

## THE SALVOPROCESS STRATEGIC ASSETS: LIFE-CYCLE VALUE OPTIMIZATION

How do you determine and prove which projects, maintenance or asset replacement tasks are really worthwhile, and when?



# Introduction

SALVO (Strategic Assets Lifecycle Value Optimization): a world-leading research and multi-industry collaboration to answer the following question -How do you determine and PROVE which asset investments, maintenance, spares, change projects or renewals are worthwhile, when and why?

The SALVO Project was a 4-year cross-sector R&D collaboration that addressed best practices in decision-making for asset management. The outputs are now 'packaged' as a systematic "SALVO Process" a robust framework for better decision-making.

The SALVO Process is a series of 'storyboards' to guide over 40 types of typical asset management decision. These range from capital investment justifications/prioritisations to optimization of inspections, maintenance, spares, life extension projects, upgrades, obsolescence and renewal timings.

All have been field-tested and proven to make very substantial business benefits (e.g. SASOL's 60% Capex savings in managing obsolete control systems) using the combination of innovative evaluation and modelling tools plus structured, modular training elements. But they have also provided a big increase in the transparency and consistency of critical decisions, with much better control of risks, short-term/long-term trade-offs and the ability to demonstrate and quantify whole life cycle asset value.



### Why SALVO ticks all the boxes:

### **Outstanding** Business Impact

SALVO methods have been applied and implemented in a range of industrial cases, with significant quantified business benefits:

- SASOL optimal renewal programme for obsolete instrumentation; with attributed benefits at least £18million in capital avoidance and deferments
- Optimised track grinding strategy for London Underground; estimated life cycle benefits of £2-4 million/year
- Maintenance and renewal strategies for filter screens, sewage pumping and other asset management plans in Scottish Water; typical individual cases yielding net benefits of c.£700k/year

### Builds skills for optimal decision-making

SALVO broke new ground in the modelling of compound strategies to find the optimal mix of interventions, intervention timing and asset life cycles. It uses advanced reliability engineering and financial maths to instantly evaluate the business impact of multiple risks and the effects of one intervention type upon the urgency or value of others, on any asset type and industry sector, and even when available data is poor or incomplete.

### Quantifies asset whole life value

Whole life cycle asset management is at the core of SALVO. The process enables optimization of the asset life cycle value in procurement, operations & maintenance decisions and end-of-asset-life decisions. The SALVO decisionsupport methods also identify and justify what is the optimal life in the first place.

### Monetizes risk

Quantitative risk management is an embedded component within the SALVO Process. The modelling tools also break new ground in the business impact evaluation of compound risk patterns and failure modes, including those introduced by planned interventions.

### Integrated approach

Proven in many industries around the world, and always yielding multi-million \$\$ benefits, SALVO brings together advanced analytics, business discipline, common sense pragmatism and the vital human factors. HOFOR, Copenhagen used SALVO & Decision Support Tools (DST) to yield net service/risk benefits valued at \$48.9m NPV within their Supply Chain and Critical Spares Workstreams and by adapting SALVO to establish an innovative cost, risk and performance optimisation process, Sydney Trains demonstrated individual decision benefits of A\$20 + million NPV.



### Integration

A core objective of SALVO was to integrate processes, people and technology to ensure asset management decisions consistently deliver optimal value. SALVO acts as a catalyst for breaking down functional silos – giving people a language, template ('decision storyboards') and tools to determine the optimal strategies and ensure consensus. At the technology level, integration ensures that the right data is obtained, and that decisions are then converted into actions and fed into work management systems, budgeting processes, resource forecasting and the organisation's risk management system.

### Asset Knowledge

SALVO provides rigorous methods to capture and quantify expert knowledge. The decision support tools also provide an excellent audit trail, recording the 'why' (basis for decisions) as well as the business case justification for what is worth doing, and when. The scenario exploration and 'what if?' methods also reveal new insights into the business drivers that most affect critical decisions.





# Multi industry collaboration to find/develop best practices

The SALVO Project collated best practices, experience and innovation ideas from a wide range of sources, delivering practical solutions that are applicable to any industry sector and types of assets.

The Core Sponsors were **The Woodhouse Partnership Ltd (project managers), National Grid, London Underground, SASOL and Scottish Water,** supported by **Decision Support Tools Ltd and University of Cambridge** for technical and modelling developments. The core sponsors provided both expertise and financial resources.

Other industrial partners were also involved at working group levels, providing peer review, field trials, case studies etc. These included **Scottish Power, Energy Networks, Halcrow, Centrica, Water Corporation of Australia, Forbo Flooring** and **Sodexo**.

A number of technology specialists were also invited to participate, to ensure that SALVO deliverables can be integrated in common EAM, business data and work management system environments. Such IT partners included **SAP, IBM** (Maximo), **Mincom** & **AMT-Sybex** (Ellipse).

### Scope and objectives

The scope of the SALVO Project addressed value-based decision-making in all stages of the asset life cycle. It set out to create clear standards, competencies, guidance and tools to help real-world decision-makers, often facing incomplete information, multiple stakeholders to satisfy and conflicting, changing priorities.

The resulting processes, training and decision support tools have also been extensively tested and refined to ensure their understandability and practical value to front-line decision-makers, able to cope with any realistic mix of patchy data, uncertainties, risks and decision options.





### A systematic decision-making approach

The SALVO team built an end-to-end process for decision-making in six fundamental steps, comprising a 'top-down' targeting of the most important and valuable issues and opportunities to be addressed, and a 'bottom-up' evaluation, justification, optimal timing and programme integration of the most appropriate actions or solutions.

The steps are illustrated in the "SALVO Smiley". Full process mapping and best practice guidance was developed for each of these steps, as described opposite.

#### **SALVO Smiley**



### The SALVO Process steps

**Step 1** recognises that an asset portfolio is often large and very diverse, and that competing priorities will often be unclear and volatile.

SALVO step 1 guidance helps you to identify asset classes and sub-groups that can or should share a common strategy through their commonality of type and functional role, age, health etc. This is not just risk and 'criticality' analysis – SALVO has researched and revealed over 40 potential factors that can be used to distinguish between asset needs: sorting out both the importance of asset management attention and the urgency of such attention.

**Step 2** drills down into the critical, urgent issues to ensure that the problems/opportunities genuinely understood and root causes are addressed. In many current cases, short-termism and a 'patch and continue' habit is found to result in recurring problems and missed opportunities. SALVO Processes identify and capture the 'why' as well as the observed symptoms and manifestations of the problem or improvement opportunity.

**Step 3** triggers the identification of *potential* interventions or asset management options. Failure mode, effects and criticality analysis (FMECA), reliability-centred maintenance (RCM) and risk-based inspection (RBI) methods, for example only consider a small range of technical interventions (proactive/design change, predictive, preventive and corrective maintenance options). SALVO has identified over 50 options that might be considered, including many non-asset and nontechnical solutions such as insurance and operator competency or incentives. Stimulation of such lateral thinking reveals potentially high value solutions. Once individual options have been evaluated, with the best value ones identified and optimally timed.

**Step 5** explores the *combinations* of such interventions and optimization of the overall, whole life cycle strategy. This includes two stages in particular, both of which include significant innovative thinking and processes:

- **blending** of multiple activities on the same asset (for optimal whole life value).
- **bundling** of multiple activities across multiple assets for delivery efficiency and shared costs, access or system downtime.

SALVO Step 5, using the quantified cost/risk impact data of Step 4 as inputs and advanced AI modelling to seek the optimal combinations, yields very big benefits. Indeed, in some cases doubling the interval between major shutdowns, in other cases reducing annual downtime by 28-50%.

Finally, **Step 6** assembles the total asset management programme of optimised strategies to see the combined Capex and Opex costs, resources, performance and risk implications (including residual, justified risks). This enables total portfolio and programme optimization within global constraints and in delivery of multiple, competing objectives. Step 6 ensures, and demonstrates, that the best value combination of things are funded and planned to be done at the right time.

#### **Step 4** is a big area of SALVO innovation. It provides the objective business case evaluation and optimization of the timing of interventions. It includes a toolbox of methods to quantify, model and resolve trade-offs in all sorts of real-life decision environments. The cost/benefit appraisal of a design modification, is very different to the evaluation of optimal inspection intervals or asset replacement timing. The level of sophistication worth applying is dependent upon the criticality and complexity of the individual cases (see matrix of decision-making methods illustrated here).

#### Decision-making methods need to vary with decision type & criticality



### **Cost, benefit, risk & sustainability** evaluation with limited data

Scenarios, intervention appraisals and business-case justified results can be constructed by a relevant small team within just 2-3 hours. SALVO uses dynamic workshop-based process that simultaneously gathers the multiple viewpoints, helps to quantify the knowledge, and provides real-time evaluation/modelling to explore trade-offs, uncertainies and 'what if?' scenarios.

### Example storyboard, guiding the systematic evaluation of an asset replacement decision



# Optimal value-based ASSET Management Decisions

Asset Management decisions need to identify and deliver best possible total value. But value is perceived differently by different stakeholders - and there are conflicting priorities, trade-offs and compromises necessary. SALVO provides the navigational rigour, the quantification methods and the trade-off calculators to identify those optimal compromises and demonstrate *why* they represent best value.

The Shamrock Diagram (below) demonstrates how the outer ring of typical business concerns can be represented by combinations of the inner five quantification techniques, which can then be used to scale their significance, explore trade-offs and identify the strategies that deliver optimal life cycle value.



# salvo Innovations

SALVO has created innovative solutions to common decision-making problems and inconsistences. It introduces process disciplines, education, leading-edge technology and human psychology, all in an integrated, adaptable framework. This includes many areas of innovation and new insights into how decisions can be optimised, consistently and transparently.

# Generic process for segmenting asset problems and clarifying priorities

A methodical, universally applicable discipline for segmenting a portfolio of assets into appropriate groups that can and should be managed with a shared strategy. SALVO ensures that scope for improvement and timing-sensitivity are drivers for prioritising attention.

# **Stimulating lateral thinking** to identify potential solutions

In Step 3, SALVO has radically broadened the thinking about how problems can be solved and opportunities exploited. SALVO introduces 43 potential options to consider, covering over 50 variants and niche solutions. SALVO supports all contributors in considering potential solutions that come out of lateral thinking, while maintaining a businessfocused approach to the managing of assets.

### New technology, new maths & knowledge capture

Quantitative modelling and evaluation methods are a big strength and innovation area for SALVO with an innovative mix of eliciting tacit knowledge, quantification methods, leading edge reliability, risk and financial mathematics. Also real-time exploration of options, intervention timings, asset life cycle costs and risks to auto-search the optimal strategies.

### **Integrate-ability**

Many users of EAM systems struggle to establish good motivation and usage of assetrelated data. SALVO shows what and how this data should be used. This provides a direct link between the technical rationale for the activity and the business significance (benefits and alignment with organisational objectives). SALVO Processes help to deliver line-of-sight connectivity.



Maintenance interval Hour(s)	Planned maintenance costs £ / Hour	Operating costs £ / Hour	Unplanned (clock- resetting) maintenance £ / Hour	Asset performance losses £ / Hour	Affected asset renewals/ expenditures £ / Hour	Total Business Impact £ / Hour
6000	39.72	4.35	2.056	29.85	2.222	78.2
8000	20.42	6.364	2.138	39.73	3.015	71.66
10000	23.31	9.814	2.576	49.52	3.313	88.54
12000	16.87	15.74	3.498	59.13	3.333	98.56
14000	15.23	25.84	4.917	68.38	3.333	117.7
16000	8.403	42.78	6.775	77.08	3.333	138.4
18000	9.49	70.48	8.951	85	3.333	177.3
RTF	0	1228	20.29	110.2	3.333	1362





## Field trials of the SALVO Processes and tools have shown that they have almost universal application to different asset types, industrial sectors, data and organisational maturities.

These cases have revealed significant cost/risk/performance gains compared to existing practices, such as:

### **Obsolescence management** and optimal replacement timing

The deferral of the renewal of "obsolete" control systems for five to nine years which yielded €25 million of net benefits in one organisation.

The approach was applied to 5 manufacturing sites in 4 countries, and a further **£18 Million of attributed benefits**), a typical result is shown below.



#### Optimal timing for upgrade/replacement of control system

### Maintenance to extend asset life

#### London Underground evaluated the optimal painting regime for steel bridges and other steel structures.

In just a few hours, it was possible to build the business case for the optimal strategy, combining risk, failure-finding opportunities, the scope escalations of delayed intervention and the asset life expectancy effects. Showing the financial payback for appropriate intervention every 4 years, Figure 9 provides illustration of one of the quantified outputs.

Similarly, the track grinding strategies were evaluated. In just a few hours, the optimal strategy for different track curvatures, train tonnages etc. was developed, with indicative net benefits of **£2-4 million/year** (through a combination of rail life cycle effects, grinding equipment rental and other maintenance costs, access charges, re-work implications and changes in failure risks).

#### Optimal painting intervals for asset life cycle and risk impact



### **Optimal blend of monitoring,** maintenance and whole life strategies

### A wide range of cases have involved re-mixing the inspections, maintenance and asset life cycle.

The optimal cleaning strategy for screen filters in a UK sewage treatment works revealed **£700k/year** savings opportunities (below).



Sewage filters: maintenance interactions and optimal strategy





### Intangible benefits

#### The SALVO Process has introduced a number of important non-financial benefits:

**Stakeholder engagement.** At both the technical and managerial levels, the SALVO process has generated very positive reactions. Even untrained, first exposure team members have commented on the pragmatism, understandability and value of the methods:

Similarly, the effectiveness of the methods in transparent business case justification is demonstrated by the **levels of acceptance of results by senior managers** (both technical and financial). The leadership team of SASOL, for example, gained real value in having their capital investment and asset renewal decisions go through the SALVO Process.

**Monitoring and predicting non-financial outcomes.** The SALVO modelling also includes tracking of any chosen non-financial attributes, such as 'carbon footprint'. These can be assigned to any interventions, asset risks or other life cycle behaviours, and the results will include predicted total exposure to these factors.

### "Didn't matter that we didn't have much data"

"Didn't give the answer I expected" "Not surprised by the result, but couldn't prove it before" "Surprised why it was the right answer" "Can easily test what-if's and scenarios" "A project that is leading the way in decision support but where the

approach is transparent enough that it's easy to see what is going on"



# Find Out More

### A portfolio of SALVO case studies can be found at: www.twpl.com/resources/case-studies

# SALVO is a fully developed, highly adaptive framework for asset management decision-making. It includes the processes, governance, decision support tools and a multi-layered competency development programme.

The processes, training and software outputs from the SALVO Project are now managed by the Woodhouse Partnership Ltd. For over 25 years, the Woodhouse Partnership has been helping organisations to improve their skills, their business practices and joined-up, value-optimised asset management. Woodhouse offers support, training, and guidance, plus an unrivalled range of experience in transformation programmes in widely varying cultures and business environments.

We can train, facilitate, license, customise and implement SALVO within your organisation, and/or provide it as an analysis and optimization service with our expert facilitators. We also provide train-the-trainer services, and options for consultants to develop their own facilitator skills.

Call us now on: +44 (0) 1635 298800 (UK) (804) 732 8626 (North America) email us at: enquiries@twpl.com or visit us at:

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