

i-cost

a new approach to

Interactive Supply Chain Cost Modelling

From

The **LOGISTICS**
Business

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INTRODUCTION

i-cost is an interactive, supply chain cost modelling tool which uses a mixture of pareto manipulation and activity based costing techniques to predict supply chain costs now and in the future. The interactive nature of *i-cost* allows repeated what-if analysis to be undertaken both to model the impact of shorter term tactical decisions and longer term strategic ones.

Typical applications of *i-cost* include determining the number of distribution centres that might be required as the business grows, testing the cost sensitivity of different locations, assessing the impact of operating a DC in different ways or testing the ability of a distribution network to cope under different business conditions.

PROBLEM

Businesses are becoming increasingly complex. Competitive pressures drive service levels up and costs down. Leading companies embrace this and force the pace. Lagging companies at best react and at worst are overcome by it.

Being a leader is not easy. Increasing business complexity makes rational, informed decisions harder to make, usually because there is a lack of information on which to make them. The problem is further compounded by factors such as:-

- ↳ The pace of change reducing the time available for making decisions;
- ↳ Increasing uncertainty making it more important that sensitivities are tested, particularly in those businesses that are particularly risk averse;
- ↳ range development taking on increasing importance, particularly within retail, but also in other businesses, is again requiring decision making to be more detailed.

All of these issues have led to the increasing use of decision support systems.

Supply Chain Modelling

The above are generalities that apply to most aspects of business strategy and none more so than in the field of supply chain strategy. From the work done by THE LOGISTICS BUSINESS in developing supply chain strategies we have seen the need for new kinds of decision support models.

Such models help with a range of common decisions but deal with these in a different way. Most important of all is that models must allow different scenarios to be investigated and their impact on the above requirements understood.

Other requirements are that the model should :-

- ↳ Relate to the business;
- ↳ Focus on core issues;
- ↳ Be pragmatic in operation;
- ↳ Be quick to run.

Strategic issues :-

- ↳ Number of DC's
- ↳ Location and size;
- ↳ Regional or central ;
- ↳ Transport impacts;
- ↳ Ranges treatment;
- ↳ Impact of automation ;
- ↳ Investment.

Tactical issues :-

- ↳ Budget development;
- ↳ Cost impact of operational decisions;

availability, planning and use restrictions, etc. The choices are usually very limited.

- ↳ Most models are generic in nature and cannot be focused on the unique issues that each business faces.
- ↳ Many models, including some so called "cost to serve" models, are not really models at all but processes which are very time consuming to repeat for different scenarios.
- ↳ Many models require as a starting point a set of business data that relates to some future projected scenario. Therefore modelling different scenarios is a two step process and the first one, to extrapolate existing data, is often the hardest.
- ↳ Some models use inappropriate levels of detail in the build up of costs.
- ↳ Models are often built using spreadsheets. Time and again these develop into unwieldy monsters into which it is almost impossible to load new data sets. Indeed the accuracy of these models often becomes questionable as it becomes more complex and harder to modify as the business changes. Often they end up being used in ways that were not intended.

WHERE DO WE GO FROM HERE ?

The problem is certainly not a new one and there are tools already available which are aimed at addressing some of these issues. They all take different approaches and have different emphases :-

- ↳ Some are really network design tools designed to come up with a total solution from scratch and yet few business look to build a complete network from scratch. The majority want to know how best to change an existing infrastructure.
- ↳ Some place great emphasis on geographical mapping techniques to identify ideal locations for new facilities and yet it is rare for there ever to be property or land available in ideal locations. Even when there are sites available other factors may need to be taken into account such as labour

IDEA FOR A NEW WAY

Given the limitations of existing modelling techniques THE LOGISTICS BUSINESS looked for a new way to model supply chains which offers new and exciting possibilities. The result was *i-cost*, the interactive supply chain cost modelling system. So what modelling techniques does *i-cost* use and how does it work ? In the following sections these techniques are described and discussed.

Paretos

Good supply chain design makes considerable use of pareto analysis and this is used extensively in *i-cost* . It is the means by which product ranges can be categorised in the most efficient way.

Some examples of how this might work are :-

- ↳ Regional distribution may be selected for high cube movement lines and central distribution for low cube;
- ↳ High cube movement suppliers are cross docked and low cube are stocked;
- ↳ Fast movers have X days of stock cover and slow movers have Y days.

Investigating paretos for the current business is relatively straight forward. However, as the business grows and develops these paretos change shape and predicting the new shape is much more difficult.

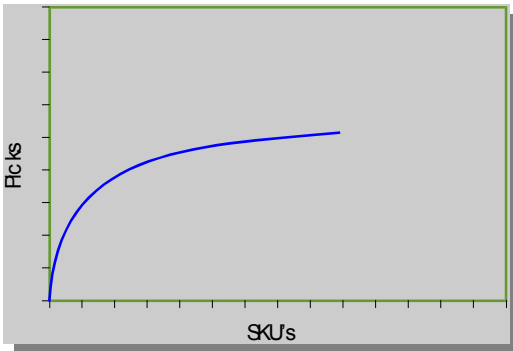


Fig. 1

The example, Figure 1, is of a pareto curve for a typical business. It shows the relationship between SKU's and cumulative picks.

A typical source of data for this would be order line details from the company's history files.

Such a pareto curve is often used in the design of an optimised picking operation so that, for example, fast movers are picked in one way, medium movers in another and slow movers in

The Pareto principle, sometimes called the 80/20 rule, was named by Dr. Juran, after the Italian economist Vilfredo Pareto, who noted that 80% of the country's wealth was owned by 20% of the population.

yet another. Such a segmentation might look like the example in Figure 2.

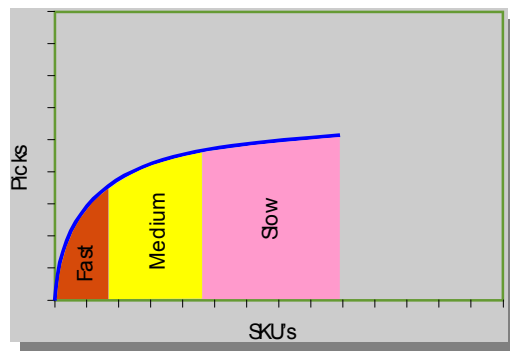


Fig. 2

If the business changes in the future we need to understand what effect these changes are likely to have on the shape of the pareto and hence on picking activities.

If, for example, it is expected that sales will grow but that the range will stay broadly the same then the pareto could look like Figure 3.

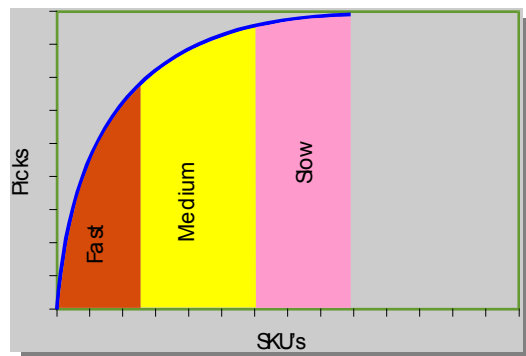


Fig. 3

In this example we have assumed that the rules defining whether an item is a fast mover or not (usually based on cube movement) are the same. This means that the fast and medium categories get bigger and the slow smaller.

Another scenario is that the business is expecting the range to grow but with little sales growth.

Because the pareto in Figure 4 has been stretched sideways the fast mover group has become smaller but the medium and slow moving groups much bigger.

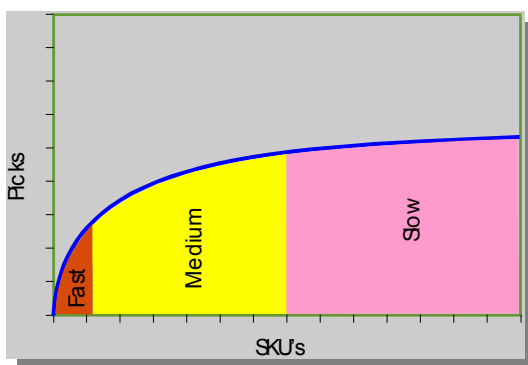


Fig. 4

Another situation is where a company has delisted many of its slow moving lines and grown the business with more medium movers. The pareto in Figure 5 has been exaggerated to illustrate a point. If it were realistic then it shows that there are now no longer any really slow movers.

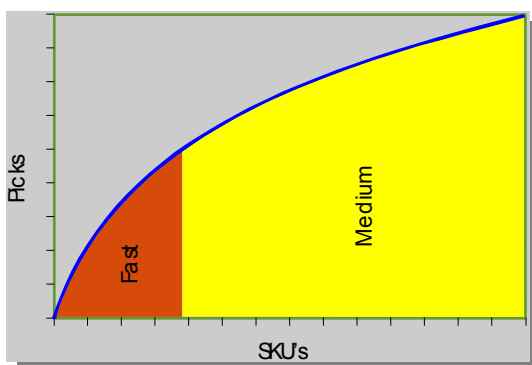


Fig. 5

In Figure 6 the company has managed to boost sales of its fastest moving lines.

This has indicated the return to three groupings with smaller fast and medium groups. The penalty for this type of change is that there is now a long tail of slow moving lines.

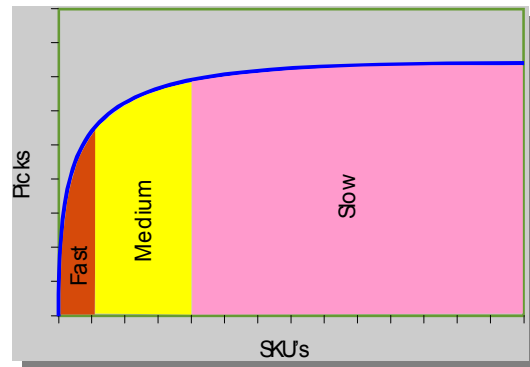


Fig. 6

Few businesses are likely to see changes as extreme as these but the purpose of the examples is to illustrate that the pareto curve which describes today's business is not necessarily a guide to what it will look like in the future.

At the same time the examples illustrate the impact different changes have on segmentation of the sku range and on the volumes being handled in each segment. By manipulating paretos based on forecasts and sensitivities, businesses can consider the effects these will have.

i-cost incorporates a method for manipulating paretos in line with forecast changes in the business and to allow this to be an interactive processes enabling sensitivities to be tested.

Activity Based Costing

Activity based costing

The idea of applying costs to activities rather than just labour goes back to the 1950's but it was not until the 1970's that terminology linking activity and cost was first used.

It was Kaplan and Cooper in 1988 at Harvard Business School who finally coined the term ABC.

In planning, improving or operating supply chains we need to understand the impact that various decisions have on operating costs. We can do this using Activity Based Costing (ABC).

This is the technique that enables us to model the actual costs of each activity performed in an organisation.

Conventional accounting techniques grew out of the industrial age when most costs related to labour and were, largely, proportional to output.

As such, costs tended to be allocated to, and controlled at, department level. This was fine when products and services were relatively simple and the role of departments clearly distinguishable from each other.

In the modern world with increasingly complex businesses and services being offered, labour is no longer the dominant cost and departmental activities are not so clearly delineated.

Indeed the philosophy of the supply chain encourages us to think and act cross-functionally. Hence traditional accounting techniques can no longer tell us what the things we do cost.

This is where Activity Based Costing comes in. Activity Based Costing requires costs to be consolidated into activity categories rather than departments or cost centres. Each category will include all of the costs that are influenced or driven by the same factor or cost driver and will include overhead and operating costs irrespective of the department they are associated with. Costs can then be allocated to products or services using the cost drivers.

The part of *i-cost* that is used to calculate costs is based on Activity Based Costing techniques. By consolidating costs against key cost drivers it is possible to build up cost profiles against different scenarios or forecasts.

In order to work with *i-cost* we need to go a step beyond conventional Activity Based Costing. The problem is that not all costs are linear, i.e. if sales double then costs will not necessarily double.

Hence *i-cost* needs to know how costs should be applied.

This may be in the form of a combination of fixed and variable costs or it may be that the costs can only be described by means of the curve of a graph.

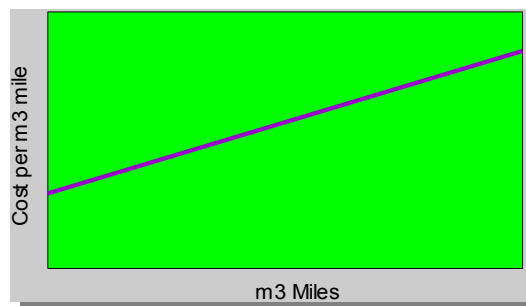


Fig. 7

Figure 7 illustrates how the cost structure for a transport operation comprises the standing costs for the vehicles, i.e. they still cost you something even if they are not moving, plus a variable cost based on how far they travel.

This latter cost will pick up all the labour costs, fuel, maintenance and possibly an element of mileage related depreciation. In this example the key cost driver is m³ miles, i.e. the volume of product moved multiplied by the distance that it is moved over. Of course this cost will be sensitive to vehicle fill and so vehicle fill would need to be one of the parameters that **i-cost** would model for sensitivity analysis.

i-cost uses Activity Based Costing techniques to identify cost drivers and uses these to build operating costs based on the activity levels being modelled. The cost impact of different scenarios can then be compared.

FACTORS TO CONSIDER

Central or regional distribution

The choice between central or regional distribution is often not easy to make. At its simplest, having a central facility to support a number of regional ones is a trade off between the increased transport costs and the reduced safety stock required, as well as possibly some economies of scale. In practice other factors must be taken into account. It may be that range development is altering the product characteristics causing difficulties for RDC's whose operation has been optimised around a different product mix.

The merits of one network compared with another can be difficult to assess as so many factors come into play :-

- Transport costs are more likely to increase than decrease in the future, possibly making centralisation less attractive.

- Good stock management may reduce the potential stock saving of centralisation;

- There needs to be a critical mass of SKU's for which centralisation is appropriate and against which the acquisition of centralised facilities begins to make sense. Once this has been achieved the marginal cost of adding more lines can significantly improve the justification. One approach is to plot the cost of distributing a sku centrally relative to the cost to do it regionally.

The graph in Figure 8 is typical and shows how some sku's are clearly cheaper to distribute regionally (probably due to high cube movement) whereas others are clearly cheaper to distribute centrally.

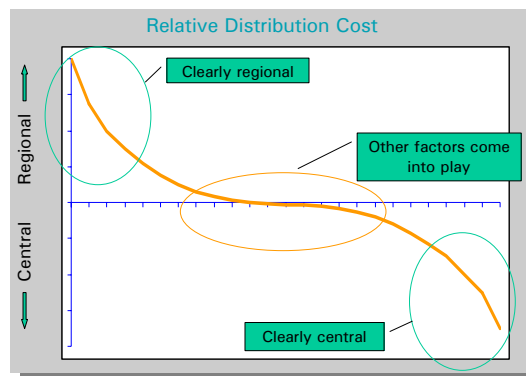


Fig. 8

Those in the middle could go either way but it has to be borne in mind that whilst the absolute cost comparison may give one picture, a marginal cost comparison could be quite different and when other factors are taken into account different again. In considering the case for centralised vs regional distribution then the model must take a total cost approach rather than a marginal cost one. This is very time consuming with most modelling techniques.

Transport considerations

Transport is a key factor in determining the regional vs central debate. As a result

distribution strategies can be quite sensitive to transport costs and future transport costs are hard to predict.

Clearly these changes cannot be predicted with any certainty and so sensitivity analysis is crucial.

Issues affecting transport

- ↪ Increase in use of tolls;
- ↪ Cost impact of increased road congestion;
- ↪ Fuel price increases;
- ↪ Environmental issues or legislation.

Some of the existing models on the market make great play of the geographical element of the model to accurately calculate transport distances and costs. However it has been shown that much simpler techniques such as taking the direct point to point distances and adding, say, 20% is almost as accurate and certainly within the tolerance required for this type of strategic modelling. Indeed some supply chains have relatively little sensitivity to precise location, for example, mail order businesses. And for other businesses the choice of location is very limited.

i-cost takes into account travel distances but uses an appropriate level of detail to match the model requirements.

Site availability

Choosing the location for a new facility used to be difficult due to the range of available options. Today it is, in a sense, getting much easier as the choice is so much reduced. In most cases an experienced person will be capable of estimating to within 50 miles or so where a DC

should be located. It then becomes a case of seeing what is available within that area.

We can then calculate travel distances from each of the potential sites to the locations they would be servicing and use this to estimate the costs for the different locations.

Staff availability

For some time companies have been finding it difficult to recruit and retain staff in some parts of the country and the problem is spreading. For this and other reasons, businesses are being driven to consider the use of automation techniques to reduce dependence on labour.

It is important therefore that the model takes account of this issue. It needs to do this through our ability to :-

- ↪ Apply different labour rates at different sites.
- ↪ Model the impact of automation to reduce dependency on labour

This latter point can mainly be covered by modelling the effect of using automation on the cost base. For example, an automated solution will carry a much higher depreciation charge than a conventional solution and a different operating cost. Labour, supervision, and possibly energy costs will be lower, whereas maintenance costs will almost certainly be higher. All of these must be covered in the model if it is to allow all scenarios to be compared.

i-cost highlights the impact of changing business metrics, e.g. if growth is slower than expected then the depreciation charge for an automated warehouse may make it more expensive to operate than a manual one. The business may still go ahead with an automated solution but will be aware of the sensitivities of the investment.

HOW *i-cost* WORKS

Data Requirements

Data requirements fall into three categories – activity data and cost data.

Activity Data

- ↳ *Throughput – Annual for longer term strategic planning, shorter for tactical planning;*
- ↳ *Master data – allows conversion of the throughput data into other units such as volume;*
- ↳ *Stock – This is for sense checking the stock predicted by the model;*
- ↳ *Transport – miles travelled and volume carried.*

Cost Data

- ↳ *Building costs – rent, rates, heat, light. Power;*
- ↳ *Staff costs – management, supervision, direct to include salaries, and all other employment costs;*
- ↳ *Equipment costs separated out by type – depreciation, maintenance.*

Infrastructure Data

- ↳ *Size and location of each part of the distribution network;*
- ↳ *Capacity of each site;*
- ↳ *Vehicle fleet size;*
- ↳ *Other equipment sizes and types, e.g. fork trucks, pallets, etc.*

Modelling Parameters

The parameters to be used by *i-cost* will depend on each customer's particular situation. It is expected that they would include :-

Activity Parameters

- ↳ *Fast and slow movers – parameters will be used to define what is a fast, medium or slow mover;*
- ↳ *Fill rates – for totes, pallets, vehicles;*
- ↳ *Stock turn – can be split between imported product and home supplied.*

Business Parameters

These parameters can apply to the business as a whole or to categories of product.

- ↳ *Sales growth;*
- ↳ *Range development;*
- ↳ *Order sizes;*
- ↳ *Pick frequency.*

Cost Drivers

Developing the cost drivers has already been discussed. *i-cost* allows the sensitivity of the values selected to be tested. Typical drivers include :-

- ↳ *cost per cubic metre mile;*
- ↳ *cost per pick;*
- ↳ *cost per cubic metre moved;*
- ↳ *cost per sku;*
- ↳ *cost per cubic metre stored.*

i-cost Process Map

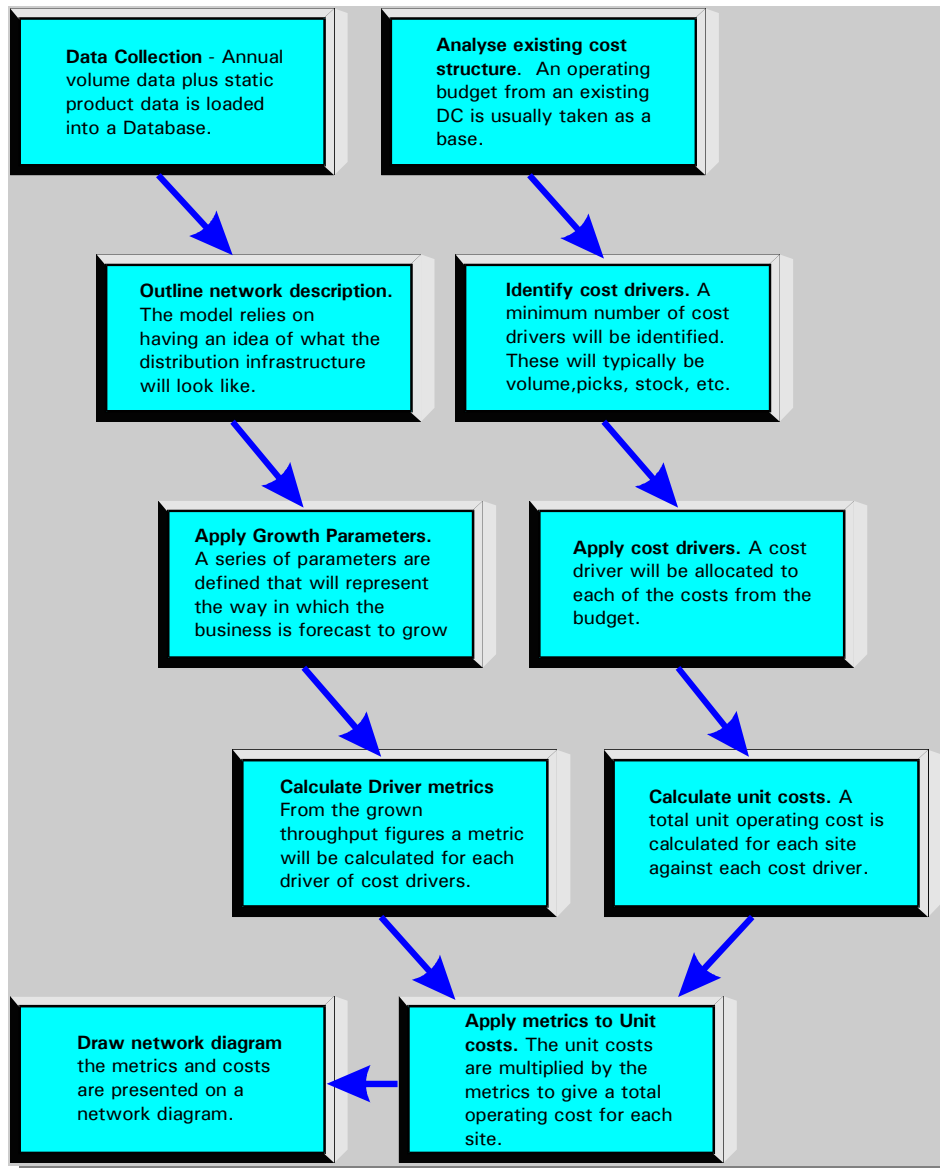


Fig. 9

The model has a number of processing stages as shown in Figure 9.

As can be seen a key part of the model development is the analysis of cost drivers. Cost drivers are the lowest common denominator of activities which drive all costs and every cost will have a driver.

For example, in some businesses stock will be the key driver of the amount of space required in a DC and so all space related costs can be allocated to the level of stock held. In a DC which is primarily a picking centre and carries minimal stock then space may be related to range.

Model Output

The screen dump in Figure 10 is a simple example of the type of output that *i-cost* can be configured to produce. It shows the main results screen where the distribution costs based on the data entered and parameters set are presented.

This screen illustrates why a generic solution is so limited as the model has to be tailored to the dynamics of the business.

In some situations it will be necessary to provide choices in the way that the output is presented. One option is to model, say, the existing depot infrastructure and present the capacity each

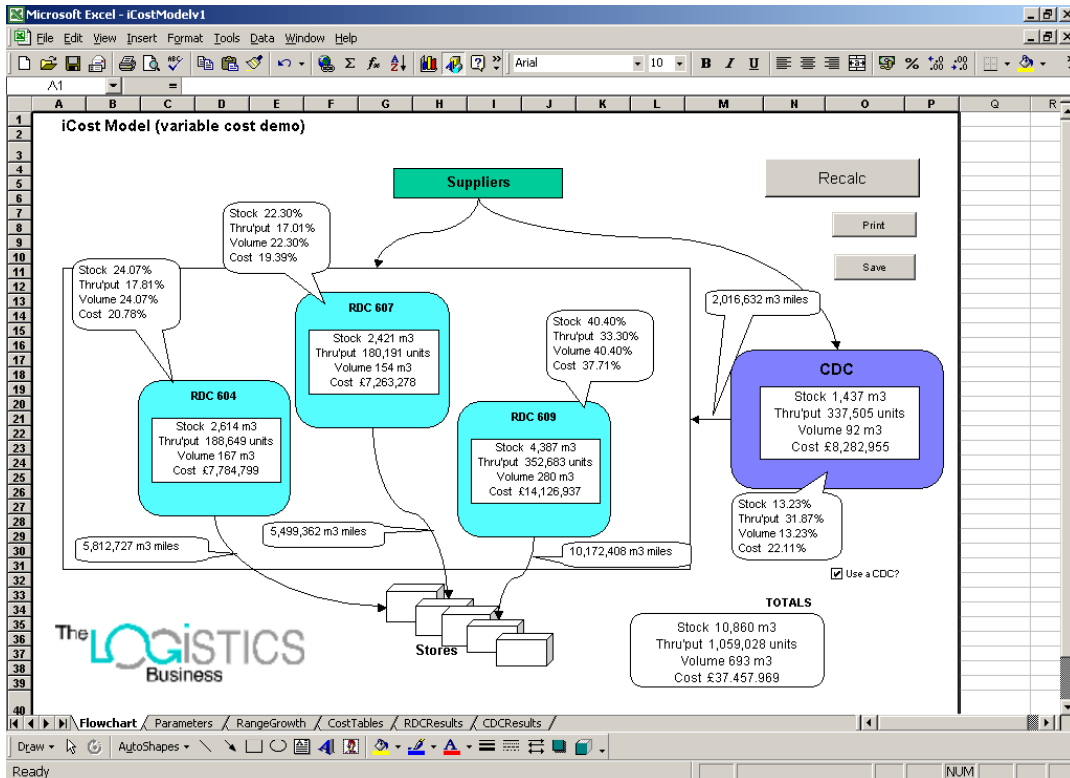


Fig. 10

It shows a network of three Regional Distribution Centres and one Central Distribution Centre. Key activity metrics for each centre are displayed together with the forecast operating cost for each. These metrics and costs are also totalled separately. A further feature of this model is that the Central facility can be added and removed by ticking a box and re-running the model. This illustrates the likely total distribution costs with and without the Central facility.

If required further output can be produced in report format.

element of the network (e.g. regional distribution centre) would have to cope with. This may be way in excess of the actual capacity but will illustrate that either the existing capacity will have to be increased or more facilities added. Costs for these options can be calculated, added into the model, and the model re-run.

Another way is to run the model with constrained capacity. In this case the model will only allow as much volume through each element of the network as it is specified to cope with. Any volume that cannot be handled will be put to an overflow location. After running

the model, if the overflow has been used, the modeller can decide how this is to be dealt with.

In order to work out the transport costs the model requires data on the distances between delivery points and Distribution Centres. There are a number of ways of doing this depending on the sensitivity of the model to the accuracy of the calculation. Very accurate techniques using vector based maps can be used but these will slow the model down and as our emphasis is on being able to do repeat runs for sensitivity analysis we want the model to run as quickly as possible. A simpler solution is to use Ordnance Survey grid references which can be converted to point to point distances and then add a percentage (techniques to prevent delivery points in South Wales, say, being linked to Distribution Centres in Somerset can be added).

Operational Use

Much of this document has discussed the use of *i-cost* as a tool for use in longer term development planning. However, it also has powerful role to play in short term operational planning. Provided the cost data is adequately specified it should be possible, and highly desirable, to use *i-cost* for shorter term tactical planning. There are a number of ways in which it might be useful :-

- ↳ A retailer with a mix of central and regional distribution might want to move lines from central to regional as peaks approach and back again after. *i-cost* could help identify which lines and when;
- ↳ When a new marketing initiative is being planned, say a two for one deal, it might be useful to demonstrate the supply chain costs of such a proposal so that the business is clear about the impact;
- ↳ In a situation where throughput is rising operations may need help in deciding the best course of action. For example, which is cheaper, to bring in more people on the same shifts or add additional shifts.

- ↳ To support the development and monitoring of budgets.

There are often choices to be made regarding seasonal peaks. *i-cost* could help understand the costs of the different options.

CONCLUSION

i-cost is an interactive, supply chain cost modelling tool. It has the following features :-

- ↳ *Tailored to each customer's needs* – not making *i-cost* generic ensures that it always meets the user's needs;
- ↳ *Pareto manipulation* – in combination with the application of user adjustable parameters, forecast changes in the business can be entered and the model run against them;
- ↳ *Use of Activity Based Costing techniques* – to enable costs to be applied to the activities and their volumes predicted for the business;
- ↳ *Based on common tools* – the model runs using a combination of Microsoft Office products to ensure ease of use;
- ↳ *Adaptable to both strategic and tactical use* – *i-cost* can be just as useful in an operational setting as for strategic network modelling.

For further information about *i-cost* or about other modelling tools including *i-flow* the interactive material flow modelling tool please contact us on 0121 333 6303.

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