Case study:  
Obsolescence and Replacement of Distributed Control System (DCS)

Problem description:  
Should the DCS system be replaced, if so when should it happen?

The study determined the optimal DCS replacement strategy, and justified the capital investment necessary despite the significant uncertainty in many of the factors considered. It revealed the optimal timing to be in 2 years time, and quantified the costs and risks of delaying beyond that point.

Results and benefits:  
Planned replacement of the DCS at the optimal time (2 further years after the study) represented a NPV benefit of approximately $5.5 Million compared to the total cost/risk impact associated with either a panic renewal immediately or the typical ‘what if?’ approach.

Distributed Control Systems are essential to the successful and safe operation of process and manufacturing sites. In this case the DCS vendor were no longer offering maintenance and technical support for the current 30-year old DCS of a large petrochemical processing plant.

As vendors no longer support obsolete systems, the maintenance costs rise and spares become more difficult to obtain, just when failure rates may also be expected to increase as the system ages. This can represent a significant risk, as well as creating increasing operating costs.

This site had 16 production units of different complexities and criticalities, each controlled by a discrete DCS system, linked together at the site level. Failure of individual DCS components (e.g. Input/Output devices) has local impact within the plant but failure of some core (controller) components would have site-wide consequences.

The challenge faced by the organisation was to determine when to replace/upgrade the DCS systems and whether to do this in a site-wide intensive programme, or through phased, unit-level upgrades.

The decision needed to consider the risks of continuing with the current system, the increasing maintenance costs and potential downtime due to failures, the capital and operating costs of different possible replacement options, as well as the future rate of change in technology and new system life cycle. And naturally there was very high uncertainty in this data.

The study we performed

The SALVO process provides the structured navigation and evaluation discipline to ensure all factors, stakeholders and scenarios were explored, quantified and evaluated on a consistent and auditable basis. This process was supported by real-time cost/risk modelling and ‘what if?’ calculations using the DST Lifespan Evaluator™ tool.

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This case involved a small team comprising inspectors, operations, maintenance and process safety personnel. It needed just 2 hours to build the basic scenario, using the SALVO storyboard for renewal decision-making, and DST Lifespan Evaluator™ to model the risks and costs and operational options available, and identify the optimal strategy. The team also developed a number of alternative scenarios and explored their impact of the optimum strategy.

The study, including testing for sensitivity to all sources of data uncertainty, revealed the optimal replacement point for the DCS systems to be in 2 years, with subsequent optimal life cycle of the new system forecast to be 20 years. This strategy yielded a ‘total business Impact’ (i.e. all costs, risks and performance implications) of approximately NPV US$5.5 Million.

It also showed that an option to replace with a higher cost system was not optimal. The NPV benefit of selecting the basic option over the improvement was option $1M and the increased failure rate scenario was not significant.

Finally, a formal decision-recording stage ensured the capture of the optimal strategy, the implementation actions and audit trail for why replacement at 2 years is the correct decision.

To perform the complex reliability, risk and financial ‘what if?’ calculations, this study used decision-support software called DST Lifespan Evaluator™. This tool was developed as part of the international SALVO project (www.SALVOproject.org) to support the analysis of asset life cycle decisions at both design/selection/procurement stage and in end-of-life decision-making (e.g. refurbish/replace justifications and optimal renewal timing). Like other modules in the DST Asset Strategy Evaluator™ suite, the tool provides:

- A structured logic, with clear ‘storyboard’ checklist to ensure all factors are considered.
- Disciplined process to capture and quantify the knowledge of cross-disciplined teams, including their uncertainty.
- State-of-the-art analytical algorithms to evaluate the life cycle cost, risk and performance of decision options.
- Sophisticated, extremely rapid sensitivity-analysis to identify which assumptions have what effect upon the decision.
- Rapid creation and evaluation/comparison of multiple scenarios, enabling the study team to compare alternatives and explore ‘what if?’ ideas - instantly.

For further information about DST Inspection Evaluator, and the SALVO processes, please contact:

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