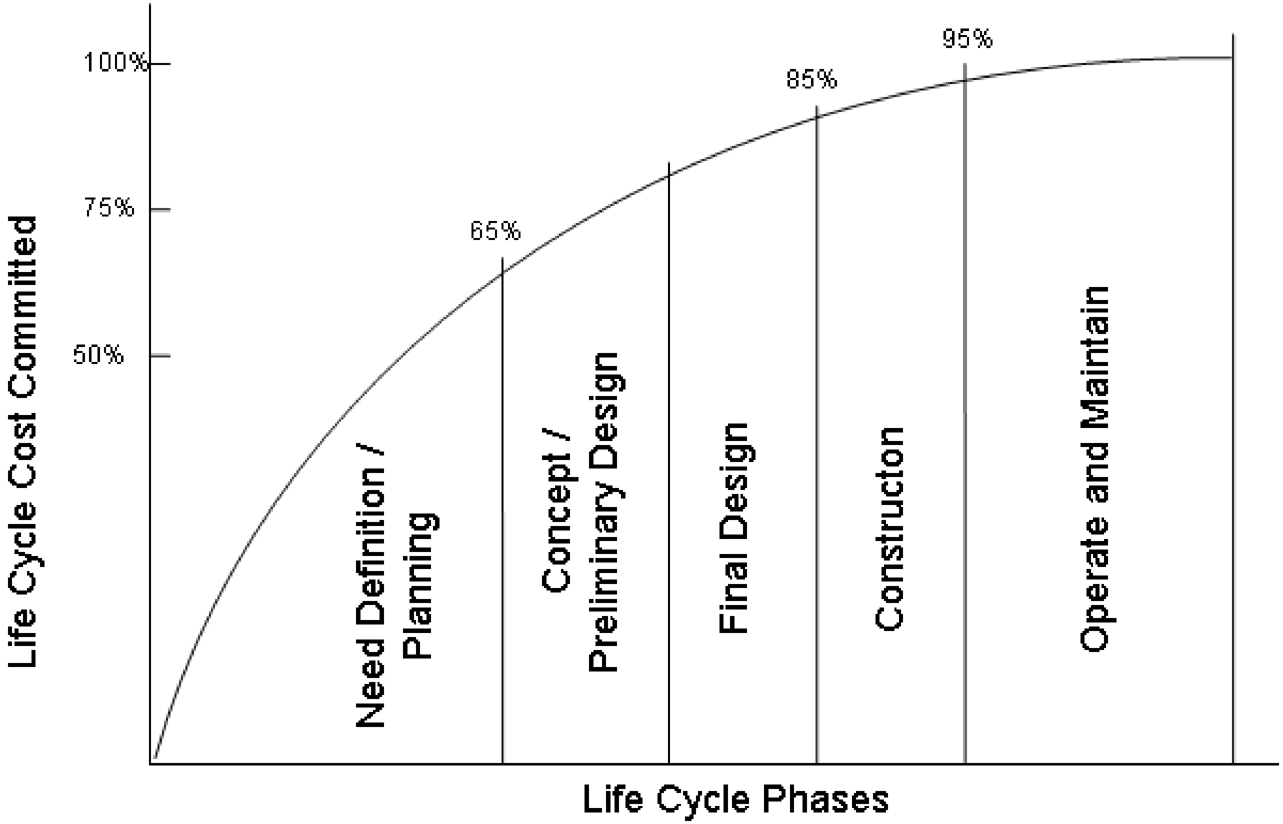
Effects on Profit of **Reducing Chance** Only

Plant and Equipment Life Cycle



Profits come from this stage of the life cycle, and are maximised when operating costs are minimised.

When Operating Costs are Committed



Life Cycle Cost Commitments

Source: Blanchard, B.S., Design and Management to Life Cycle Cost
Forest Grove, OR, MA Press, 1978

"Of concern is that up to 95% of operating costs are predicated during the capital phase. Once a plant is operating there is very little that can be done to reduce costs because they are substantially fixed by the plant's design.

It is clear that low operating costs are designed into the plant and equipment during feasibility, design and construction. "

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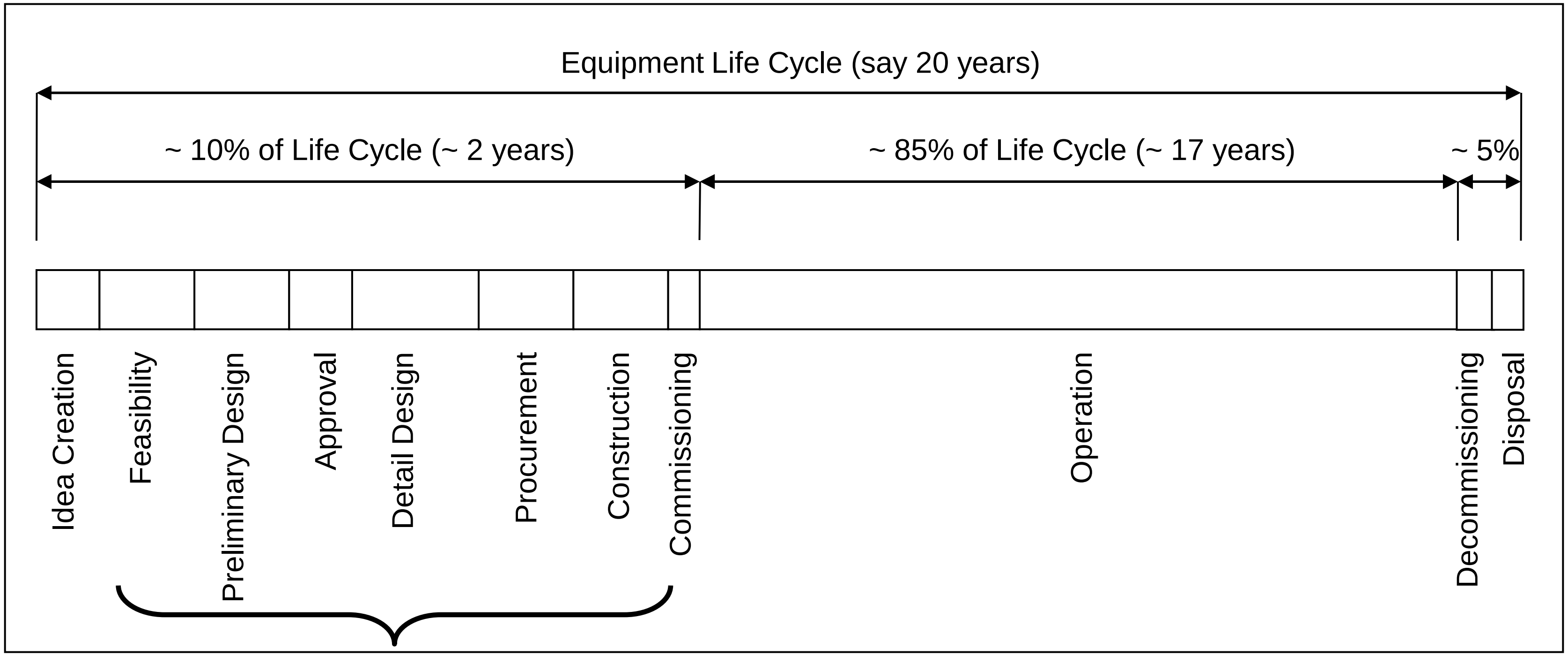
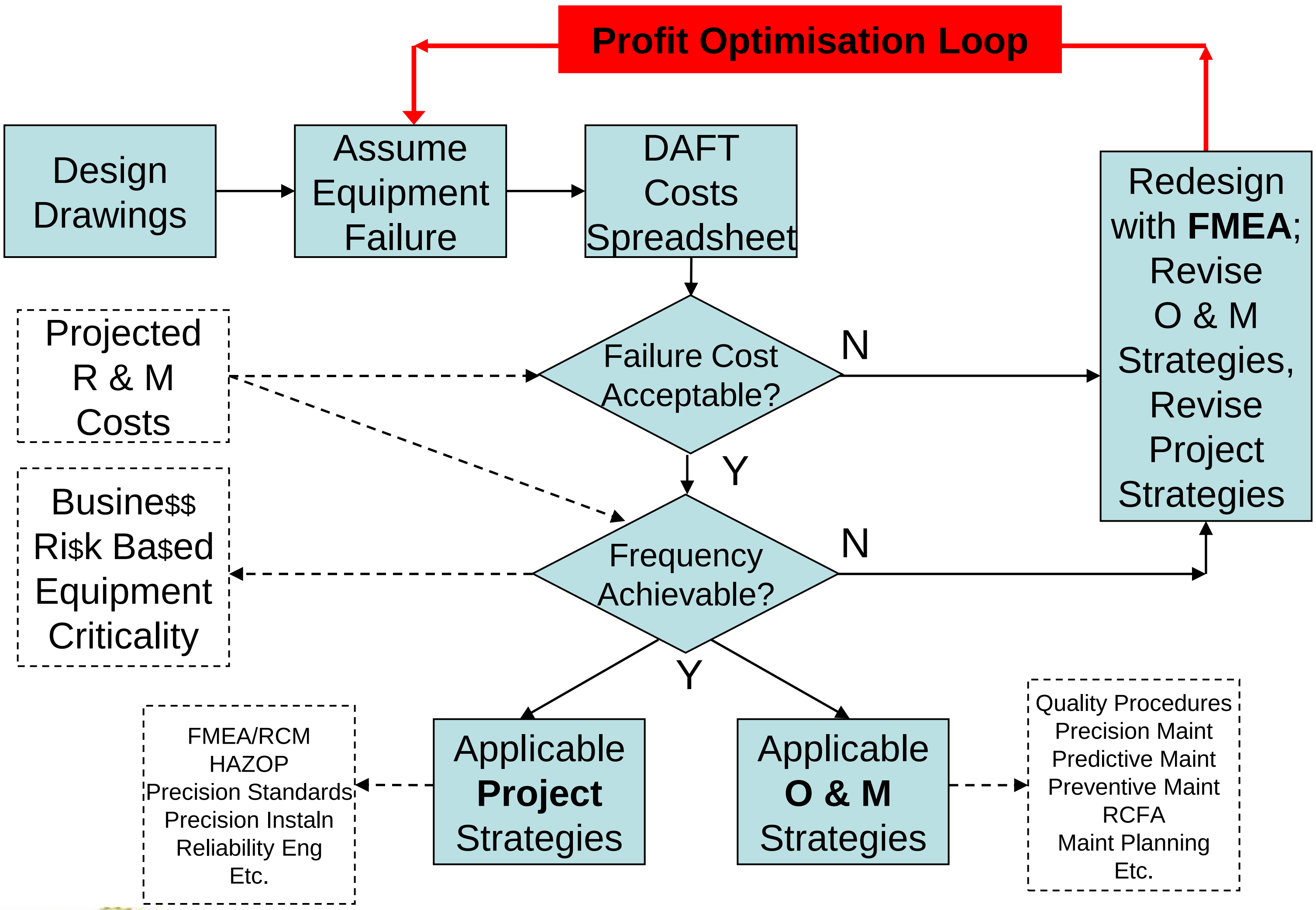
Maximising Life Cycle Profits



The Project Phase is the time to control the future costs of failure

Life Cycle Risk Management Strategy
Optimised Operating Profit Method

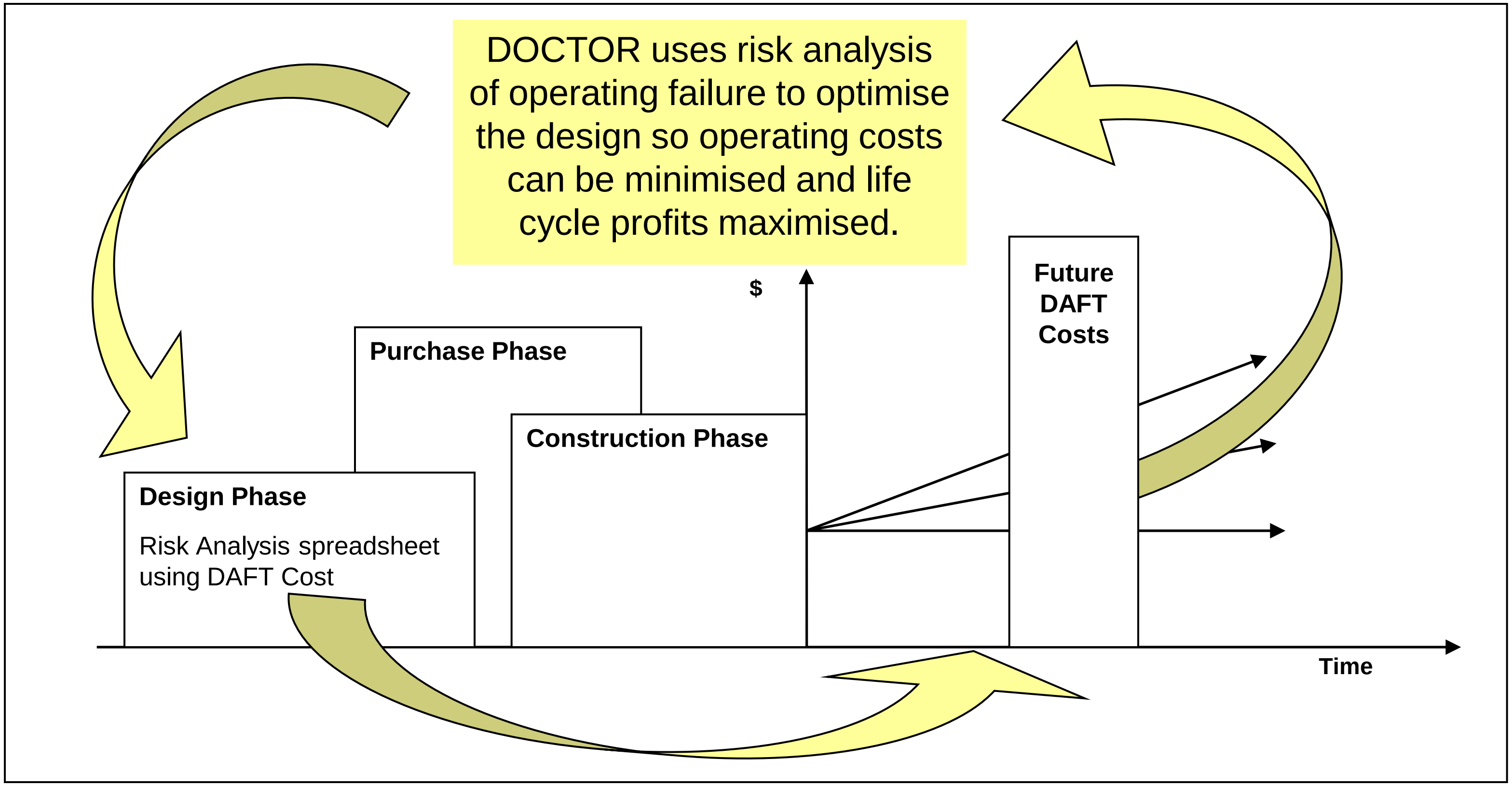


Calculating DAFT Costs

Category	Sub Category	Sub-sub Category	Unit Cost	Units	Total Cost
EQUIPMENT	Production	Setup personnel			
		Quality Control			
		Delivery			
		Engineering			
		Other Production related personnel			
	Maintenance	Repair personnel			
		Parts person			
		Engineering			
		Other Maintenance Support personnel			
	Management	Floor Supervisors			
		Maintenance Manager			
		Production Manager			
		Engineering Manager			
		General Manager			
	Administrative	Maintenance Secretary			
		MIS			
		Accounting			
		Legal			
	Cost per Unit	Raw Material			
		Direct Labour Input			
		Indirect Labour Input			
		Processing Costs			
	Units per Hour	Rated Equipment Rate			
	Energy Surge Cost	Electrical (Eg: High torque motors)			
		Gas (Eg: oven temperatures)			
	Set-up	Extra material, product/tool delivery			
		Manpower (supervisory too)			
	Percent Reduced	Parts per hour lost			
	Equipment Fatigue	High torque motor, heater elements			
		Computer monitors, mechanical fatigue			
	Scrap produced	Is it recyclable, salvageable?			
	Quality	Inspection cost, Rework cost			
	Other Cost	Site specific start up cost factors			
	Bottleneck Losses	Cost per Time Unit			
	Downstream Equipment	Cost per Time Unit			
	Sales Lost	Cost per Time Unit			

Category	Sub Category	Sub-sub Category		Unit Cost	Units	Total Cost
LABOUR	Labour Per Part / Labour	Direct Labour Input				
	QC	Direct QC labour related to downtime	First product inspections			
			Re-work inspections			
		Indirect labour related to downtime	Return shipment sorting			
			Material			
			Trips of QC personnel to			
	Maintenance	Direct maintenance labour	Mechanic / Technicians			
		Indirect maintenance labour	Maintenance Manager,			
			Parts person, set-up			
			Secretary, and others that			
	Engineering	True hourly cost of Engineers	From accounting			
		Track time associated with downtime support	Troubleshooting			
			Specifications			
			Re-engineering			
	Management	True hourly cost of Managers	From accounting			
		Track time associated with downtime support	Visiting downed			
			Related meetings and			
			Related administrative			
DOWNTIME	Lost Time					
	Reduced	Capacity loss				
		Maintenance time				
	Scrap					
	Band Aid					
	OEM	Time and material				
		Expenses				
		Downtime losses				
	Tooling	Tooling damage caused by Machine				
		Machine failure caused by Tooling				
	Parts & Shipping					
	Cost of this occurrence	Associate cost to permanent fix done later				
		Parts used for band-aid repair				
		Amount of times band-aided till				
	Percentage of all other	What percent of full speed, increased				

Design, Operation and Cost Total Optimisation Review

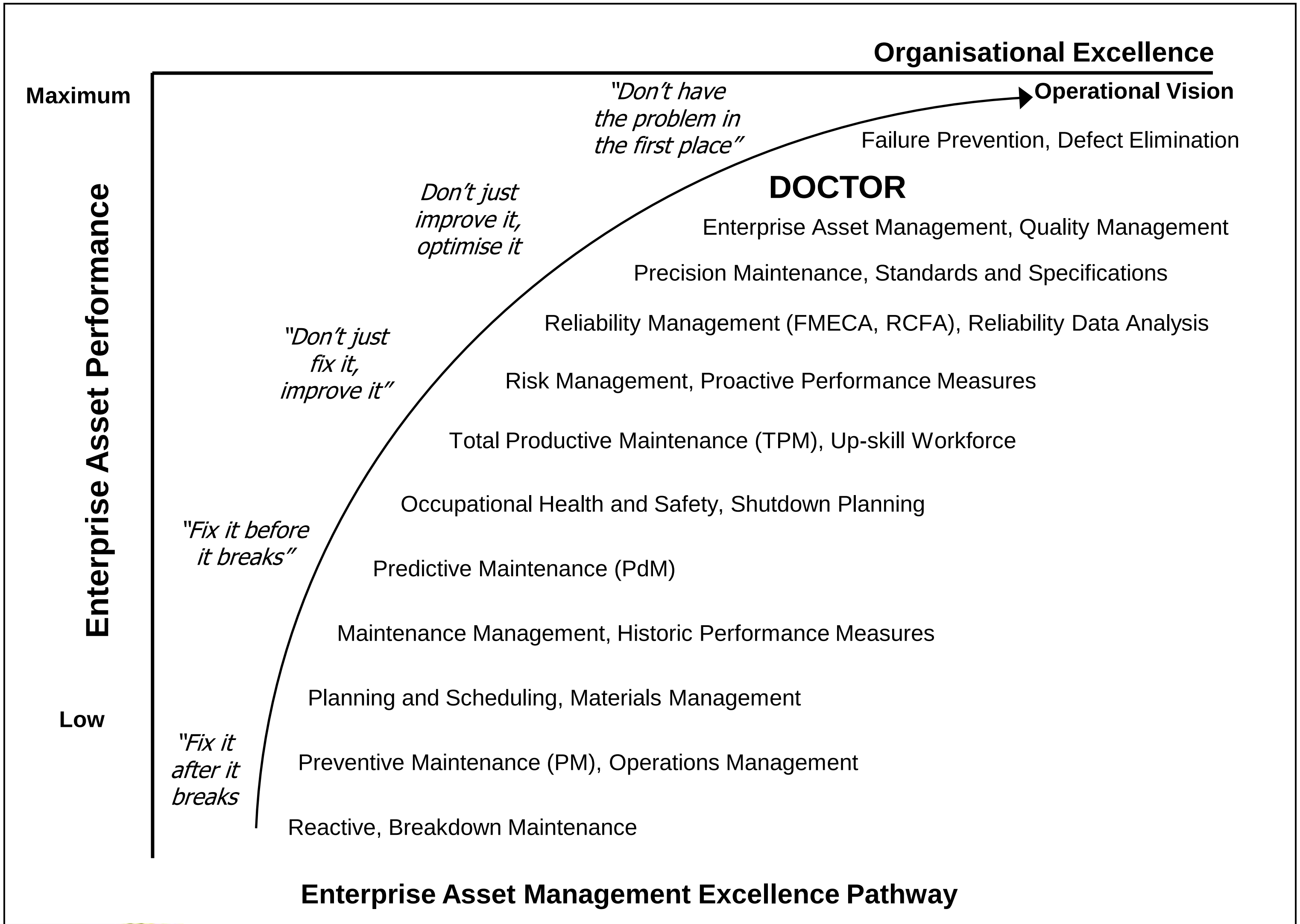


Risk – Reduce Chance or Reduce Consequence?

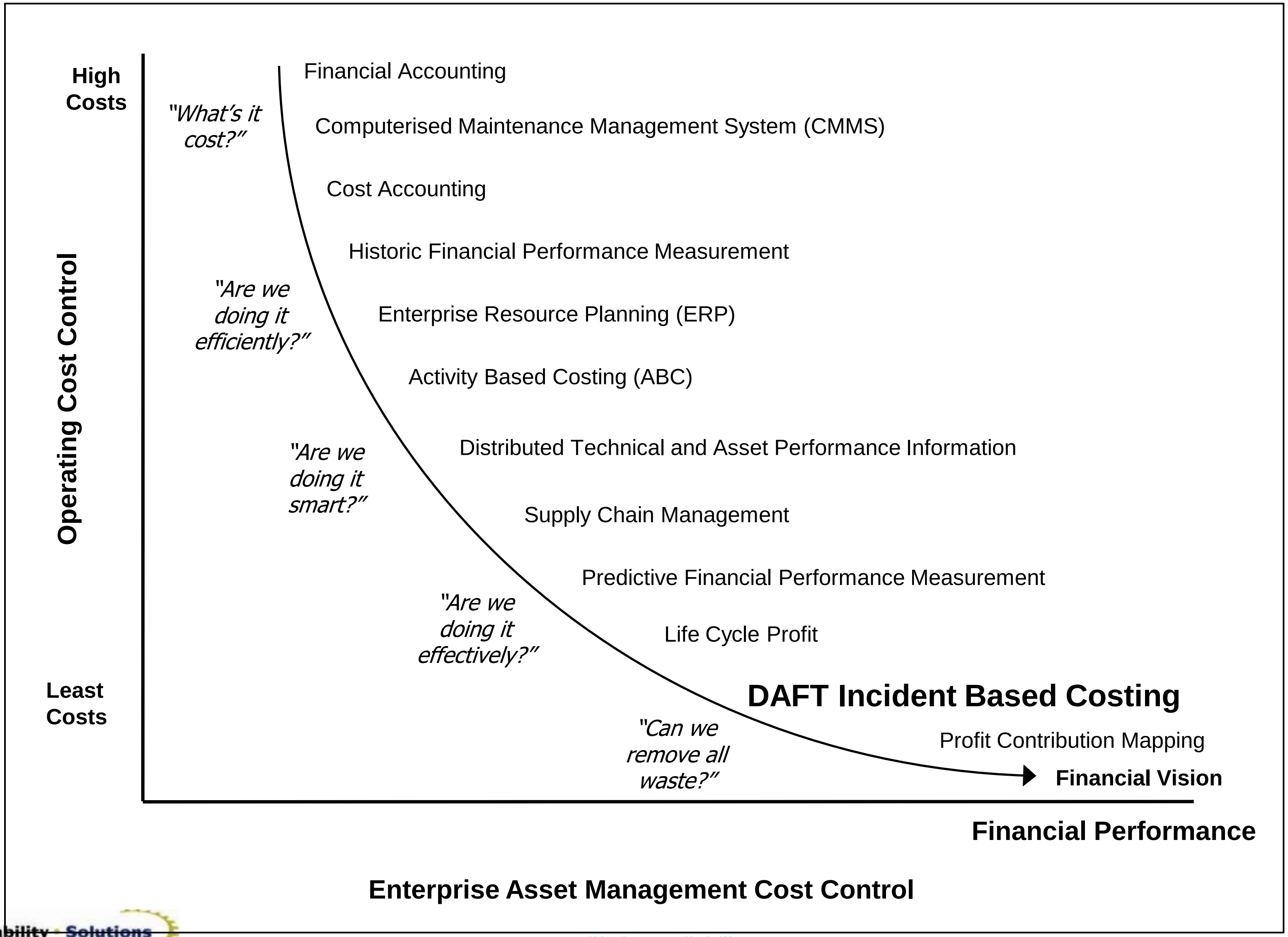
Risk = Chance x Consequence

Chance Reduction Strategies	*Consequence Reduction Strategies*
• Engineering and Maintenance Standards • Failure Design-out - Corrective Maintenance • Failure Mode Effects and Criticality Analysis (FMECA) • Statistical Process Control • Hazard and Operability Study (HAZOP) • Root Cause Failure Analysis (RCFA) • Precision Maintenance • Hazard Identification (HAZID) • Training and Up-skilling • Quality Management Systems • Planning and Scheduling • Continuous Improvement • Supply Chain Management • Accuracy Controlled SOPs • Design, Operation and Cost Total Optimisation Review (DOCTOR) • Defect and Failure True Cost (DAFTC) • Oversize/De-rate Equipment • Reliability Engineering	• Preventative Maintenance • Predictive Maintenance • Total Productive Maintenance (TPM) • Non-Destructive Testing • Vibration Analysis • Oil Analysis • Thermography • Motor Current Analysis • Prognostic Analysis • Emergency Management • Computerised Maintenance Management System (CMMS) • Key Performance Indicators (KPI) • Risk Based Inspection (RBI) • Operator Watch-keeping • Value Contribution Mapping (Process step activity based costing) • Logistics, stores and warehouses • Maintenance Engineering
Done to reduce the chance of failure	Done to reduce the cost of failure

The Necessary Practices



The Necessary Financial Methods



DOCTOR and DAFT Costs are insightful tools project people can use to prevent operating failures and maximise operating profit.

Now we can connect the designers and the operators together throughout the life cycle.