Extracting Maximum Performance from Process Assets

Have You Hugged Your APC Recently?

A look at the value of APC revamping

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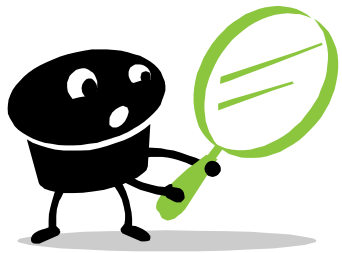
Who are Apex Optimisation?

- Small group of experienced process control engineers (previously known as ProSys Engineering)
- Based throughout Australia (and NL added recently)
- Provider of APC design expertise, implementation engineering and associated training
- Wide experience on a range of DCS platforms and APC technologies (ambidextrous stance)
- Australian client list includes BHP Billiton, Rio Tinto, Woodside Energy, Santos, Caltex, BP, Chevron
- More details at www.apex-opt.com

Agenda

- What is Advanced Process Control?
- Why does APC Performance Deteriorate?
- How can we improve APC benefits further?
- Some Case Studies
- What's the Value of Appropriate Revamps?
- Different Revamping Strategies
- APC lifecycle management
- Questions / Comments from the audience

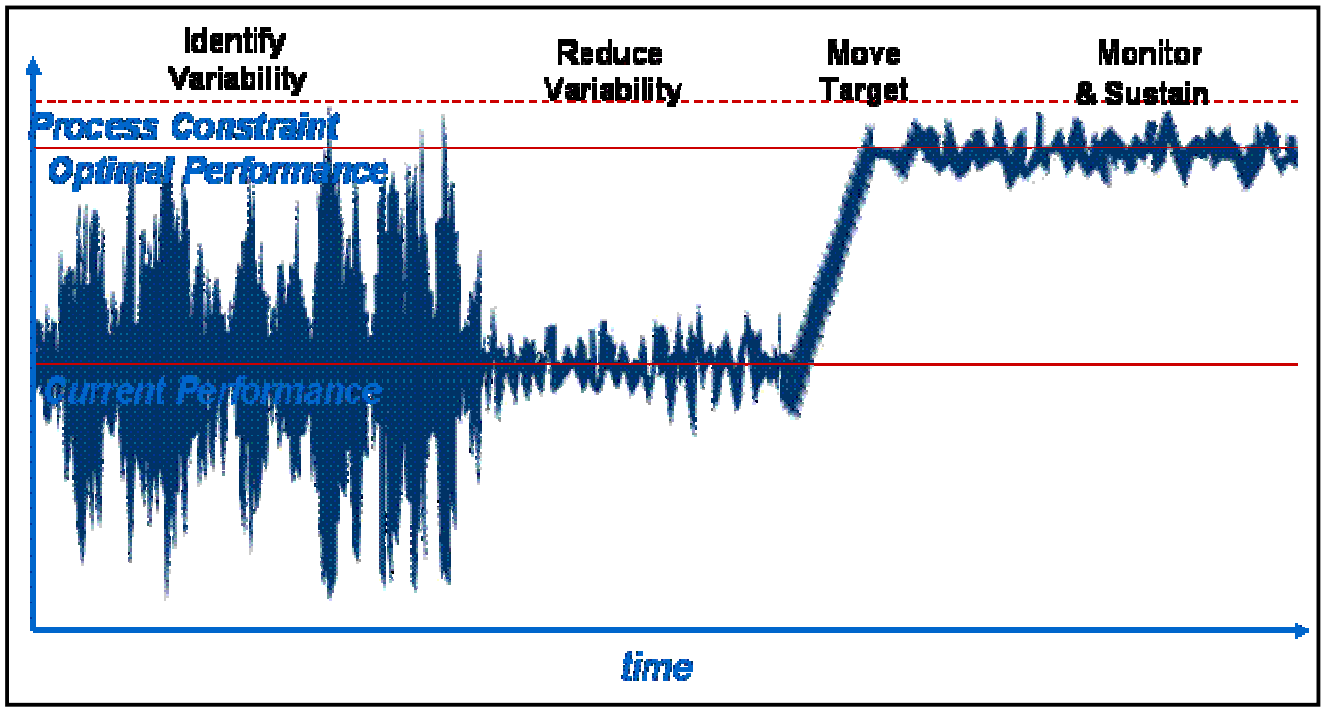


Process Control in Context

Business objective: Maximise profitability and reliable shareholder return on investment

- Plant Objectives
  - Maintain Health, Safety and Environmental standards
  - Meet Overall Production and KPI Targets
  - Reliably Maintain Minimum Cost Operation
- Process Control Objectives
  - Keep plant safe (within alarm / trip constraints)
  - Deliver predictable and steady operation whilst meeting product quality specifications
  - Facilitate plant optimisation (maximise charge, product yields, energy efficiency) to increase profit

How Does Process Control Deliver Benefits?



- Assuming that there is some economic advantage to pushing the process in an optimal direction...
- A reduction in variation (improved control) allows the average target value to be moved closer to constraints (process optimisation)

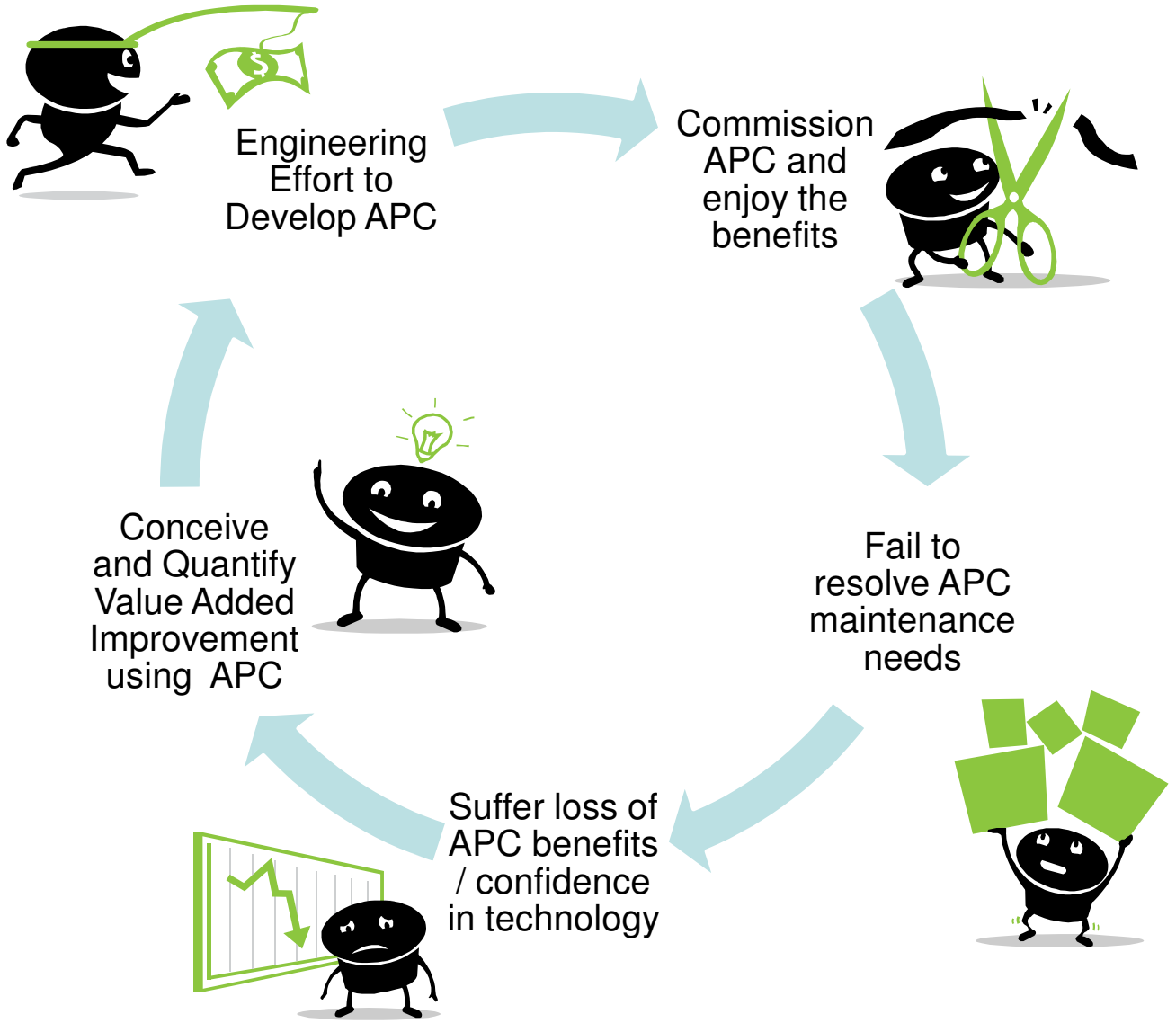
What is Advanced Process Control?

- APC software delivers functionality extra to the DCS regulatory control (i.e. similar to a cruise control in a car)
- Benefits of APC are typically associated with the optimisation nature of the selected technology
- Multivariable Predictive Control (MPC) has been favoured in the Hydrocarbon Processing industries to date with growing use in Minerals Processing, Power Generation etc
- MPC applications have several parts:
  - A generic hardware and software platform
  - A plant specific MPC design (structure) and response model
  - Tuning settings for the control and optimisation action
  - Ancillary customisation to provide discrete logic, mode switching etc

The Design Basis for APC

- The APC design (structure, process model and tuning) are the results of the APC designer's engineering judgements
- The APC designer makes these judgments based upon:
  - Their skill and experience in APC development
  - The capability of the hardware and software platform employed
  - The process context in terms of physical arrangement and capacity, DCS control design and performance, dynamic responses recorded at the time of step testing
  - The operating company's objectives in terms of process economics (i.e. product and utility values) and logistical needs
- At the completion of commissioning, the APC will (generally) be considered to be running as best it can.
- Organisational awareness and satisfaction should be high

The Vicious Cycle + Analogy



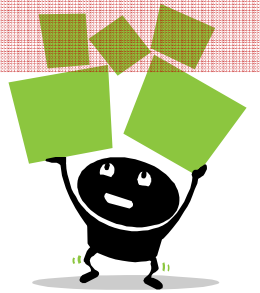
The Vicious Cycle + Analogy

Engineering Effort to Develop APC

Commission APC and enjoy the benefits

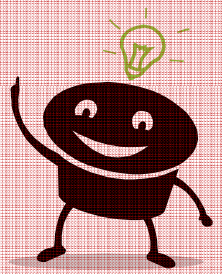
The difficult teen years… but somewhat earlier!

Fail to resolve APC maintenance needs



Suffer loss of APC benefits / confidence in technology

Conceive and Quantify Value Added Improvement using APC

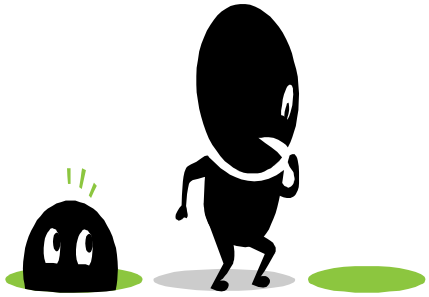


The responsibility of parenthood…

APC Vulnerabilities

Threats to sustaining the original APC benefits include:

- Hardware or Software platform becoming obsolete can impact reliability, system compatibility and availability of support
- Changes in process context can result in model mismatch and/or inappropriate APC design
- Slow instrument maintenance practises can erode DCS control and therefore APC performance and uptime
- Scarcity of experienced control engineers and personnel turnover can impact negatively



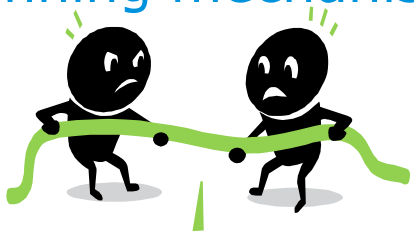
APC Vulnerabilities – Why?

These threats are prevalent in the modern operating plant:

- Hardware or Software platform changes
  - Vendors are constantly improving their products and competing for market share
  - Support can become scarce for older systems
- Changes in process context
  - Process engineers are constantly looking to improve the process performance with equipment improvements
  - Marketing is constantly looking for ways to increase production value
  - Government legislation changes (e.g. clean fuels specs)

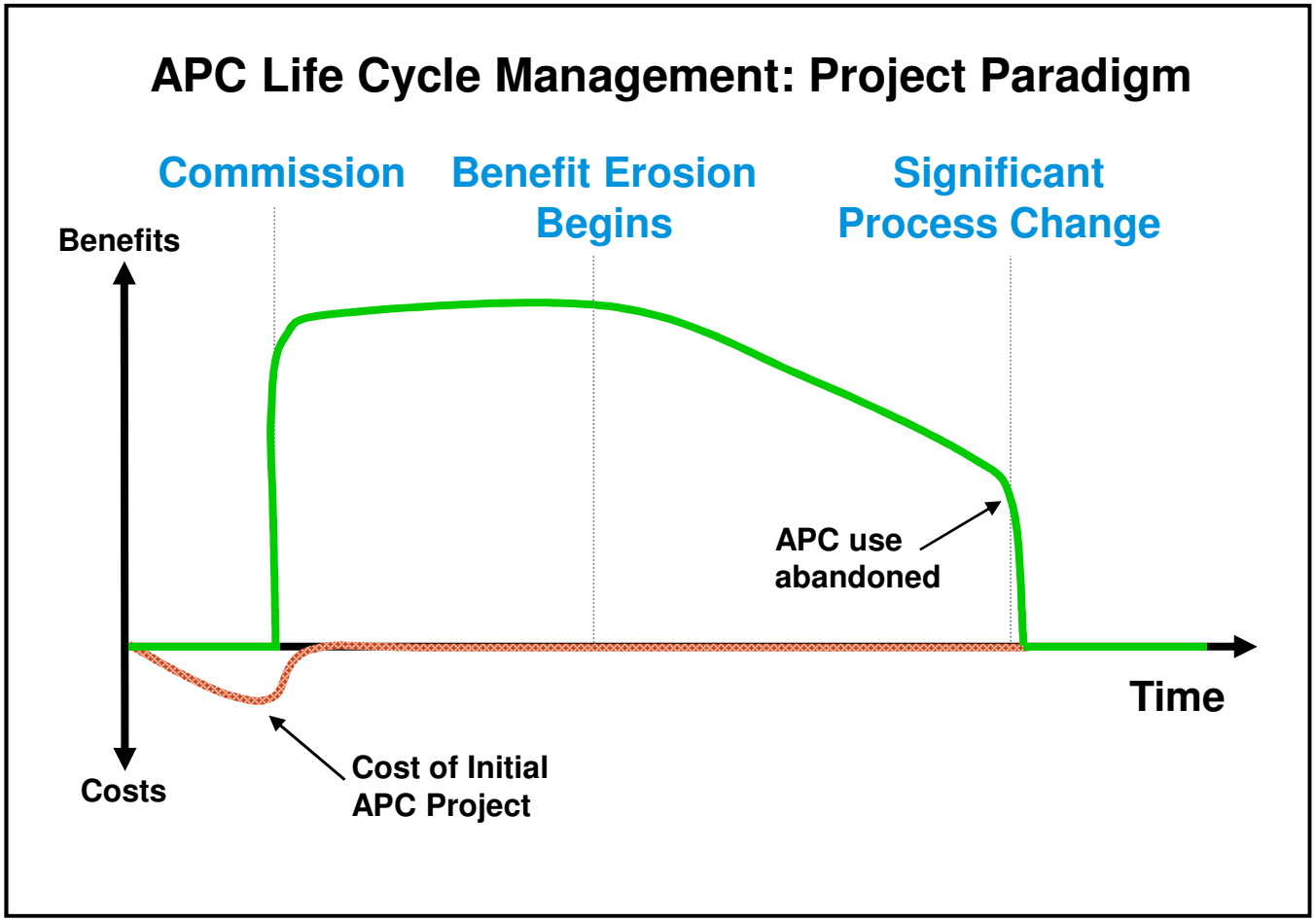
APC Vulnerabilities – Why?

- Slow instrument maintenance practises
  - Focus and competition on maintenance costs leads to more regimented prioritisation and planning
  - Some faults represent losses which are more difficult to quantify… they don't fit with the maint planning mechanism



- Scarcity of experienced personnel
  - Justification for APC improvements requires understanding, innovation and effort
  - "How do I predict the benefits of an upgrade of an existing APC which is currently running?"
  - APC maintenance can be difficult unless a good understanding of what's 'under the bonnet' can be developed
  - Unless the responsible engineer has good prior experience or involvement in the original project, it can be difficult

Negative Lifecycle Trends



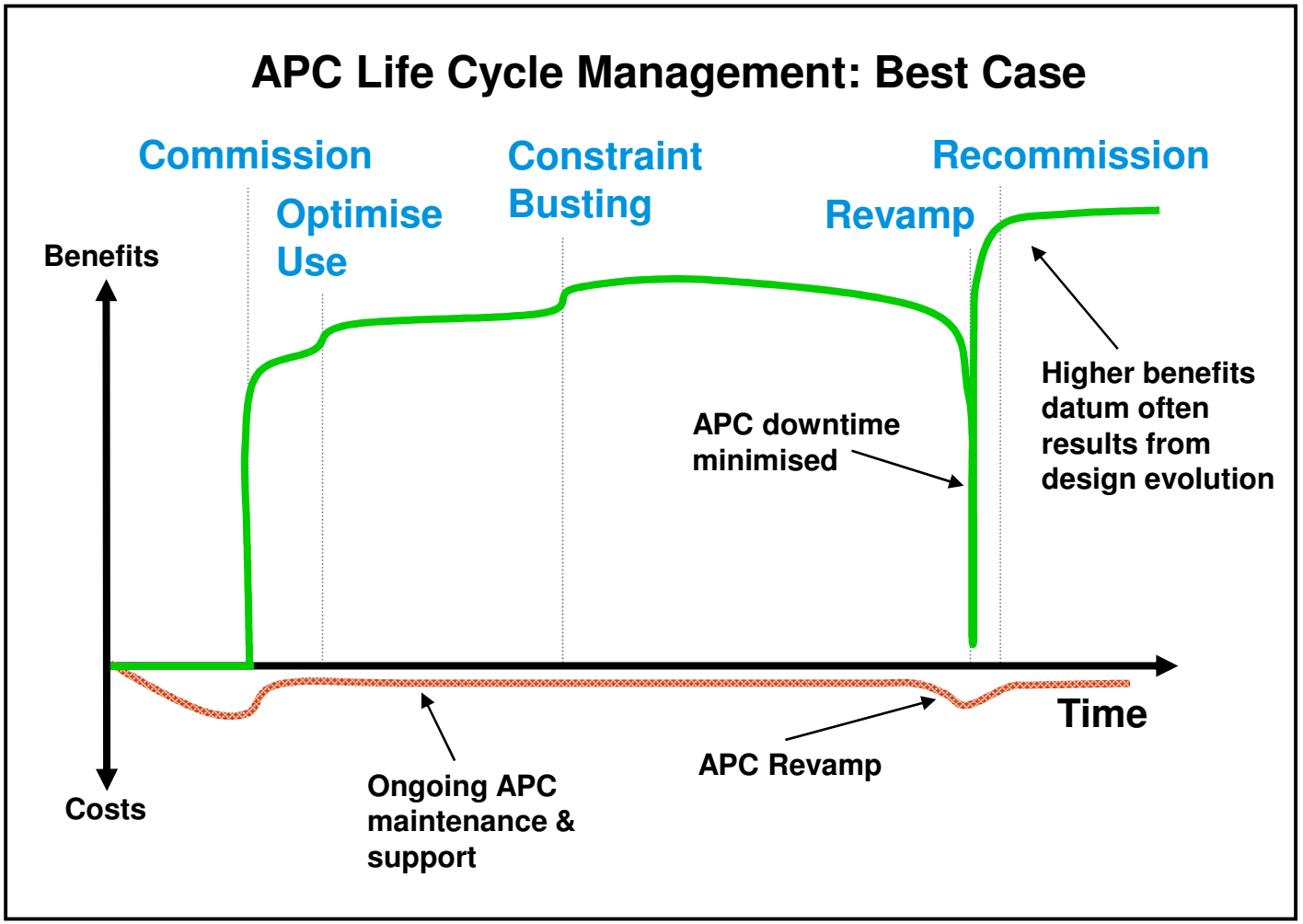
The technology is installed but the original value is not sustained…

APC Opportunities – After Commissioning

A new APC delivers a paradigm shift which can be further exploited:

- The operators now manage the plant in a consistent manner and the APC usage can be optimised by the process engineers to magnify the performance benefits
- Hard data on active constraints can justify capacity creep opportunities to further improve production
- Iterations on operator training and feedback can fuel design improvements which take performance further
- Revamp planning can be co-ordinated with major context changes to minimise benefit losses

Positive Lifecycle Trends



The technology is fully exploited to maximise the value delivered

APC Revamp Case Studies

Oil Refinery MPC Revamps

- Lube VDU MPC Revamp
  - Improved distillate yield
  - Large reduction in viscosity variance
  - Stripper level protection added
  - Project payback < 4 months
- CDU MPC Revamp following Clean Fuels Upgrade
  - Fast track project used an automated plant testing tool
  - MPC benefits promptly recaptured after major plant changes
- Alkylation MPC Revamp
  - A 6% increase in production very positive for the octane pool
- Hydrotreater MPC Revamp (refinery limiting unit)
  - A 5% throughput increase = multimillion dollar annual return
  - Project payback of << one month

APC Revamp Case Studies

Two Oil Refineries with the same problem:

- Old MPC Hardware and Software platform no longer supported
- One approach - Site wide technology upgrade of MPC hardware and software (reusing existing designs / models)
  - Project driven by reliability risk to MPC benefits, contractors engaged to complete upgrade
  - All active MPCs upgraded within one year, allowing decommissioning of the old MPC computer platform
  - Increased product yield on one CDU (due to exploitation of new software functionality) paid for the entire project
- The other approach – prioritised full revamp of each MPC
  - Slower switch over of MPCs but new design + models...
  - One MPC application remains on the old platform
- Which is the best approach?

APC Revamp Case Studies

Woodside Energy LNG Complex (NW Australia):

- Gas Plant MPC Revamp
  - Payback < 1 month due to improved LPG extraction
  - 70% of benefits due to improved design
  - Improved operator/engineer expertise on process and MPC

- LPG Fractionation Unit MPC Revamp
  - New design approach adopted to column flooding limit
  - Improved use of degrees of freedom during discrete operating modes
  - Capacity increase of > 10% with no hardware changes or production impact

The Value of Appropriate Revamping

Revamping can be much more profitable than the original APC project!

The costs are lower:

- The hardware and software exists
- Personnel Training costs are lower
  - Operations personnel know how to drive APC
  - Engineering support personnel can get more involved in the project
- Typically the size of the application is smaller
  - Design evolution can produce a more succinct design which is cheaper to develop, teach, document and maintain
- Automated plant testing techniques can be considered
  - A starting model is required for closed loop testing

The Value of Appropriate Revamping

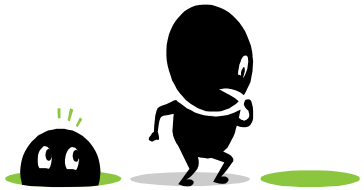
The benefits can be significant:

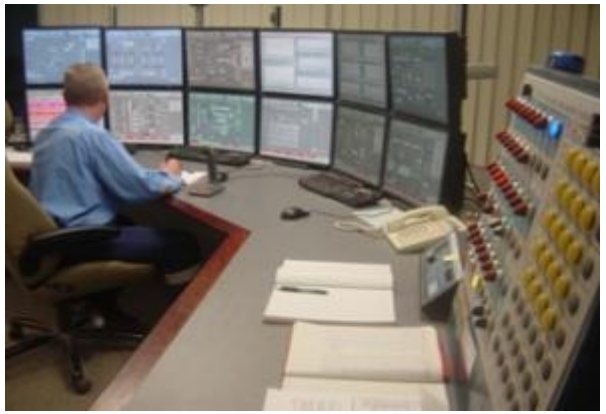
- Design evolution delivers more value
  - More valuable functionality can be added
  - Existing objectives can be pursued more effectively
- Site Expertise develops further
  - Operators receive retraining on MPC, the process science and good operating practises
  - Support Engineers understand how to strip it down and rebuild it
- Elusive instrument maintenance issues are resolved
  - The higher profile of a formal revamp can help fix the maint planning priorities
- The value of APC is reiterated to the organisation
  - Mgmt is re-educated on the value of APC (= support for future APC)
  - Ops + Engineers understand how the APC benefits are delivered

APC Revamping Strategies

How deep do we go with an APC revamp?

- Simply remodel the existing design? (potentially automated!)
- Do some stepping during the day and polish up the models?
- Sounds pretty cheap to do...





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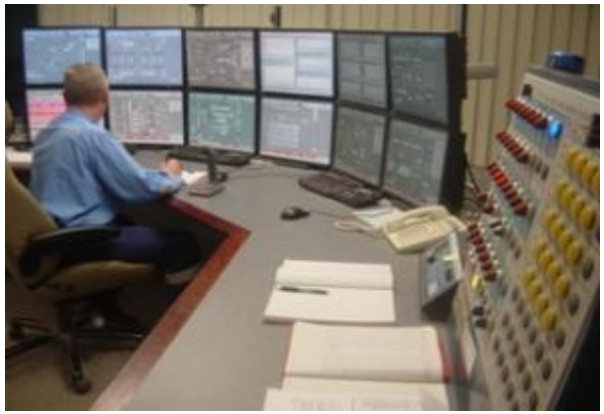

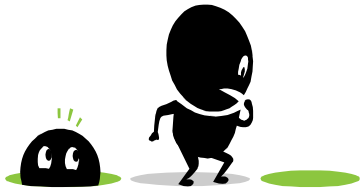

- But...
  - What's the value of design evolution?
  - Should the DCS control layer design be improved?
  - Is all the instrumentation working well? Loops well tuned?
- When the design represents a significant slice of the value, slight improvements can deliver big increases in benefits
- Revamps don't happen regularly – complete thorough retraining and get momentum behind locking in the gains

APC Revamping Strategies

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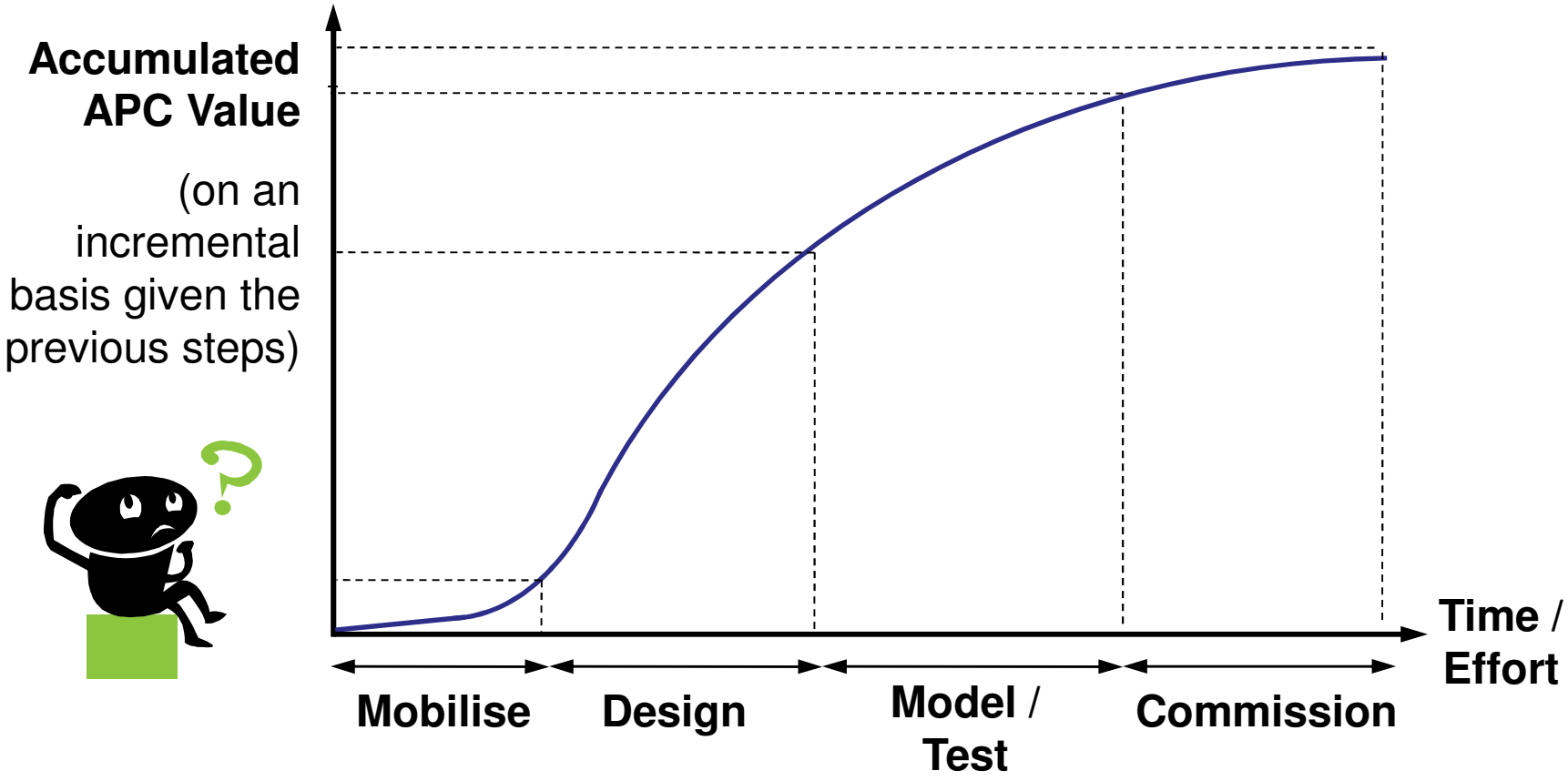

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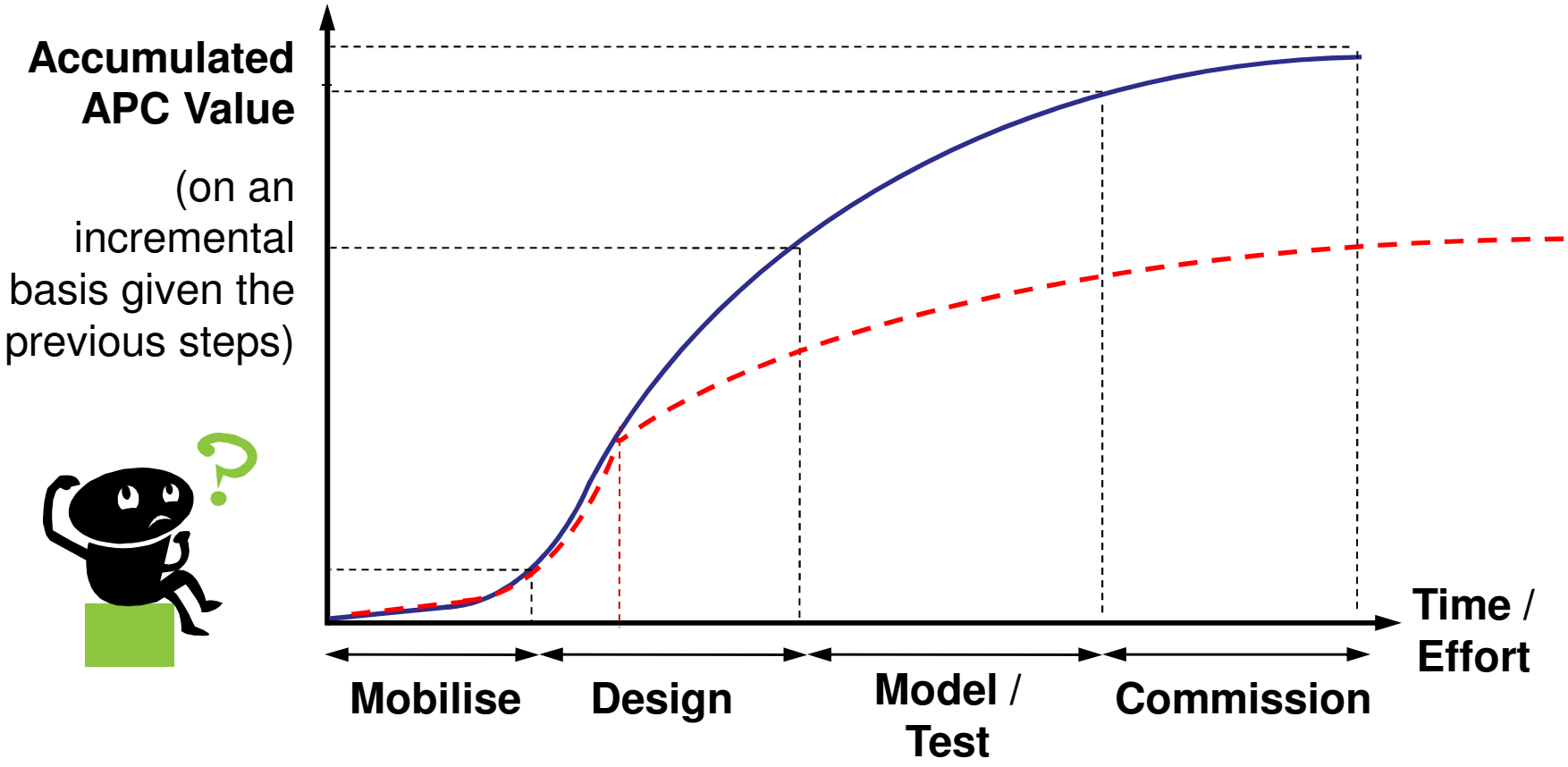

The design phase has the biggest value gradient – exploit it!

APC Revamping Strategies

Do it in-house using local resources:

- Perhaps negate need for funds justification?
- Let my people develop by doing it themselves
- Flexible schedule and we can tinker at it when convenient?
- Keep all our IP wrapped up and make sure local knowledge is leveraged

APC Revamping Strategies

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- But...
  - What's the opportunity cost of tying up my scarce resources?
  - What's the cashflow associated with a longer execution?
  - Should we be training our people without a trainer?
  - What experience could a contract engineer bring to the table?
  - Is our special IP process design related or process control related?

APC Revamping Strategies

Do it using contract engineering:

- Requires the justification of real money and contractor mgmt
- Sometimes little guarantee of whether the CVs in the proposal belong to the engineers that arrive onsite...
- May not help the development of my young engineers
- May not fully harvest local knowledge to get the best design

APC Revamping Strategies

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- May not help the development of my young engineers
- May not fully harvest local knowledge to get the best design
- But...
  - Work proceeds according to the agreed schedule
  - A higher profile project may lure greater organisational support
  - Increased pool of skills and experience feeds design improvement
  - Project outcomes will be better documented and therefore more durable in time

APC Revamping Strategies

Do it using a Hybrid Team:

- Still need to tackle funds justification

But...

- Engineers develop the best by working with a range of experienced mentors
- Project profile and focus delivers prompt schedule and support throughout the organisation
- A greater pool of experience provides design improvement
- Frontline support provided by confident inhouse engineers with informed contract support available if required
- Project is formalised with thorough scope decisions and documentation – results are durable into the future
- Relationship with a resource provider is further developed

Recommended Lifecycle Management Tasks

APC Maintenance

- Daily review of performance to ensure that the tuning, custom logic and process model are fit for purpose
- Ensure that operator expertise and support are sustained

Optimise APC Usage

- Weekly review of how the APC fits with plant objectives
- Operators = Drivers, Process Engineers = Navigators, Control Engineers = Motor Mechanics

APC Revamps

- Initiated by planned changes in process context or sustained poor performance which can not be resolved via routine maintenance
- Conducted on a project campaign basis to ensure adequate focus

APC Technology Upgrades

- Necessary if hardware reliability problems can not be resolved
- A software value gap or lack of support can justify an upgrade

Elements of Success for Maximising Benefits

- Open Communications between Planning, Engineering & Operations
  - A common understanding of plant objectives and economics prevails
- Organisation Wide Acceptance of the Value of APC
  - Process engineers use these tools to their advantage
  - Instrument maintenance priorities reflect the impact upon APC benefits
- Organisational Commitment to Facilitate APC Maintenance
  - Control Engineers are given the mandate to complete APC maintenance
  - Resourcing, Training and Stability of the Control Engineering group is crucial
- Access to External Expertise when required
  - Site support teams are typically very lean and require extra help for project work

Maintain Perspective

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Often it's not what you do but how you do it!

In Summary

- APC can deliver significant plant benefits
- APC is not a generic commodity – the specific design and tuning employed represents most of the value
- APC Revamping is required to maintain and increase benefits in the face of a changing plant context

- Although APC is used in many industries, relatively few users extract the full value of the technology by managing the lifecycle needs well. This remains an opportunity to be exploited for many APC users.

Any Questions / Comments?