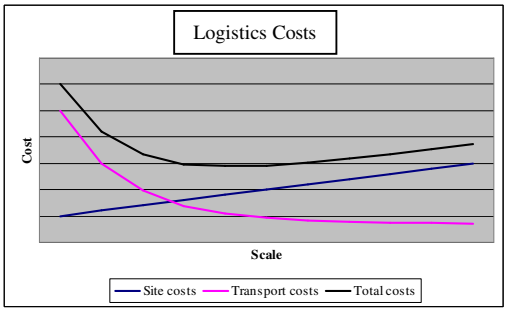
Logistics network optimisation

If you operate a complex logistics network you may face issues such as:

- What is the best number and locations of production or distribution sites?
- Which products should I make/assemble/store/cross dock at which locations?
- Which vendors such I use?
- Which customers should be served from which sites?
- What is the cost of serving customers?

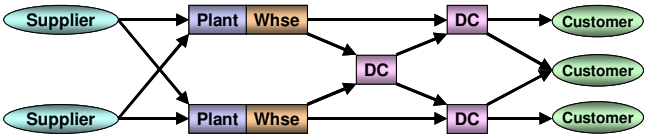
The costs in a supply chain are all interlinked. As the number of sites increases, the site costs will tend to increase, but transport costs will tend to decrease. Ensuring that these trade offs are quantified accurately is key to successful modelling. It is also important to represent the constraints in a network, such as the capacities of sites and the maximum transit time to customers.



We use the Infor Network Designer (formerly known as CAPS) to carry out this type of project. It allows you to define complex networks using realistic costs and constraints, and then optimises the flows, opening and closing sites as necessary. As the system is relatively easy to set up, it can be used for small projects as well as large ones.

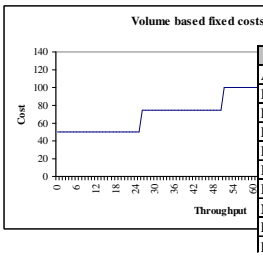
Defining the network

Sites are 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, allowing the flow on sites and lanes to be costed and controlled accurately. Where production is being modelled, bills of materials can be used to convert products into other products.



Site costs

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. They can



ID	Cost/unit	Fixed Cost
AUT	0.84	471,853
BEL	1.00	495,887
FRA	0.71	437,224
DEU	1.05	479,543
HUN	0.45	264,656
IRL	0.56	314,569
ITA	0.70	366,810
NLD	0.79	388,596
POL	0.57	254,574
PRT	0.27	170,321

even be related to volume, with step changes to reflect capital investment and economies of scale.

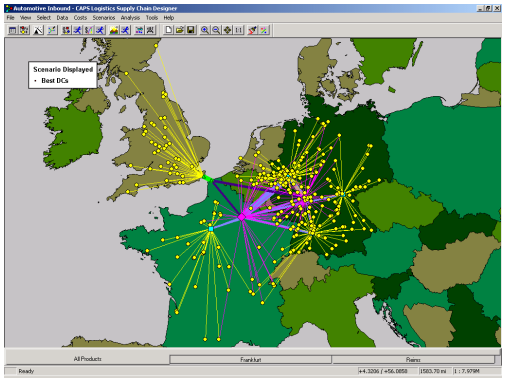
Lane costs

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

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 Network Designer will select the lowest cost. When carrying out pan European projects, the rates can be varied according to the country of origin. Simple cost formulae can also be used.

Optimisation

An integrated scenario manager controls the modelling process, keeping a record of the data changes and constraints used in each scenario. We can lock certain sites open or closed and enforce or override capacity limits on sites. We can also constrain 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 MILP solver which is embedded within Network Designer. When the solver has reached the optimum solution, the product flows are displayed graphically for ease of understanding. Detailed cost and flow reports are also available.



Typical process

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

- Collect data on volumes, costs and constraints.
- 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.

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