

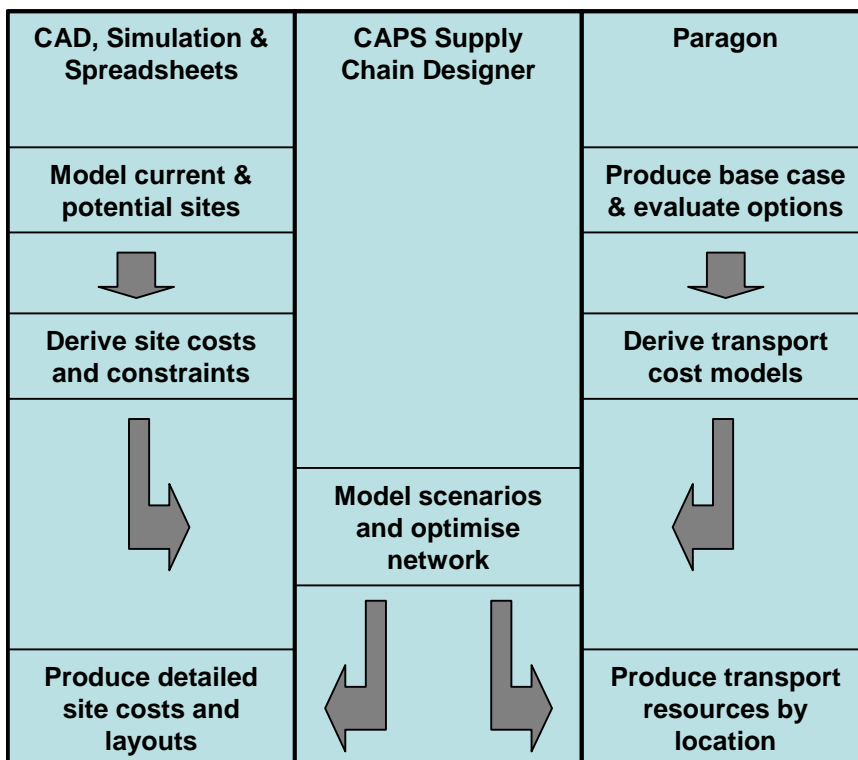
LOGISTICS MODELLING – a new integrated approach can get the best out of strategic and tactical modelling tools.

By Phil Gibbs, Logistech

When approaching a logistics project there is often a dilemma about which type of modelling tool to use. A network planning tool is excellent at minimising the overall costs in a complex supply chain, possibly making decisions on opening and closing sites taking into account constraints such as production and storage capacities. However, how do you arrive at the costs and how do you take into account operating constraints such as delivery time windows and shift patterns?

If you are carrying out a project where you are evaluating specific operating methods, you may want to use a more detailed tool such as a CAD system, warehouse simulation model or a routing and scheduling package. These will help you to establish, for example, the space and labour requirements for different methods of operation, or the impact on vehicle numbers and the distance travelled if you open time windows and introduce double shifting, but they only address a small part of the supply chain at a time. When you use these tactical tools there is a danger that you will over analyse one part of the supply chain and miss the big picture.

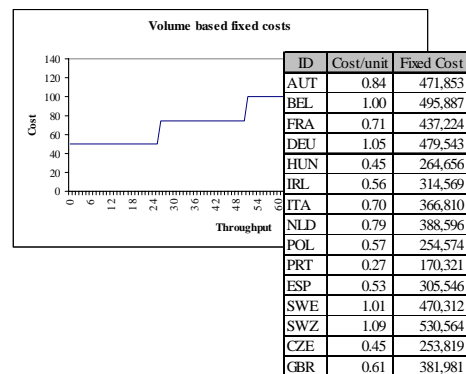
At Logistech we have resolved this dilemma by using the different tools in a coordinated and integrated manner. Tactical and operational tools are used to derive the cost tables to drive a network model and to resource and verify the results. The network model is used to develop the strategic solution, examining the whole logistics network in a single optimisation. The overall process is shown in the chart below.



Developing cost models

For site costs, it is often necessary not only to establish the costs in the current operations at different levels of throughput, but to establish the costs of new sites to see whether the optimiser will prefer them. CAD drawings can be compiled and resource spreadsheets or simulation models used to quantify the effect of different operational methods and different levels of throughput. In a simple network modelling tool, site costs will be expressed as a fixed and variable cost, but what if the system decides to double or treble the throughput at a site – is that fixed cost still valid? Also, is the handling cost or space cost the same at all sites being considered? The answer is almost certainly, no.

With a more sophisticated tool like the CAPS Supply Chain Designer, site costs can apply to a site, or a product at a site, or on a production line at a site. Costs can be fixed or variable and may be related to a country or region as well as a product. Costs can be related to volume: fixed costs can have stepped increases to reflect the additional management that is needed for a larger more complex operation; variable costs can have stepped reductions to reflect economies of scale of production. We may also decide to co-locate sites – we could have automated, mechanised and manual versions of a site at a single location to see which one the system decided to open. But however sophisticated the tool, we still have to work out the underlying costs and establish the regional variations.

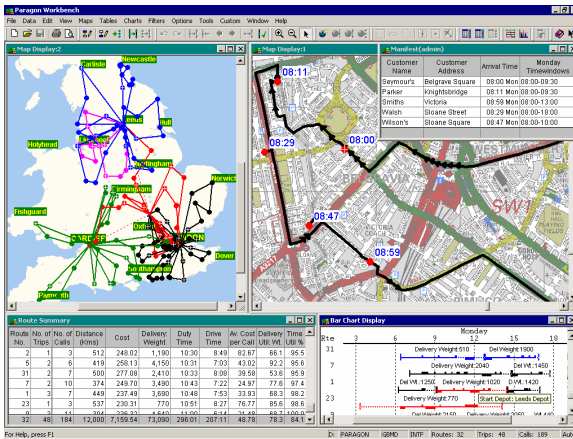


Modelling transport costs

Cost/drop	Drop size					
Distance	1	2	3	4	5	6
25	18.43	26.83	34.94	45.27	55.60	65.92
50	20.00	27.55	39.35	46.72	57.41	68.10
75	21.14	32.22	40.44	52.59	59.23	70.28
100	21.50	34.62	41.53	54.04	66.56	78.40
125	21.86	35.35	49.49	55.50	68.38	81.26
150	22.23	36.07	52.13	67.24	70.20	83.44
175	22.59	36.80	53.22	69.63	86.05	102.46
200	22.95	39.77	54.31	71.09	87.86	104.64

Transport costs are modelled on the lanes that connect sites together. Lane costs can be fixed or variable and can be set up to represent own vehicle costs, full load and part load rates tables, and modes such as parcels, air and sea freight. Tables can have rates for specified origins and destinations or have distance bands.

A series of rates can be presented and the system will select the lowest cost. When carrying out pan European projects, we can vary the rates according to the country of origin. Simple cost formulae can also be used.

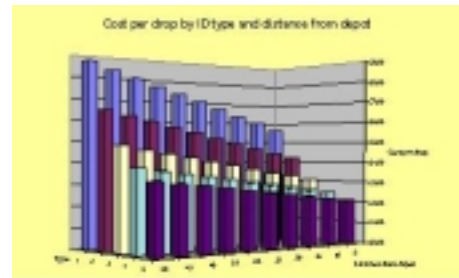


When a dedicated fleet of vehicles is used, either owned or contracted, deriving the cost tables is more difficult. We use the Paragon routing and scheduling system for this stage of the work. When we build a base case, we take a sample week and use settings such as unloading rates, vehicle capacities and running speeds that are a reflection of the current operation. The base case will produce a fleet size, operating statistics and overall cost that can be validated against the existing operation and management accounts. A

number of runs may have to be undertaken, with discrepancies investigated, to produce a reasonable match. We will then generate spreadsheet reports on customer locations, drop sizes, stem and inter-drop speeds and distances. These statistics may be summarised by postal area or geographic characteristics, depending on the project.

Cost apportionment model

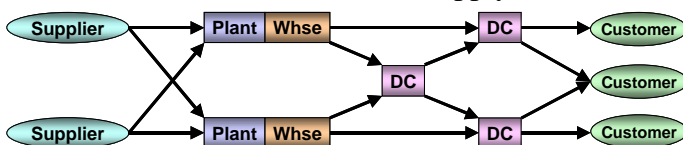
We then use our spreadsheet costing model to cost a delivery at time, making the assumption that a vehicle carries deliveries that all have the same characteristics as the one being costed. General inputs include the vehicle cost per day and mile and the vehicle capacity and unloading rate. As each delivery is costed the model considers the drop size, stem and inter-drop speed and distance that apply to that particular delivery.



It tests whether the vehicle will run out of driving time, shift time or capacity, then calculates the cost per drop for the most constrained. An additional test is carried out to evaluate whether the cost would be lower if the vehicle did two trips per day. With mixed fleets, multi day runs and double manned vehicles, a delivery can be costed several times and the lowest cost selected. When this analysis has been completed, a drop size distance banded cost table can be produced for use in CAPS.

Modelling scenarios

When we have developed the cost models we can build the network model and optimise the sites and flows. Sites can be defined as demanding, supplying or flow through and are connected with lanes, which represent the possible transport movements. There is no limit to the tiers in the model. Supply and demand can be defined at product level and



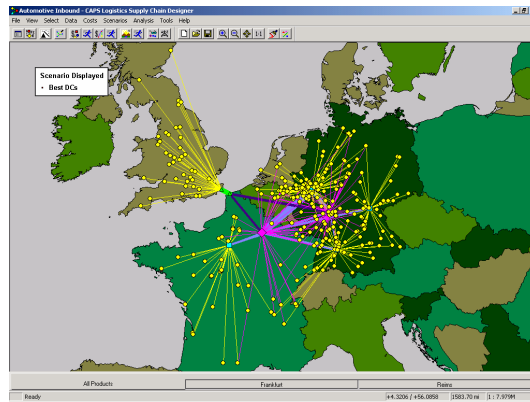
where production is being modelled, bills of materials can be

used to convert products into other products.

Although each project is different, the following steps are typical:

- Produce a base case, where the flows are constrained to replicate the existing operation. This validates the data and assumptions and provides the basis for comparing scenarios.
- Produce an optimised base case, keeping the existing facilities but optimising the product flows.
- Run a series of scenarios, allowing the solver to choose from a set of unconstrained candidate sites.
- Run scenarios to establish the additional cost of using existing sites.

An integrated scenario manager controls the modelling process, keeping a record of the data changes and constraints used in each scenario. We may be locking certain sites open or closed and enforcing or overriding capacity limits on sites. We may also be constraining the solution, by forcing the solver to open a certain number of sites, or not loading all transport modes. When the scenario is set up, the problem is sent to CPLEX, a proprietary mixed integer linear programming solver which is embedded within the SCD. When the solver has reached the optimum solution, product flows are displayed graphically for ease of understanding. Detailed cost and flow reports are also available.



Refining and resourcing the solution

Although we will have been careful to ensure that our site and transport cost models reflect reality, clients will often want to carry out a more detailed analysis before committing to a major strategic change. Not all the following areas will be tested, only those that are critical to the success of the project. We may want to establish:

- The rental values or labour rates for the sites that have been used, as we may have assumed the same values for all sites within a region.
- The internal and external site layouts, possibly using a CAD package, for the activity levels given by CAPS.
- The direct and indirect manning levels, using spreadsheet resource models or even a simulation package.
- The vehicle fleet required at each location, by using a routing and scheduling package such as Paragon.

When this phase has been completed, we will have used a combination of strategic and tactical tools to ensure that we have examined the big picture, but not ignored the operational detail.

Phil Gibbs is the Managing Director of Logistech, a supply chain consulting company that specialises in computer modelling and the analysis of supply chain economics. Services include: deciding on the number and locations of production and distribution facilities, determining how and where products should be sourced, manufactured and stored, establishing vehicle requirements, transport mode and method.