As engineers we have many ideas on how to do things differently and better. However, too often our ideas are thwarted by financial and commercial departments, sometimes rightly, sometimes wrongly.

Cogitare is a young and dynamic niche consultancy that specialises in systems optimisation and asset management. We have developed a methodology for optimising complex engineering systems, called the Systems Optimisation Process (SOP).

The SOP provides a metric to sell and justify change and ideas so that they can be implemented and also restrains the engineering imagination where it is not (yet) viable. It marries systems engineering with economics, and combines performance, asset management, cost and risk modelling to determine the most profitable investment decision for either the public or private sector.

Engineering provides the options and determines performance. Economics determines the relative value of each option and which is best for the business.

SOP applied to London Underground

We have applied the SOP to help London Underground reduce its whole-life system costs by more than £0.5 billion and energy consumption by more than 20 per cent.

Typically, 80 per cent of life-cycle costs are determined at the concept design stage, demonstrating the importance of getting it right early on. We have used the SOP to explore how plans for new trains, signalling, operating solutions and power infrastructure could best improve performance and revenue, and reduce energy consumption and costs. We have managed to cut energy usage for the Victoria, District and Metropolitan line upgrades by 20 per cent and bring overall system costs down by £0.4 billion, while reducing Capital costs by £250 million. We are currently applying the SOP to study similar improvements for all London Underground line upgrades and help value-manage the tendering process for major projects and verify that tender performance is delivered.

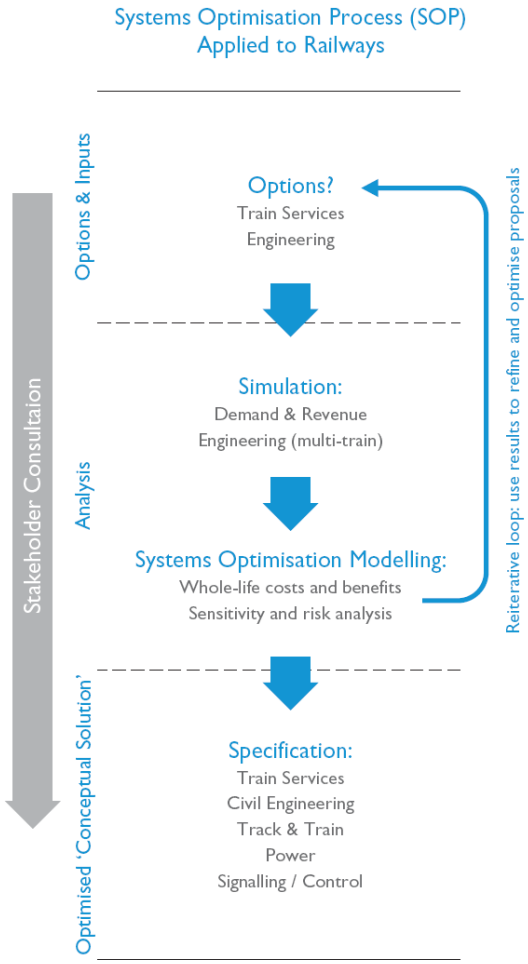
How does it work?

We use a complete system approach, looking at the bigger picture and working out what will benefit the system as a whole. The evaluation can be at any level of complexity depending on the data, simulators and modelling tools available.

Systems Optimisation Phases:

- *Phase 1: Define options.* This phase involves significant stakeholder consultation to ensure the feasible system options are captured. The challenge is to identify the system options when most of the experts are knowledgeable about individual elements of the system and not the system as a whole.
- *Phase 2: Analysis.* This starts with a mix of ***Operational and Engineering Simulation*** studies with commercial or bespoke simulation packages to derive a set of simulation reference scenarios to represent the options. Simulation can be data hungry and time consuming. The secret is to simulate a limited number of scenarios from which the results for all options can be interpolated/extrapolated. The reference case simulation scenarios and additional operational inputs and parameters feed into the ***Systems Optimisation Modelling*** which calculates the whole-life costs and benefits for each option and outputs cashflows, NPVs (Net Present Values) and business case ratios.
  - The best option optimises the trade-off between the whole-life costs, and revenues/benefits.
  - The systems optimisation modelling automatically performs sensitivity analysis on the modelling and simulation inputs and determines the robustness of the answer and the associated risk.
  - The systems optimisation modelling automatically optimises combinations of key inputs. For a railway this could be operational system parameters such as service levels and operating speeds to answer the question: At what point is the service no longer worth improving due to the negative impacts on costs and society such as increased energy consumption?
- *Phase 3: Specification.* The simulation and systems optimisation modelling produces an optimised 'Conceptual Solution' for the whole system and/or assets within the system. For a rail infrastructure project this would typically comprise a specification for the cost (the engineering – trains, signalling and control etc.) and the benefits (the services and speeds at which to operate).

Often in the UK expected train service levels are fixed and the optimisation process is used to find the lowest whole-life cost solution to provide a specified level of performance.



How can SOP be applied?

The SOP is relevant to many industries – from transport networks to health and utilities services, facilities management and building design. Typical applications include:

- Designing new infrastructure, major upgrades and extensions.
- Value-management of the supply chain – development of tenders, tender evaluation, validation of performance delivered, development of performance-based contracts.
- Managing existing assets - finding the most efficient combination of maintenance, refurbishment and replacement.
- Optimising business processes and government services.
- Design and implementation of decision-making tools including models and IT data solutions.
- Facilitating public–private partnerships.
- Devising and implementing incentive structures.
- Risk assessment and cost-benefit analysis.
- Change management, partnership working and conflict resolution.

www.cogitare.biz
+ 44 20 7183 2521
info@cogitare.biz