

## The SALVO Process

The overall SALVO Process is a top-down targeting of the key problems and needs for attention, followed by a bottom-up evaluation, justification and coordination of what is worth doing, when, to address these issues. In particular, it addresses some of the most critical cost-, performance- and risk-based decisions in asset management; decisions such as *"How can I evaluate and justify optimal shutdown intervals and worksopes for continuously operating systems?"* or *"How can I evaluate and justify which jobs to do in unplanned shutdown opportunities?"*

These decisions frequently involve very uncertain assumptions about risk, performance impact and life cycle costs. Individual decisions also need to be considered in the context of competing priorities, budget or resource constraints and opportunities to bundle of work with other activities. It is also essential to develop a clear and credible business case in language that financial investors, safety managers, regulators and technical staff can all understand and accept.

### **Optimal bundling of activities for delivery (Shutdowns and Turnarounds optimisation) (Extract from chapter 5)**

The other form of the SALVO process Step 5 combinatorial studies is the seeking of delivery efficiencies through shared costs, downtime, resources or other overheads. This is particularly important in management of asset systems in continuous operation, where downtime is very costly. In such cases, there is a strong motivation to coordinate activities into intense planned shutdowns, 'turnarounds', 'outages' or 'possessions' (the names vary by industry sector). It is also commonly encountered in widely distributed asset networks, where remote site visits, with time and logistics costs, mean that opportunity alignment of activities can share such overheads.

The evaluation of optimal work bundling is therefore a case of quantifying the benefits obtainable by sharing costs, downtime or other overheads but also calculating the impact of performing the individual tasks at a sub-optimal timing – such as the additional risk created by waiting for the bundle opportunity, or a cost premium if the opportunity arises ahead of its personal optimum. Seeking the best compromise among multiple activities, each of which has a cost/risk/performance trade-off involved, is a very complex task. The SALVO research considered various technologies to assist in the 'combinatorial modelling' and found that conventional simulation methods could not cope with the volume and complexity – exploring just 10 activities over a 1-2 year planning horizon for their optimal timings and bundling (including alignments of tasks to every 2<sup>nd</sup> or 3<sup>rd</sup> occasion of others) represents 10<sup>27</sup> possible permutations. This requires a simulation method known as Genetic Algorithms to explore the vast range of possibilities: as the name suggests, it exploits a random mutation and selective 'survival' process to learn which activities work well in combination (alignment or at timing multiples of each other). Performed tens of thousands of times, the search engine can filter out the poor alignments (high Total Impact EAC) and propose a good combined total programme (lowest Total Impact EAC).

**Before** (each task performed at its 'personal' optimal timing)

Assembled (preferred)														
Task Name	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Pumps: Lifespan						1								
Control systems: Lifespan				3										
Electr system: test				1			1			1			1	
Schedule totals														
Planned Capex	0	0	0	2150	0	15000	150	0	0	150	0	0	150	0
Planned Opex	1347	1347	1347	1347	1346	1346	1033	1033	1033	1033	1033	1033	1033	1033
Planned overhead	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planned downtime impact	0	0	0	150000	0	0	0	0	0	0	0	0	0	0
Risk exposures	2343	2343	2343	2343	1658	0	0	0	0	0	0	0	0	1386
Asset Performance losses	99.47	99.47	99.47	99.47	99.47	99.47	0	0	0	0	0	0	0	0
Other amortised costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Total business impact</b>	<b>3789</b>	<b>3789</b>	<b>3789</b>	<b>155900</b>	<b>3101</b>	<b>68100</b>	<b>52570</b>	<b>2419</b>	<b>2419</b>	<b>52570</b>	<b>2419</b>	<b>2419</b>	<b>52570</b>	<b>2419</b>

Total programme EAC £31,930/year

**After** (re-optimized for shared costs, downtime and overheads)

Optimized Unconstrained Preferred timing														
Task Name	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Pumps: Lifespan								1						
Control systems: Lifespan														
Electr system: test		1						1					1	
Schedule totals														
Planned Capex	0	150	0	0	0	0	0	15150	0	0	0	0	0	150
Planned Opex	1406	1406	1406	1406	1406	1406	1406	1406	1010	1010	1010	1010	1010	1010
Planned overhead	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planned downtime impact	0	50000	0	0	0	0	0	0	0	0	0	0	0	50000
Risk exposures	2977	2977	3288	3288	3288	0	0	0	0	0	0	0	0	2883
Asset Performance losses	100.8	100.8	100.8	100.8	100.8	100.8	100.8	100.8	0	0	0	0	0	0
Other amortised costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Total business impact</b>	<b>4484</b>	<b>54630</b>	<b>4794</b>	<b>4794</b>	<b>4794</b>	<b>4794</b>	<b>4794</b>	<b>69940</b>	<b>3893</b>	<b>3893</b>	<b>3893</b>	<b>3893</b>	<b>3893</b>	<b>54040</b>

Total programme EAC £17,030/year

**Figure title – Comparing the costs (Total Impact EAC) of an optimised work bundling programme with the programme of individually optimised timings to determine the most cost effective strategy**

All the methods described in the book are field-proven, practical ways to target the right problems in the first place, to identify appropriate interventions and risk control options, and to evaluate the cost/benefits of these options, even when available hard data is limited. Uniquely, SALVO brings together the human factors of motivation, cross-disciplinary collaboration and communication skills, with the technical and financial disciplines necessary to develop a robust business case for optimal asset management strategies.

Buy the book *'Asset management decision-making: The SALVO Process'* written by John Woodhouse online at [www.twpl.com](http://www.twpl.com)