Computerised Vehicle Routing and Scheduling (CVRS) for Efficient Logistics
Foreword

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The aim of this guide is to:

- Help more organisations gain an understanding of, and move towards the use of, computerised vehicle routing and scheduling (CVRS)
- Provide an overview of CVRS systems, covering their uses, likely benefits, negative aspects and associated costs
- Provide readers with sufficient information to be able to identify, purchase and implement the best solution for their organisation

The guide includes a checklist of questions you need to ask when considering CVRS as an option for your business and details of organisations that can provide you with further information.

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1 Introduction

Computerised vehicle routing and scheduling (CVRS) systems are very sophisticated software packages that are used to generate and optimise routes and schedules for transport operations. In addition to holding a digital map of the road network, these systems also hold information concerning customer locations and delivery and collection windows, quantities and types of goods to be delivered or collected, vehicle availability and capacities and driver shift patterns. Customer orders are input into the system, which then generates the optimum set of routes that meets the delivery need.

1.1 Who Should Use this Guide?

The guide will be of benefit to anyone who is involved in a project to assess, select and implement CVRS, such as:

- Transport managers
- Logistics professionals
- Distribution planners
- Consultants
- IT department staff who want to better understand the use of such systems

1.2 About this Guide

This guide is aimed at transport operators looking to optimise vehicle operations. Many operators of larger fleets are already benefiting from using CVRS systems to process the large amounts of information involved in planning vehicle operations. However, many other fleet operators still rely on largely manual processes to plan the work of their vehicles, and perhaps, have neither the knowledge of the capability of modern CVRS systems, nor the time and resources available to investigate them.

The guide is intended to help more organisations gain an understanding of, and move towards the use of, CVRS. It provides an overview of CVRS systems, covering their uses, likely benefits, negative aspects and associated costs, with the intention of providing readers with sufficient information to be able to identify, purchase and implement the best solution for their organisation.

The guide also briefly covers the related topics of journey planners and vehicle telematics.

1.3 Other Sources of Information

The Freight Best Practice programme, funded by the Department for Transport, offers authoritative, independent and practical information and advice to help UK companies improve the cost-effectiveness of their transport operations. This information is disseminated through publications, DVDs and software, together with seminars, workshops and other events. A full list and description of available resources is available on the Freight Best Practice programme website at www.freightbestpractice.org.uk, or through the Hotline on 0845 877 0 877.

For those looking for specific CVRS advice and information, each of the suppliers listed in Section 6 of this guide has a website which contains a great deal of relevant information, including case studies of companies which have successfully implemented CVRS. A shorter introduction to CVRS, ‘Concise Guide to Computerised Vehicle Routing and Scheduling (CVRS)’, is also available from the programme, via the website or Hotline.

Vehicle telematics is not an integral part of CVRS, but is linked, and its use will become more widespread in the next few years. Appendix 3 offers an introduction to the topic, while detailed information on this technology is contained in the Freight Best Practice ‘Telematics Guide’.
1.4 The Structure of the Guide

The guide contains the following sections:

- Section 2 provides a general introduction to CVRS systems and journey planners
- Section 3 outlines the advantages of CVRS and describes in more detail the way a system works and the outputs it produces. It also looks at the drawbacks that need to be overcome before a CVRS system can successfully be implemented, and details the results of a survey of CVRS users
- Section 4 helps you to assess the feasibility of introducing CVRS in your organisation
- Section 5 looks at the various stages involved in implementing a system
- Section 6 discusses how to choose the right system supplier, and contains a list of some of the key suppliers as well as a summary of system capabilities created from suppliers’ replies to a questionnaire
- Section 7 contains case studies highlighting the experiences of organisations that have chosen to implement CVRS systems
- Appendix A gives more of the detail about CVRS systems and their features
- Appendix B looks at journey planners and the way they work
- Appendix C gives an overview of vehicle telematics
- Appendix D reproduces the supplier questionnaire that was used to obtain the summary of system capabilities in Section 6, and which you can also use to gain information about systems under consideration

2 Computerised Routing for Transport Operations

Two types of computerised system can help organisations to plan their routes: computerised vehicle routing and scheduling systems, and the less sophisticated journey planners. The main part of this guide is primarily concerned with the former type of system, which can provide benefits in many areas in addition to rapid planning of routes. Journey planners are covered in more detail in Appendix 2 of this guide.

2.1 Computerised Vehicle Routing and Scheduling Systems

What Do They Do?

CVRS systems can take large numbers of customer orders and calculate the most effective way of meeting them. They calculate the time and resources required to complete the work, using collection and delivery information and observing the pre-determined parameter settings that control the way in which the transport operation is run. Parameters can include road speeds, load size, customer opening times and driver hours. The CVRS process is shown in Figure 1 on the following page.

Systems can be used for dynamic daily or weekly planning, as well as for strategic analysis. On a daily basis, they quickly produce routes which meet the laid down parameters. Transport planners can then further optimise the routes and schedules using their expertise, local knowledge, relationship with customers and so on. For instance, planners may know that a certain customer will accept a later or earlier delivery if they are telephoned first. They can then override that customer’s delivery rules and let the CVRS system re-plan routes, often with even better results. When the user decides that the solution is as good as it can be, it can be used to generate outputs, for example, a printed map, a report or a delivery schedule.

The powerful capabilities of the software include the ability to:

- Reduce operational costs by minimising resource requirements i.e. the number of vehicles and drivers for a given workload
- Determine the most appropriate depot from which to schedule specific calls
- Observe all customer access constraints e.g. closed days, vehicle size and type restrictions, delivery time windows and pre-booked times
Reduce loaded and empty mileage
Accommodate collections and deliveries en route without exceeding payload tonnes, available load space or drivers’ hours limits

Who Should Use Them?
Vehicle routing and scheduling systems are generally used by organisations operating fleets of ten or more vehicles, particularly for multi-drop work, where the scheduling task is complex. Systems will also bring real benefits where only limited time is available for planning.

Menzies Distribution delivers over 7 million newspapers and magazines every day against a very tight turnaround time. Products are cross-docked, picked and packed, then consolidated for delivery to the retailer. High speed, efficient distribution is paramount as the product has a short shelf-life. The company has introduced CVRS to assist manual schedulers in the redesign of delivery sequences on a depot-by-depot basis. Menzies also uses CVRS to test the effects of alternative scenarios, a move that has enabled the company to venture into new markets, confident that it knows what to expect.

2.2 Journey Planners

What Are They?
A journey planner is a piece of software containing a digital road network, with roads defined by a range of categories and speeds, and with the ability to calculate the best route between any two given locations. It can also devise a route that includes any number of call points.

What Do They Do?
Journey planners are generally used for manual planning of single journeys, where the user decides the calls to be made on each journey and uses the journey planner to determine the best route (shortest, fastest or avoiding certain roads) and the best call sequence. Road speeds can be set by the user for each road category, to replicate the average speeds which vehicles are expected to achieve.

The journey planner will produce route plans, either in map form or as a series of directions, which can be issued to drivers as necessary. The process involved is shown in Figure 2 overleaf.
What is the Difference Between a Journey Planner and a Vehicle Routing and Scheduling System?

The essential difference is that a journey planner makes fewer decisions. The user reviews the orders to be fulfilled and assembles them into provisional routes with identified call points. These routes are then entered into the journey planner, which uses in-built roadmaps and associated parameters to identify the optimum delivery or collection sequence, and calculate the time and distance for the whole journey.

The user reviews the routes, adding or removing call points or changing the call sequence, perhaps to meet a particular customer’s delivery time requirement. Routes can then be re-submitted to the journey planner until the optimum solution is found.

Who Should Use Them?

Owing to their relatively limited functionality, journey planners cost considerably less than vehicle scheduling systems, making them affordable to smaller organisations. They can be very effective for organisations operating a small fleet, perhaps five or six vehicles, where the number of routes to be planned or the number of calls to be routed is small. They can also be used for a range of monitoring purposes, including checking distances on tachograph records and haulier invoices, identifying the number of customers within a given distance of a depot and so on.
3 Why Use CVRS?

3.1 Why Change to CVRS?

CVRS systems rapidly process information concerning customer locations and requirements, types and quantities of goods to be delivered and/or collected, and match these to available vehicle capacity to produce the most economical routes and achievable schedules.

By so doing, CVRS systems can help you to:

- Improve the utilisation of your transport resources
- Reduce journey times
- Minimise vehicle mileage
- Reduce operating costs
- Improve the reliability of delivery schedules

Since introducing CVRS, West Country Foods has been able to balance its deliveries much more evenly among vehicles and plan routes that are far more efficient. The company has saved thousands of pounds a month in fuel, wear and tear and depreciation, and has also reduced the number of vehicles required. The simultaneous improvement in customer service has also been significant.

Systems can also be used to ‘model’ possible changes to a transport operation, for example, a different vehicle size could be entered to see what effect this would have on the number of vehicles needed to meet current requirements. In addition, strategic reviews can be carried out, and the impact on operations of more immediate changes, such as the addition of a major new customer, can be quantified.

3.2 What Information is Processed by a CVRS System?

A CVRS system holds a range of data covering the road network (including digital maps and road speeds), details of vehicles’ availability and capacity, driver shift patterns and customer information (including locations and delivery and collection windows). A system will also hold a range of parameters that define the way in which deliveries and collections, or ‘calls’, must be made, such as:

- The maximum number of overnight stops
- Whether the vehicle is to deliver on the way out, or go to the furthest point loaded and deliver on the return leg

CVRS systems are usually operated by transport planners or schedulers who assess the routes and use their expertise to refine them as necessary before passing them to other personnel for order picking and loading.

3.3 Applications for CVRS Systems

Most businesses use a CVRS system in a number of ways. Tasks tend to fall into three main areas: operational, strategic and commercial.

Operational

A CVRS system can have a direct and positive impact on the active operation of a business, determining delivery and collection sequences and vehicle routes.

Key operational tasks include:

- Dynamic daily scheduling
- Weekly scheduling
- Validation and/or optimisation of existing manually planned routes
- Scheduling from multiple depots

Dynamic daily scheduling can achieve major cost benefits, particularly for operations where there is no regular daily delivery pattern (e.g. home deliveries). Weekly scheduling is more appropriate for supply chains, where the transport planner is aware of the projected delivery requirements for at least one week ahead. For multi-depot organisations, depots may be manually assigned to customers or the CVRS system can assign them based on cost-effectiveness.
The introduction of CVRS has enabled DW Weaver to generate monthly route reviews which take account of on-going changes in its milk collection and delivery business. Route plans are now produced much more quickly and accuracy is greatly improved, with allowances made for road speeds and loading and offloading times. The company has a better idea of mileage run, driver workload and vehicle arrival times at both collection and delivery points. Overall vehicle mileage, and hence costs incurred, have also been reduced.

Strategic

Strategic applications are concerned with planning for possible future developments. CVRS systems can provide organisations with a greater understanding of the resources they would need and the likely costs associated with different set-ups. Key strategic tasks include:

- Planning resource requirements and budgeting for forecast business, seasonal variations in demand or new or revised regional depot structures
- Evaluation of alternative options (e.g. comparing the cost-effectiveness of in-house and third party distribution strategies)
- Testing the effect on resources and costs of various parameters and assumptions (i.e. providing answers to the ‘What if....?’ questions)
- Testing the effect of service level changes for all customers, or groups of customers

Commercial

Commercial applications are those designed to produce resource and cost figures for a particular set of existing or planned operating parameters. They can have an impact on active operations. Key commercial tasks include:

- Assisting with the preparation of tender submissions and calculating vehicle and man-hour requirements to meet third party contracts
- Modelling changes to the business or determining the most cost-effective method of providing the desired level of customer service

3.4 Data Output and Reports

Modern CVRS systems have comprehensive reporting capabilities, with data outputs including:

- Route reports (screen and print)
- Resource utilisation and cost reports (screen, print and file)

Load manifests or daily traffic sheets showing the allocation of drivers and vehicles to routes
- Performance monitoring reports (comparing actual results with planned)
- Route summaries showing distance, time, calls, quantity and cost
- Dispatch reports showing run dispatch and return date or time
- Resource utilisation bar charts showing the time spent on driving, other duties and break and rest periods
- A range of cost reports

In addition to creating customised reports directly from the system, users can export data to spreadsheet or database applications (e.g. Excel®, Lotus 123®, Access® or Lotus Approach®), or to other proprietary data handling and report writing packages for further manipulation. Exported data can also be merged with other related management information.

3.5 The Benefits of CVRS

Most companies introduce CVRS to help them to use their transport resources more efficiently. Through CVRS you can achieve a better vehicle fill, make better use of available time and run fewer miles for the same workload, all helping to reduce transport costs and contributing to the profitability and/or competitiveness of your business.

Broadly speaking, benefits can be split down into two categories: operational efficiency, and management and service enhancement, as shown in Figure 3 opposite.
Operational Efficiency

Improvements to operational efficiency result in doing the same work with fewer resources or doing more with the same resources. The key elements are faster planning and better routes. Faster planning generally enables companies to accept orders later, while still allowing them to refine and optimise the routes to be used. In addition, CVRS invariably produces better routes, necessitating fewer vehicles and drivers, or enabling more product to be delivered on the same fleet. Either way, the result is lower cost per delivery, or unit delivered.

In summary:

- Regularly putting more goods on vehicles requires fewer vehicles and drivers
- Improved allocation and scheduling can result in a tighter fleet profile
- More efficient routes with improved call density will reduce vehicle mileages
- Delivery plans can be readily reviewed, perhaps when late orders are received, and routes then quickly revised while maintaining efficient use of transport resources
- For multi-depot operations, the planning process can be centralised, perhaps with detailed route optimisation carried out locally, which may enable depots to support each other rather than having to bring in additional vehicles
- It may be possible to reduce the number of staff involved with the planning process or make more efficient use of planners’ time through reduced administration effort, paperwork and planning processes
Management and Service

Management and service enhancement is less easy to quantify, but still important. Many benefits enhance the operation and generally contribute to improvements in the overall service level, although they may not directly improve the operational efficiency of the transport fleet. However, CVRS can help to build a structure which is efficient and can accommodate growth without undue deterioration in service level.

With better planning, routes and timeframes will be more achievable, resulting in fewer missed calls and hence, fewer re-deliveries, reducing the strain on resources. Better communication between people and between systems results in more reliable order fulfilment, increasing customer satisfaction. Companies can also benefit from being able to forecast the effects of change, such as changes to the number of customers or overall levels of business, and therefore being able to plan more accurately for change.

In summary:

- More realistic schedules reduce the demands on drivers
- Good schedules are more likely to be achieved, reducing the number of late deliveries and hence customer complaints and the need for re-deliveries
- Electronic storage of accurate customer information makes the business less dependent on the skills and knowledge of an individual scheduler
- Different elements of the distribution operation can be integrated, such as functional (e.g. multiple drops, full load activity) or geographic (e.g. multiple depot operations)
- Production planning and order processing can be integrated, leading to efficiency improvements
- The elimination of manual data entry and the automatic production of delivery documentation reduce the risk of error
- With faster routing and scheduling customer order cut-off time can often be later
- More flexible and comprehensive transport management reporting is possible, covering drop density, volume delivered, distance run and hours used
- Changes within the business, such as more frequent deliveries, am and pm commitments, night deliveries and shorter lead times can be modelled quickly and accurately

For G & P Batteries (see case study in Section 7 page 28), CVRS plays a key role in achieving a critical 90% vehicle fill and has reduced daily planning time by around five hours a day. CVRS has also realised improvements in transport management and administration, and management is confident that the current planning staff will be able to handle an expected doubling of throughput. CVRS is also providing good management information on current achievements, as well as forecasts of costs for anticipated future routes.

3.6 Maximising the Benefits of CVRS

The benefits of CVRS systems are maximised when the software is integrated with other supply chain management software. For example, CVRS inputs, such as orders, can be downloaded from a sales order processing system and CVRS outputs can directly generate picking lists or load assembly information and specific management information.

Almost three quarters of the items dispatched by Alstons Cabinets are made to order, with scheduled orders forming the basis of manufacturing planning. Until recently the whole process was carried out manually, by sorting hard copies of customer orders and passing the information on to other parts of the business.

The simultaneous introduction of Material Requirement Planning (MRP) software and CVRS has radically improved the efficiency and effectiveness of the company’s planning. Orders routed by CVRS are automatically uploaded into the MRP system for production planning. Errors have been reduced significantly, orders are no longer ‘forgotten’, and response to customer queries is much faster and more accurate. In addition, better routes and more effective use of vehicles have enabled Alstons to reduce its fleet size without any deterioration in customer service.
In addition, implementing CVRS will realise most benefits in organisations where the planning task is more complex, and more information needs to be considered when generating routes. Manual scheduling is at its most vulnerable where the task is complicated, but the time available for planning is limited. Under extreme pressure schedulers may forget things or make mistakes. Although a CVRS system rarely generates perfect routes first time, it will not overlook anything and, with input from the scheduler, the optimum solution will quickly be generated.

How Complex is the Planning Task?
A number of factors may influence the complexity of the transport operation, all of which need to be taken into account. The following list includes many of the more common ones, but individual organisations may well have specific factors.

- **Vehicle resources** - take into account:
  - The number of vehicles to be scheduled
  - The range of types and capacities of vehicles which must be used

- **Driver resources** - take into account:
  - The number of driver shifts
  - Limitations on the hours that drivers are able to work and drive

- **Customer requirements** - take into account:
  - The number of deliveries and collections
  - Customer time windows (i.e. narrow or wide)
  - The range of loading or unloading rates
  - The number and spread of booked times (e.g. the number of 8 am bookings will dictate the minimum number of vehicles required)
  - In a weekly plan, the collection or delivery day required
  - Constraints on the vehicle types that can be handled at individual call points
  - The existence of bulk consignments (i.e. single orders for one customer exceeding the capacity of the largest vehicle)

- **Operational factors** - take into account:
  - The range of products with varying weights, cubic capacities and characteristics
  - The need for goods to be carried in vehicles with multiple compartments (e.g. tankers, ambient, chilled or frozen)
  - Restrictions on product compatibility, prohibiting different products being carried in the same vehicle
  - The number of trips required per shift
  - In multiple depot operations, constraints on which customers can be served from which depots
  - The need to schedule night trunking work and depot delivery work

3.7 The Drawbacks of CVRS
As with most significant changes to working practices, there may be some initial drawbacks with CVRS, although these tend to be overcome fairly quickly, with a high level of satisfaction reported amongst users. Indeed, most users would regard a move back to manual routing and scheduling as unthinkable.

The main drawbacks are seen as:

- **Complicated implementation** - implementing a CVRS system is not simple, and will need the investment of both time and money to ensure success. However, CVRS generally provides a rapid return on investment

- **Complexity of operation** - CVRS brings a new level of complexity and sophistication to transport planning, which needs to be handled carefully. Planning staff generally develop into their revised roles, but will need training, support and encouragement. Care will be needed to ensure the availability of back-up staff with the necessary skills to cover for unplanned absences

- **Lack of flexibility** - CVRS imposes some rigidity in the way that things are done, making short cuts more difficult as they could introduce errors. However, modern CVRS systems can be tailored to individual requirements. If user needs are well defined and made clear to system suppliers, and adequate preparation is made before implementation, any lack of flexibility should not cause a major problem

3.8 Survey of Current CVRS Users
An e-mail survey of some 700 members of the Freight Transport Association (FTA) was conducted during August and September 2004. The survey was intended to determine the extent to which CVRS has penetrated the industry and to gain a better understanding of the ways in which any systems are used. The survey was confined to companies operating ten or more vehicles.
Of those companies that responded, 22% were using some form of CVRS, with a further 7% actively considering the use of such a system. A similar survey conducted some four years ago indicated that 23% of companies were using CVRS, suggesting that the market penetration of such systems has not changed significantly. This relatively low figure is perhaps surprising, since over 90% of CVRS users in the current survey indicated that they were either ‘satisfied’ or ‘very satisfied’ with their choice of system and supplier.

The breakdown of CVRS users by sector is shown in Figure 4, and shows that the majority of current users are distributors and wholesalers. Within each sector, users of CVRS encompassed a diverse range of businesses, with those identified through the survey including a bed manufacturer, a fuel oil distributor, a third-party distributor, a plastic pipe manufacturer and a battery recycling operator.

In response to the survey, over 50% of companies not using CVRS stated that the systems simply did not suit their operations, and they were therefore staying with manual processes. However, when the survey results were used to compare companies that have chosen to use CVRS with those that have not, remarkably little difference was discovered. The fleet size profile of the two groups was virtually identical and a very similar spread across sectors was found, as shown in Figure 5. As the majority of users were satisfied with their systems and reaping benefits, this finding indicates that many more companies could be benefiting from CVRS. Modern CVRS systems can readily be customised to suit a particular operation, and suppliers are increasingly seeing their role as ‘configure and implement’, rather than as simply selling a software package.

While those companies surveyed tended to use CVRS systems for a variety of reasons, the majority used CVRS for regular operational planning for vehicles on either a daily or a weekly basis. A significant number were also using their systems for strategic reviews and business development purposes. The survey findings are shown in Figure 6.
A wide range of benefits were identified during the survey, as shown in Figure 7, on page 10. The results support the view that most companies use CVRS systems principally to improve their operational efficiency, with more than half of users realising reduced operating costs and around 30% realising reduced fleet size and fuel costs. Better management reports and improvements to customer service were also widely reported.

In summary, relatively few companies currently use CVRS systems, but those companies that do are satisfied with the results and would not return to manual routing and scheduling. Most CVRS users were looking to make efficiency gains - more output for the same resource or the same output for less resource - but have also realised other service-related or strategic analysis benefits. Improvements in service, control and communications are also common.

3.9 The Role of Vehicle Telematics

Telematics is defined as the use of computers to control and monitor remote devices or systems. By far the largest market for telematics to date is the transport market, where data gathering and transmission is becoming increasingly widespread and important. Applications include the monitoring of vehicle performance, vehicle position tracking and real-time gathering of proof of delivery or collection, through hand-held data terminals carried by drivers.

Both telematics and CVRS can be successfully used independently. For instance, telematics can be used to provide vehicle performance or location information without the use of CVRS. Similarly, a CVRS system can successfully generate vehicle routes and schedules without the use of any form of telematics. However, an increasing number of businesses are recognising that using both systems together can offer a significant step forward in vehicle and customer service management and control. The prospect has also been made more attractive in recent years, as not only has the cost of such systems fallen, but also their functionality and reliability have improved.

By using CVRS and telematics together, a transport management team can develop a vehicle plan and know, often in very great detail and in real-time, the extent to which the plan is being followed. This knowledge enables quicker reaction to changes and offers the ability to be able to divert or redirect vehicles for additional work, warn customers of a late delivery or collection before they are even aware that anything has started to go wrong.

Further information on telematics can be found in Appendix 3 of this guide. More detailed information on basic technology, descriptions of telematics in use, case studies and details of products and suppliers can be found in Freight Best Practice programme ‘Telematics Guide’. A copy of the guide can be ordered via the Freight Best Practice programme website at www.freightbestpractice.org.uk or by calling the Hotline on 0845 877 0 877.

4 Is it Worth Introducing CVRS?

The decision to introduce CVRS cannot be taken lightly. With proper management, CVRS can be successfully introduced and is likely to provide a rapid return on investment, improvements in efficiency and customer service, and many other benefits for years to come. However, it will entail a significant project that will have an impact on staff and, if it is not managed properly, may lead to a temporary deterioration in customer service.

This section looks at various factors that will help organisations to decide if CVRS is right for them.

4.1 Is CVRS a Practical Option?

CVRS systems are currently helping a wide range of organisations to make the most of their transport resources. Answering the following questions will provide a useful starting point for organisations trying to decide if CVRS is a practical option for them.

- Is a large fleet (e.g. more than twenty 3.5 tonne vehicles) operated?
- Is a multi-drop delivery service provided?
- Is there a substantial number of customers?
- Is there a wide range of order sizes and product types and sizes?
- Do customers have a range of individual requirements, for example, set delivery windows, short lead times, specific vehicle types, etc?
- Does delivery requirement change from day to day or from week to week?
- Is a limited amount of time available for load planning?
- Are delivery options, service levels, vehicle types or depot locations likely to change?
- Are transport resources underused or overstretched?

If the answer to any or all of these questions is ‘Yes’, CVRS is likely to bring benefits.
4.2 How Much will a System Cost?

It is difficult to make a general statement about the costs associated with purchasing, installing and running a CVRS system. Today’s systems are generally tailored to meet the specific needs of an organisation, with costs dependent on many factors, including:

- Functions required
- Number of system users
- Size of vehicle fleet to be routed and scheduled
- Number of depots within the organisation
- Number of customers
- Number of calls to be routed

The only way to get an accurate idea of costs is to contact a supplier and discuss system requirements. Details of several suppliers can be found in Section 6 of this guide. As an indication of the possible costs involved however, a single user system to plan the work for a fleet of 20 - 25 vehicles typically costs in the region of £25,000 - £30,000, with on-going licences and support likely to cost around £3,000 per year.

While system costs are not insignificant, most systems realise a wide range of benefits and generally prove a very worthwhile investment, with relatively short payback periods quite common. It is worth remembering that:

- Cost savings for established operations are typically of the order of 10-20% of transport costs
- CVRS can enable businesses experiencing rapid growth to meet increasing demand without having to increase staffing levels, whereas several additional staff may be required with manual vehicle routing
- Improved communications between systems and departments tend to yield efficiency improvements and better levels of customer service: although difficult to quantify, these benefits may offer companies the edge over their competitors

Where system costs are of particular concern, it may be worth considering a lower cost, budget system where functionality is reduced. Another alternative is to use a service provider, where orders are uploaded to the Internet and planned routes returned. This latter option is slower, but can still result in benefits.

4.3 What Other Costs are Involved?

CVRS project costs go beyond the price of the software alone. Other areas of expenditure may include:

- Creating interfaces with existing systems
- Customising the CVRS system
- Gathering and validating customer data
- Calibrating the system to use existing fleet road speeds and loading and unloading times
- Briefing drivers, planners and schedulers, and sales and customer service staff
- Staff training

Taking all costs into account from the start will ensure that return on investment can be accurately gauged, and should also avoid overspending later in the project.

4.4 Example Project Costs and Savings

Table 1, shows some typical costs for a single-site CVRS project implemented to reduce transport costs by improving efficiency, and highlights the resulting savings. Clearly, as each project is different, the costs and savings shown can only be indicative, although they are representative of those experienced in practice.

Table 1  Example CVRS project costs and savings

<table>
<thead>
<tr>
<th>Organisation details</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Current annual transport spend</td>
<td>£1,500,000</td>
</tr>
<tr>
<td>Fleet size</td>
<td>25 vehicles</td>
</tr>
<tr>
<td>Depreciation period for CVRS project</td>
<td>3 years</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project costs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Set-up</td>
<td></td>
</tr>
<tr>
<td>Hardware (PCs, printers, interface)</td>
<td>£3,000</td>
</tr>
<tr>
<td>Software</td>
<td>£30,000</td>
</tr>
<tr>
<td>Implementation</td>
<td></td>
</tr>
<tr>
<td>Training</td>
<td>£2,000</td>
</tr>
<tr>
<td>Data verification and cleansing (3 man weeks @ £1,500)</td>
<td>£4,500</td>
</tr>
<tr>
<td>Project management (10 days @ £500)</td>
<td>£5,000</td>
</tr>
<tr>
<td>Total project costs</td>
<td>£44,500 (A)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Annual costs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Depreciation (1st, 2nd and 3rd years)</td>
<td>£11,000 (B)</td>
</tr>
<tr>
<td>System updates and maintenance (2nd and 3rd years)</td>
<td>£3,000 (C)</td>
</tr>
<tr>
<td>Retraining (2nd and 3rd years)</td>
<td>£2,000 (D)</td>
</tr>
<tr>
<td>Total year 1 costs (implementation plus depreciation)</td>
<td>£55,500 (A+B)=G</td>
</tr>
<tr>
<td>Total year 2 and 3 costs (recurring costs only)</td>
<td>£16,000 (B+C+D)=H</td>
</tr>
<tr>
<td>Cost saving year 1 (8% of transport spend, equivalent to two vehicles) @ 50% (assuming six months to implement project, followed by six months in operation)</td>
<td>£60,000 (E)</td>
</tr>
<tr>
<td>Annual cost savings year 2 onwards (8% of transport spend, equivalent to two vehicles)</td>
<td>£120,000 (F)</td>
</tr>
<tr>
<td>Net financial benefit in year 1</td>
<td>£4,500 (E-G)</td>
</tr>
<tr>
<td>Net financial benefit in year 2</td>
<td>£104,000 (F-H)</td>
</tr>
<tr>
<td>Net financial benefit in year 3</td>
<td>£104,000 (F-H)</td>
</tr>
</tbody>
</table>

Note: This example assumes a relatively modest cost saving of 8% (10 - 12% savings are common) and ignores the effect of increasing transport unit costs, such as the cost of fuel.
When trying to decide on the feasibility of implementing CVRS, it is worth completing a table similar to that shown in Table 1, taking into account project-specific details. For example, many organisations will use different accounting practices for depreciation and project management and data cleansing costs may be lower where in-house capabilities exist.

5 Implementing CVRS

Implementation of CVRS is very company-specific, depending on many factors such as the size of the operation and what is expected from the system. However, most projects involve four distinct phases:

- The first phase - when a project plan is drawn up
- The second phase - when system requirements are defined, suppliers consulted and the decision to proceed is taken
- The third phase - when the system is installed, training carried out and CVRS put into use
- The fourth phase - when fine tuning takes place and the system is optimised

This section provides guidance on key implementation issues in each of these phases.

5.1 First Phase: Preparing a Project Plan

The decision to adopt CVRS, together with the selection of a supplier and the implementation of a system, is a significant project in any organisation, and a carefully constructed plan is essential. Figure 8 shows a possible project plan, highlighting the tasks that may be involved. The tasks may well vary from company to company, but typically a number of the tasks will be interdependent, and overall project length may be fairly long (20 weeks in this example). In addition, a communications programme should be worked out at this stage to ensure that staff are briefed through the whole project.
5.2 Second Phase: Defining Requirements and Deciding to Proceed

Brief Staff
Implementing CVRS is much like any other major project, and keeping people informed at every stage of the process is vital.

It is particularly important to keep load or transport schedulers and planners well informed. They may feel threatened by the move and might think they are being replaced. However, emphasise that knowledgeable user input is essential to implement, customise and operate the system, and maximise the benefits.

Planning and scheduling staff tend to carry a lot of information in their head, such as customer delivery windows and vehicle access restrictions, which will need to be put into the system. Where these staff are not computer literate, remember to make allowances for individual training needs within the project plan.

Encouragement is vital. Visits to sites already using CVRS may prove invaluable, enabling staff to see real systems in action.

Drivers may also feel threatened. Talk of making more efficient use of resources may imply that they will have to work even harder, and there may be resistance to following schedules derived by computers that obviously can have no experience of life on the road. Emphasise the importance of driver input. Drivers keep a lot of information in their head which will prove vital to the success of computerised routing and scheduling.

Staff briefing and communication needs to encompass those outside transport. For example, sales and customer service teams will have additional information on customers. It is also important that sales teams have a realistic view of the improvements that CVRS will bring, for example, in terms of lead times and improvements to customer service levels.

Define System Requirements
System requirements must be carefully defined at an early stage in the project so that the search for a suitable system can get off to an organised and structured start. Do not assume that the system must mimic the current logistics operation; this may not necessarily be the best option. Talk to transport planners and schedulers to find out what is ideally required.

When looking to define requirements, consider:
- How many vehicles will be operated?
- What types of vehicle will be operated?
- How many customers and call points are there?
- How many calls are expected in a peak day or average week?
- Must set vehicles be operated on the same set routes?
- Do vehicles stay out overnight?
- Do vehicles return to depot, reload and go out again during a working day?
- Are routes variable or are they fixed?
- Do vehicles collect goods, from either customers or another depot?
- Is there a fixed cut-off time for order acceptance?
- Do any single orders exceed the capacity of the largest vehicle?
- Are high street or door-to-door deliveries made?
- How does the system need to interact with existing IT systems?

Appendix 4 contains a more comprehensive list of questions which may be used to evaluate potential CVRS systems. The list may also prove useful when deciding how best to run an operation and when selecting system functions.

System Selection
Having identified the need for CVRS and the level of interaction with other IT systems, further evaluation of the options can begin. Three steps are generally involved:

- Evaluate systems:
  - Keep requirements clearly in mind
  - Compare inherent system capability with defined requirements
  - Consider the potential to customise systems to meet requirements
  - Arrange demonstrations (using actual data where possible)
  - Compare prices (purchase and maintenance), and look at possible leasing arrangements, if required
Short-list systems: - Visit reference sites to see systems in operation  
- Take up references

**Decision to Proceed**

At this stage in the project, the decision must be taken as to whether to proceed with CVRS or stick with current routing and scheduling operations. If the project is to go ahead:

- Revise the project plan as necessary to reflect any changes made during system definition or any additional training needs identified during staff briefing  
- Remember to communicate any significant changes to the relevant staff

5.3 **Third Phase: Obtain and Set Up System**

**Obtain System**

With the key decision to proceed having been taken, the project will gain a higher profile and momentum. Use the information gathered during the first phase to select the final system and place the order. Once the system specification is known, the project can advance while awaiting system delivery.

**System Interfaces**

Many logistics operations benefit from links with other IT systems, an option facilitated by CVRS. The preferred extent of system interaction will have been discussed during system definition. Amongst the most common are links with:

- Sales order processing, as orders are almost inevitably downloaded electronically  
- Customer service software, where customer parameters and addresses are stored  
- Manufacturing planning, for made-to-order goods  
- Business reporting systems, to generate management reports and key performance indicator information

Once the requirements have been decided, allow enough project time to create and test all interfaces before the system goes live.

**Plan Training**

One of the few advantages of manual routing and scheduling is that little or no training is required. Geographical knowledge, product knowledge and customer knowledge, together with some simple rules, such as the number of drops per day, are practically all that is needed to create a set of routes. Because of this, the task can generally be carried out by a number of people; for example, drivers often successfully move into the traffic office to provide holiday cover. Although temporary staff may not produce routes as good as those generated by the regular planner, they will enable deliveries and collections to be made until the regular staff are back in place.

With CVRS, the situation is very different. With training, the systems are relatively straightforward to use: without training, most people will find them impossible to use. Consequently, it is critical to have enough trained people within an organisation who can stand in when scheduler(s) are sick or on holiday, or if they leave.

For the majority of organisations, planning and scheduling staff will need specific training in the use of the CVRS system. Even where previous experience exists, staff will need training on the specific software package selected for successful operation. Train back-up staff almost to the standards of the regular staff, and ensure they get to use the system on a fairly regular basis to remain familiar with the system. In this way, they will be able to do the job when required.

Remember to include training costs in the project budget and to allow sufficient time within the plan.

**Purchase Hardware**

Ensure that sufficient time is allowed within the project plan to buy the necessary hardware and have it delivered.
Data Assembly

CVRS systems can process vast amounts of data quickly to produce a routing and scheduling plan. However, the quality of the results depends on a high degree of data accuracy.

The implementation process needs to include:

- Data gathering
- Verification
- Cleansing and testing

Fortunately, data can be imported electronically from external sources, such as other computer databases (e.g. addresses from customer databases and order quantities from sales order processing systems), in most commonly used formats, such as spreadsheet, CSV or PRN files. Using these external data sources will minimise manual data entry, thereby minimising the chance of introducing data errors. Once data have been input, allow enough time to set up and test the data: this should highlight all but the most insignificant errors.

A brief introduction to data assembly is given here. More detailed information is contained in Appendix A of this guide.

To plan routes, the CVRS system will need data on:

- Order and product volumes so that the CVRS system can work out the fit on a vehicle
- Customer details, including:
  - Unique customer reference number
  - Name
  - Full address with postcode or grid reference, so that the system can locate the customer on in-built digital maps
  - Specified delivery day
  - Specified time windows
  - Specified vehicle types
- Customer orders
  - Unique order reference number
  - Order size
  - Delivery or collection
- Vehicle parameters
- Driver details
- Other data
  - Sequence of delivery
  - Priority
  - Booked time
  - Loading and unloading time

Calibrate Road Speeds

To be able to generate an accurate and realistic schedule, the CVRS system will also need data on road speeds. Systems have an in-built digital roadmap with a set of default road speeds: usually these speeds will relate to a number of vehicle types, for various categories of road.

Check the default values against the actual speeds that drivers usually achieve, determined through driver surveys or tachograph charts for actual routes. Adjust the settings within the system to representative levels and then test their validity by generating known routes and comparing the computer-generated timings with those achieved in practice. Continue to refine road speeds until there is close correlation between the CVRS system and current experience.

System Set-up

Users can set parameters that correspond to their individual operations, tailoring the way the system works. To ensure that the best solutions are obtained, the software supplier will provide advice as to any advanced parameter settings or ‘fine tuning’ of parameters and system set-up that may be required for particular operations.

The precise structure of parameter files will depend on the system, but they normally fall into three main groups:

- Data parameters
- Scheduling parameters
- Advanced parameters

The lists below indicate what each of these groups typically contains. While the lists may appear daunting, most parameters have a default setting representative of
many operations. The number of parameters is indicative of system capability and flexibility, and does not imply the system will be difficult to use.

Typical data parameters include:

- General (company name, distance unit, percentage of standard speeds, minimum time, distance between calls and closed days)
- Load-related (load unit, fixed, minimum or maximum call time)
- Driver-related (legal driving limits, break/rest periods and shift length)
- Shift-related (start and finish times, hourly payment rates, minimum shift cost and overnight allowance)
- Vehicle types (access group, load capacity, depot time allowances, percentage of speeds and loading rates and fixed and running costs)
- Product-related (product type, product units per load unit, loading and unloading times and revenue)
- Depots (location, opening times, throughput capacity and closed days)

Typical scheduling parameters include:

- Scheduling period in days (some systems will schedule up to several months)
- The number of overnight stops permitted
- The number of trips per route (i.e., the maximum times the vehicle can return to a depot on any route)
- Whether collections are made at the end of the route
- Whether the fleet is fixed
- For fixed fleets, the number of vehicles and drivers at each depot
- Vehicle and driver departure times
- The use of skeleton routes as the basis for building up daily routes

Typical advanced parameters include:

- Deviation and cluster settings, which affect the grouping of calls on a particular route and the degree to which the vehicle can be permitted to deviate from the most direct route in order to make additional calls
- Optimisation settings, instructing the system of the method of optimisation (e.g., time, distance and cost)

**System Testing**

Once the system is fully set-up and considered to be ready to go live, it is essential to carry out as much testing as possible, in order to both ensure that no errors have been introduced, and enable users to familiarise themselves as much as possible with the system in advance of commissioning.

**5.4 Fourth Phase: Go Live**

For the majority of users, a CVRS system will enhance the effectiveness of their operation for years to come. Few users would wish to return to pigeon holes, maps, pins and string, or whiteboards. There will be some on-going work involved to ensure that the system continues to produce the best solutions.

**Post-implementation Review**

Although it is tempting to forge ahead with the new system once it is in place, it is also a very valuable exercise to look back over the project and assess its success, and whether the company could have benefited from carrying out any part of the process differently.
System Fine Tuning

Spend time with the software supplier for a number of weeks, or perhaps even months, after implementation is complete. By this time, staff will generally be familiar with the system and its daily use, but they may not be using it to its best effect. There may well be unused features within the system which could bring additional benefits. In addition, some of the detailed parameters could be modified slightly to enable the automatic generation of better routes and schedules, without having to rely as much on user input.

On-going System Optimisation

The field of CVRS is evolving, with constant developments and improvements coming to market each year. Since the only certainty is that things will change, try to stay closely in touch with the selected system supplier and keep an eye on the wider marketplace. Being aware of enhancements as they come along offers the chance to make changes to operations or the CVRS system itself, and realise further benefits.

6 Product and Supplier Selection

Selecting the right product from the right supplier is important. This section outlines some of the selection issues, lists some suppliers of major systems currently available, and also summarises the features of those systems.

6.1 Finding the Right Supplier

Relationships

A CVRS system and its supplier are inextricably linked, each having their own characteristics and capabilities. Project implementation and system set-up will involve considerable contact with the supplier, with contact continuing through system upgrades, staff training and perhaps user groups. Picking the right company is essential if working together is to be a success. It is particularly important where there is likely to be extensive tailoring of the system to meet operational needs.

Support, Training and Development

Support, training and development are critical if the system is to produce the best results.

When considering which system or supplier, the following checklist may prove useful:

- How long does training take?
- What level of computer knowledge is required of staff that will use the system?
- What arrangements exist for annual maintenance?
- Can the system adapt and keep pace with the transport operation developments within the organisation?
- Is the system capable of readily interfacing with other software in use or under consideration (e.g. order processing and warehouse management systems)?
- Is the CVRS system continually being developed and enhanced?
- How frequently are updates issued and how are they distributed?
- Is support from the software provider available 24 hours a day?
- Is support available online?
- Does the supplier provide a software manual?
- How comprehensive are the ‘help screens’?
- What proportion of the supplier’s client base is using extensively customised systems?
- Are maps provided for all European countries where the organisation operates?
6.2 Listing of Key Suppliers

Table 2 lists the suppliers of the main systems available in the United Kingdom at the time of writing (2005). The list is by no means exhaustive, as additional companies come into the market from time to time, perhaps from Europe or the United States, and companies continually develop and expand their systems.

**Note:** The inclusion of a supplier does not represent an endorsement of their system from the Freight Best Practice programme or the Department for Transport, nor does the inadvertent exclusion of any supplier imply any criticism of their system.

<table>
<thead>
<tr>
<th>System name(s)</th>
<th>Supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIPS</td>
<td>Distribution Planning Systems Bridge House Bewdley Worcestershire DY12 1AB Tel: 01299 400528 Website: <a href="http://www.dips.co.uk">www.dips.co.uk</a></td>
</tr>
<tr>
<td>LogiX</td>
<td>DPS International Ltd Lygon Court Hereward Rise Halesowen West Midlands B62 8AN Tel: 0121 585 6633 Website: <a href="http://www.dps-int.com">www.dps-int.com</a></td>
</tr>
<tr>
<td>Optrak</td>
<td>Optrak Distribution Software Limited Princess Mary House 4 Bluecoats Avenue Hertford Hertfordshire SG14 1PB Tel: 01992 411000 Website: <a href="http://www.optrak.co.uk">www.optrak.co.uk</a></td>
</tr>
<tr>
<td>Paragon</td>
<td>Paragon Software Systems plc Allen Court High Street Dorking Surrey RH4 1AY Tel: 01306 732600 Website: <a href="http://www.paragonrouting.com">www.paragonrouting.com</a></td>
</tr>
<tr>
<td>Roadnet</td>
<td>121 Systems Ltd Broadway Business Centre 32a Stoney Street, The Lace Market Nottingham NG1 1LL Tel: 0115 924 7104 Website: <a href="http://www.121logistics.com">www.121logistics.com</a></td>
</tr>
<tr>
<td>Descartes Delivery Management Solution</td>
<td>Descartes Systems UK Limited The Mill House Business Centre Station Road Castle Donington Derby DE72 2NJ Tel: 0870 164 6355 Website: <a href="http://www.descartes.com">www.descartes.com</a></td>
</tr>
<tr>
<td>TruckStops</td>
<td>Kingswood MapMechanics Canal Court 155 High Street Brentford TW8 8JA Tel: 020 8568 7000 Website: <a href="http://www.mapmechanics.com">www.mapmechanics.com</a></td>
</tr>
</tbody>
</table>

6.3 System Summary Based on Suppliers’ Questionnaire Responses

Tables 3 to 11 summarise some of the capabilities and characteristics of the main systems available within the UK market. The tables are compiled from answers provided by suppliers to the questions set out in Appendix 4. Where all suppliers have provided similar affirmative answers, the questions have been excluded from the tables.

All of the systems listed have a high degree of functionality, making them complex and difficult to summarise. Prospective users need to look carefully at a number of systems in considerable detail, to find the one best suited to their operations and requirements. The tables may help to short-list systems for further consideration.
Table 3: Data verification

<table>
<thead>
<tr>
<th>Question</th>
<th>DiPS</th>
<th>LogX</th>
<th>Optrak</th>
<th>Paragon</th>
<th>Truckstops</th>
<th>Roadnet</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the process for address verification?</td>
<td>The postcode displays a map showing the location on a grid. Verification is carried out by address management software (QAS and QASnet).</td>
<td>Usually ‘Quick Address’ is used. Verification is carried out by codepoint geocode data, plus Gazetteer and optional street level address verification are used.</td>
<td>Correction is carried out by the user, with ‘AFDPostcode’ available as an option.</td>
<td>Codepoint geocode data, plus Gazetteer data, plus address verification are used.</td>
<td>Verification is carried out by address management software (QAS and QASnet).</td>
<td>Either a proprietary geocoding system using the Royal Mail Address Manager, or Latitude/Longitude data from Navteq can be used.</td>
</tr>
<tr>
<td>What is the process for address verification?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>The user can check that postcodes and placenames are valid and get grid co-ordinates.</td>
<td>Verification is done by address management software (QAS and QASnet).</td>
<td>The system allows specification of up to 10 different customers, with owner’s in-house measures as capacity limits.</td>
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</tbody>
</table>

Table 4: Data parameters

<table>
<thead>
<tr>
<th>Question</th>
<th>DiPS</th>
<th>LogX</th>
<th>Optrak</th>
<th>Paragon</th>
<th>Truckstops</th>
<th>Roadnet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can the system plan deliveries for nominated days?</td>
<td>The user can specify a specific day for the delivery, and the system allows for choice of days.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>The system allows specification of up to 10 different customers, with owner’s in-house measures as capacity limits.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No limit</td>
<td>No limit</td>
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<tr>
<td>The system allows specification of up to 10 different customers, with owner’s in-house measures as capacity limits.</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No limit</td>
<td>No limit</td>
<td>No limit</td>
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<tr>
<td>The system allows specification of up to 10 different customers, with owner’s in-house measures as capacity limits.</td>
<td>35 days</td>
<td>14 days</td>
<td>14 days</td>
<td>No limit</td>
<td>No limit</td>
<td>No limit</td>
</tr>
<tr>
<td>The system allows specification of up to 10 different customers, with owner’s in-house measures as capacity limits.</td>
<td>30,000</td>
<td>No limit</td>
<td>No limit</td>
<td>20,000 customers, 20,000 calls per schedule</td>
<td>No limit</td>
<td>No limit</td>
</tr>
<tr>
<td>The system allows specification of up to 10 different customers, with owner’s in-house measures as capacity limits.</td>
<td>Morning and afternoon shifts are possible by the user, with the option of double shifting.</td>
<td>Double-shifting is easily accommodated</td>
<td>Double-shifting is easily accommodated</td>
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<td>Double-shifting is easily accommodated</td>
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<tr>
<td>The system allows specification of up to 10 different customers, with owner’s in-house measures as capacity limits.</td>
<td>Each vehicle has its own specification of shift availability.</td>
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<td>Roadnet</td>
<td>Descartes Delivery Management Solution</td>
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<td>-------------------------------------------------------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Can the system model pre-allocated routes (with or without a predetermined sequence)?</td>
<td>Yes</td>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>The user can define routes or 'static' routes, and can also build routes based on a fixed geographic area</td>
<td>Yes</td>
</tr>
<tr>
<td>Can system priorities be set? For example, minimise time, distance?</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td>The system is predominantly a tool to optimise time and distance</td>
<td>Profitability, distance, time and other variables may be assigned and used for optimisation</td>
</tr>
<tr>
<td>Can the system extend customer opening time to permit completion of a delivery?</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td>The system distinguishes between 'arrive in time' windows, and 'depart in time' windows</td>
<td>Yes, time windows have optional flexibility</td>
</tr>
<tr>
<td>Does the system allow for vehicles to commence a new trip part way through a working shift?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Reloading or multi-trips are achievable, and extended runs and multi-day routes are also possible</td>
<td>Yes</td>
</tr>
<tr>
<td>Can the system schedule 'tramping' (i.e. collecting from one point on a route and delivering to another point on the same route)?</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td>The system can collect and onward deliver, add to an existing delivery and deliver or collect, ensuring orders are carried out on the same route</td>
<td>Yes, multi-activities also using multi-activity pick-up and drop-off</td>
</tr>
</tbody>
</table>
Table 6  Advanced parameters

<table>
<thead>
<tr>
<th>Question</th>
<th>DiPS</th>
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<th>TruckStops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can the system spread deliveries at specified intervals (e.g. weekly/fortnightly) over an extended schedule period?</td>
<td>Yes</td>
<td>The system can be configured to take into account multiple scheduling periods</td>
<td>Not directly, but orders can be allocated specific days in a multi-day period</td>
<td>Yes, using the Multi Period Planner option</td>
<td>The Territory Planner module allows sequential delivery schedules of up to 12 weeks</td>
<td>Yes</td>
<td>Yes. Frequency scheduling is handled with a database front-end to allocate and balance workload across the scheduling cycle. The system then routes the scheduled workload. It can also convert contracts with a service frequency into a number of calls</td>
</tr>
<tr>
<td>Can the system prioritise orders for delivery?</td>
<td>Yes</td>
<td>Yes, nine levels of priority are available</td>
<td>Yes</td>
<td>Yes</td>
<td>Orders can be given an urgency factor between 0 &amp; 100. This allows identification of critical jobs and those of less importance. Where there are excess jobs, the less urgent will be left off the routes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Can the system schedule tractor units and trailers separately?</td>
<td>Yes</td>
<td>Visual Planner is due in 2005 and will enable the physical resource, tractor, trailer and driver, to be allocated individually</td>
<td>Yes, indirectly</td>
<td>Yes</td>
<td>The system can create, maintain and schedule tractors and trailers separately</td>
<td>Not yet, but this enhancement is due for release in early 2005</td>
<td>The system interfaces to systems which handle driver/tractor scheduling. Solutions are also available for tractor/trailer scheduling</td>
</tr>
<tr>
<td>Can the system split large consignments across a number of vehicles?</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>The system can split orders and multiple orders to the same stop. Split orders are given a new number, prefixing the new order number with the account number, the original order number or a custom prefix</td>
<td>Not yet, but this enhancement is due for release in early 2005</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 7  Mapping

<table>
<thead>
<tr>
<th>Question</th>
<th>DiPS</th>
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<th>Roadnet</th>
<th>Descartes Delivery Management Solution</th>
<th>TruckStops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can route paths be displayed?</td>
<td>Yes</td>
<td>Route paths can be displayed at various levels of detail</td>
<td>Yes</td>
<td>Yes</td>
<td>The user can display routes using straight lines (point to point) or along road paths</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Can individual trips be displayed?</td>
<td>Yes</td>
<td>Individual trips and multiple trips can be displayed at various levels of detail</td>
<td>Yes</td>
<td>Yes</td>
<td>Single and multiple routes can be displayed on the map</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Table 8  Modelling

<table>
<thead>
<tr>
<th>Question</th>
<th>DiPS</th>
<th>LogiX</th>
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<th>Paragon</th>
<th>Roadnet</th>
<th>Descartes Delivery Management Solution</th>
<th>TruckStops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Briefly describe the system's capability for modelling (e.g. strategic or operational schedules)</td>
<td>The system can be used strategically and operationally.</td>
<td>The system can be used strategically and operationally.</td>
<td>The system can be used strategically and operationally.</td>
<td>The system can be used strategically and operationally.</td>
<td>The system can be used strategically and operationally.</td>
<td>Strategic planning tools allow the modelling of distribution centres, zoning (where desired) and also picking of routines within a distribution centre/warehouse to optimise the layout. A simulation tool allows customers to simulate order pools entering the planning systems, using their data off-line for modelling/optimisation.</td>
<td>The system can be used for strategic and operational scheduling. Strategic uses include tender preparation and 'what if...' analysis. Operational uses range from daily scheduling to fixed route revision exercises.</td>
</tr>
</tbody>
</table>

Table 9  Management reports

<table>
<thead>
<tr>
<th>Question</th>
<th>DiPS</th>
<th>LogiX</th>
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<th>Paragon</th>
<th>Roadnet</th>
<th>Descartes Delivery Management Solution</th>
<th>TruckStops</th>
</tr>
</thead>
<tbody>
<tr>
<td>What management reports are produced by the system?</td>
<td>Reports are tailored to the user's requirements (included in purchase price)</td>
<td>A series of customisable reports are available, in excess of 80 currently, in Access, Excel, HTML, for example</td>
<td>The system includes a data warehouse for holding data long term. The user can customise reports based on any existing data</td>
<td>The system produces a comprehensive set of management reports, including route and trip summaries, utilisation summaries and key performance indicators. Reports, utilisation charts and map displays can be output as HTML for web browser access</td>
<td>The system includes 74 standard reports, and routing plans and real-time data can be exported to the entire organisation using an intranet-based set of web tools</td>
<td>Numerous key performance indicator reports are available as standard.</td>
<td>The system produces route summaries and detailed route listings, as well as details of unscheduled deliveries</td>
</tr>
<tr>
<td>Can the user generate customised reports?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>The user can define custom tabular reports or use in-built Crystal Reports for text and graphical reporting</td>
<td>The system has an open database and generates customised reports using Crystal, Cognos, etc. Reports can be accessed directly through Roadnet</td>
<td>Yes</td>
<td>Yes, the system includes a report writer</td>
</tr>
<tr>
<td>What other transport management software can be interfaced with the system (e.g. telematics, fuel management, GPS)?</td>
<td>The system can be interfaced with wages, telematics and GPS software</td>
<td>The system has already been interfaced to or integrated with vehicle telematics, in-cab &amp; mobile communication, transport management systems, fleet management and GPS systems</td>
<td>The system can be interfaced with POD and tracking software</td>
<td>The system can be interfaced with transport management, telematics, vehicle tracking and navigation systems. The Fleet Controller module links with real-time tracking to provide early warning of late arrivals and 'plan versus actual' reporting</td>
<td>The system can be integrated with major ERP and retail systems. Other options enable integration with in-cab or hand-held devices, GPS and ePOD systems. Partner providers provide actual versus planned information, as well as on-board vehicle management and security</td>
<td>The system has fully open XML architecture</td>
<td>The system can interface with ESP from ESS, Trademan FreightDesk, and MicroLise Opus. Also there are interfaces for on-board devices, tracking systems, GPS and PDAs, etc</td>
</tr>
</tbody>
</table>
### Table 10  Support/training/technical support

<table>
<thead>
<tr>
<th>Question</th>
<th>DIPS</th>
<th>LogiX</th>
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<th>Roadnet</th>
<th>Descartes Delivery Management Solution</th>
<th>TruckStops</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the typical frequency of software updates?</td>
<td>Quarterly</td>
<td>Typically two per year</td>
<td>Six-monthly updates, with intermediate customer-specific releases when required</td>
<td>Annually, or more frequently on request</td>
<td>One major release every 11 months, regular minor updates every three months</td>
<td>Quarterly minor updates, with major releases planned annually</td>
<td>Annually</td>
</tr>
<tr>
<td>What is the typical frequency for map updates?</td>
<td>Annually</td>
<td>Typically two per year</td>
<td>Six-monthly</td>
<td>Typically annually</td>
<td>Maps are sourced from an outside vendor and strategic partner, Navteq, who produces four distinct map releases a year</td>
<td>Quarterly</td>
<td>Annually</td>
</tr>
<tr>
<td>What is the training time required for an average operator?</td>
<td>Two days</td>
<td>Two days plus one back-up</td>
<td>Four to five days</td>
<td>Two days</td>
<td>Four days with an additional two to three day 'advanced' training course</td>
<td>One day for a dispatcher, five days for an expert user and 12 days for a super-user</td>
<td>Two days</td>
</tr>
</tbody>
</table>

### Table 11  Market

<table>
<thead>
<tr>
<th>Question</th>
<th>DIPS</th>
<th>LogiX</th>
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<th>TruckStops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approximately how many UK companies use your system?</td>
<td>40</td>
<td>There are in excess of 300 systems deployed throughout the British Isles</td>
<td>25+</td>
<td>300</td>
<td>6</td>
<td>60</td>
<td>More than 2,400 customer sites worldwide</td>
</tr>
<tr>
<td>What is their approximate range of fleet sizes?</td>
<td>10 to 500</td>
<td>4 to 500+</td>
<td>3 to 2,000</td>
<td>6 to 800</td>
<td>20 to 800+</td>
<td>10 to 800</td>
<td>10+</td>
</tr>
</tbody>
</table>
7 Case Studies

This section features a number of case studies that reveal individual companies’ experience of introducing a CVRS system into their transport operation. The case studies highlight the many benefits achieved.

7.1 Menzies Distribution Achieves Better Speed and Accuracy in Planning

Edinburgh-based Menzies Distribution is a leading provider of added value distribution and marketing services to the newspaper and magazine supply chain. Menzies uses 1,400 vehicles to deliver over 7 million newspapers and magazines each day to over 21,000 customers, clocking up 93,000 miles in doing so.

Products arriving from publishers in the early hours are cross-docked, picked and packed, then consolidated for delivery to the retailer. High speed, good organisation and overall efficient distribution are paramount when the product has such a short shelf-life.

A number of issues led Menzies to investigate CVRS as a potential solution to distribution problems. The company experienced large increases in both market and catchment size, depots were being rationalised and pressure was mounting to contain distribution costs. As each depot acquired more business, and individual newspaper and magazine weights increased relentlessly, delivery rounds became ever larger and heavier. It became increasingly necessary to split and re-split runs, and it became more and more difficult for manual scheduling to resolve issues. Short-term expediency tended to take over, leading to unbalanced routes. Consequently, it became clear that it was time to use technology and tools to support the planners.

In late 1998, Optrak Distribution Software was chosen to provide a high-tech and cost-effective tool to help improve Menzies’ customer service levels, whilst managing transport costs. As is often the case with implementation of new technology, Optrak was initially treated with scepticism. The Optrak team invested a lot of time working with local management and staff to increase their understanding of the system and win support.

The Optrak system provides 90% of the routing and scheduling solution very quickly. At that point, routes are reviewed by local planners who use their vital local knowledge to refine the results and ensure a practical, achievable solution. The system deals with daily weight variations, and supports the planning of deliveries from 36 depots, each with an average of around 800 visits per day. In addition, with several newsagents often located on the same street, the right visiting sequence is critical. The Optrak solution goes right down to street number accuracy, using eight-figure grid referencing to allow location of each premises right down to a ten-metre square.

Optrak proved invaluable when the newstrade introduced its ‘Focus on Distribution’ initiative, setting the groundwork for the introduction of mutually-agreed retailer delivery times. Menzies found Optrak to be an excellent tool for planning how best to meet the optimum delivery window.

The CVRS system is now used strategically and tactically on a depot-by-depot basis around the UK, assisting manual schedulers in the redesign of delivery sequences. It is also used strategically, to test the effects of alternative scenarios, and has enabled Menzies to venture into new markets, confident that it knows what to expect. The move into evening newspaper distribution was supported by an evaluation carried out with Optrak.
Optrak software has proved to be a worthwhile and valuable tool for Menzies, a partnership recognised in February 2002, when Menzies Distribution and Optrak Distribution Software were jointly awarded the 'Fleet Management Systems 2002 Partnership Award'.

7.2 West Country Fine Foods Improves Periodic Transport Planning

West Country Fine Foods is a specialist distributor of premium chilled and frozen foods to the hotel and catering market. The company is based at Codford St Mary in Wiltshire, with additional bases at Newton Abbot, Bristol and Warrington. It serves most of the western half of the country, using a fleet of around thirty 3.5-tonne refrigerated vans.

The business is seen as a distribution company, receiving in large quantities and shipping out in small quantities, with a real emphasis on service.

Most orders are received between 20:00 and midnight. All vehicles must then be loaded and ready for dispatch by around 05:00, so there is no room for inefficiency in the routing and scheduling process. Previously, delivery schedules were worked out manually but, in an operation with around 3,000 live accounts, this was a highly complex process and led to inevitable anomalies. Some journeys could be completed in five hours, whereas others took 11 hours and, with drivers left to plan their own routes, distribution was not completed as cost-effectively as it could have been.

CVRS was introduced as part of a wider ranging scheme to improve the overall logistic efficiency of West Country Fine Foods. After short-listing several options, Kingswood MapMechanics’ CVRS system, TruckStops, was chosen to plan deliveries nationwide. The system is now used every three months to replan the company’s fixed routes and test the impact of adding new customers or changing load volumes.

As a direct result of introducing CVRS, West Country Fine Foods has been able to balance deliveries much more evenly amongst vehicles, and plan routes that are far more efficient. As a result, fewer vehicles are required, fuel costs have been cut by thousands of pounds a month, and wear and tear and depreciation have been reduced. In purely financial terms, the system paid for itself within just two months, but the simultaneous improvement in customer service has also been of real benefit to the company.

West Country Fine Foods has also taken a full copy of GeoConcept, a geographic information system also supplied by Kingswood MapMechanics. This system can be used in close conjunction with TruckStops to analyse and fine-tune logistics activities, as well as performing wider network planning and marketing activities. Benefits are being realised beyond pure logistics activities. For instance, the system has enabled the company to identify the profitability of individual routes, and there are plans to expand on this capability in the future.

7.3 Alstons Cabinets Enhances Transport Efficiency and Supply Chain Systems Integration

Alstons Cabinets supplies bedroom furniture from its base in Ipswich to over 2,000 customers across the UK. The vehicle fleet consists of 22 rigid vehicles and trailers, completing between 500 and 600 orders every week.

Almost three-quarters of the items dispatched are made to a specific customer order, with scheduled orders used as the basis for manufacturing planning. Just a few years ago the whole process was carried out manually by sorting hard copies of customer orders and then passing the information into other parts of the business.

The simultaneous introduction of Material Requirement Planning (MRP) and Paragon CVRS software has radically changed the process and improved the efficiency and effectiveness of manufacturing planning.
Orders are now downloaded into Paragon for routing, before being uploaded into the MRP system for production planning. As customer time windows and delivery preferences are held in the CVRS system, successful planning no longer depends on someone’s memory when planning routes. Consequently, errors have been reduced and orders are no longer ‘forgotten’ because of people working under pressure.

Other areas have benefited from improved communication. With suitable system interfaces, the information in electronically-generated routes can be circulated widely, quickly and accurately. This action has drastically reduced internal queries and errors, and improved the response to customer queries.

There have also been a number of operational benefits. Better routes and more effective use of vehicles have enabled the fleet size to be reduced by 20% (from 25 to 20 vehicles), bringing with it reductions in running costs and revisions to contract hire arrangements. Critically, however, this move has been achieved without any deterioration in customer service. Planning is now reliable enough to make best use of vehicles without them regularly running late and missing deliveries through attempting to do too much.

Alstons is now also using telematics to provide real-time vehicle tracking. Not only has this change enabled the company to inform its customers where vehicles are and when they will arrive, but it has also provided improved vehicle and load security.

7.4 DW Weaver Achieves Better Speed and Accuracy in Operational and Strategic Planning

DW Weaver is based in Endon, Stoke on Trent and operates from four sites running 70 vehicles across England and Wales. Milk is collected either daily or on alternate days, seven days per week, and is delivered to dairies and reload points. The diverse collection fleet consists of vehicles ranging from 26-tonne rigid tankers to 44-tonne articulated vehicles.

In addition to collections, the company also runs a trunking fleet comprising around 44-tonne, 29,000-litre articulated tankers. Unlike the collection fleet, these vehicles operate across the UK. In addition to regular delivery destinations, these vehicles also make tramping runs collecting and delivering away from base.

Routes for milk collection are largely fixed and manual planning using ‘maps and string’ was used until recently, with planners making minor changes as milk yields varied. However, the task was becoming increasingly cumbersome and time-consuming, and there was always concern about accuracy of plans.

Weavers therefore decided to implement a computerised vehicle routing and scheduling system. DPS Ltd’s LogiX system was selected, and has enabled the company to carry out monthly route reviews that take account of the on-going changes. The planning process is now much quicker and accuracy is greatly improved, with schedules making allowances for road speeds and loading and offloading times. As a result, the company has been able to make better forecasts of mileage run, driver workload and vehicle arrival times at both collection and delivery points. There has been a reduction in overall vehicle mileage, with a subsequent reduction in transport costs.

LogiX has also proved particularly useful for generating quotations, and producing quick answers to ‘what if.....?’ questions from customers.

7.5 Silentnight Beds Makes More Efficient Use of Rigid Vehicles and Trailers

Silentnight Beds is a leading manufacturer of beds, with an annual output of 400,000 mattresses and 200,000 bedding sets i.e. mattresses and bed bases. Although some stock is manufactured in advance of anticipated demand from major customers, most product is made to specific customer order. Product is delivered throughout the UK, with three principal routes to market:

- ‘Home delivery’ on behalf of major high street retailers, normally to private homes, and frequently a single item, which generates around 3,000 deliveries per week
- ‘High street’ deliveries, consisting of substantial orders to retailers, which generates around 500 deliveries per week
- ‘Trunked’, large orders, usually full loads, often using stand trailers delivering into distribution centres for major catalogue companies
Silentnight’s delivery fleet consists of 55 vehicles, 50 of which are drop-bodied drawbar rigids for home and high street deliveries, supplemented by five articulated vehicles used principally for trunking operations. The vehicles operate solo on shorter routes, but usually run with trailers over longer distances.

Prior to the introduction of CVRS, all route planning was carried out manually using ‘piles of paper’. The process was time-consuming and complex, as the delivery profile varied across the year, and the resultant routes were less than optimal. A Paragon CVRS system was introduced many years ago and has consistently delivered improved routes requiring less input from transport planning staff.

Progressive functionality improvements have increased effectiveness. The software successfully handles Silentnight’s particular requirement for operating drop-bodied drawbar vehicles. Whole outfits are routed to a focal point, from where the rigid vehicle completes a delivery route before returning, swapping bodies, and setting off to complete a second route. After that, the whole outfit is reunited and returned to base.

Paragon is integrated into the wider business process. On a daily basis, customer orders for a single delivery region are downloaded into the system. Planned routes are then uploaded into manufacturing systems for planning, and into customer service processes to trigger letters and phone calls to customers, confirming orders and delivery addresses and arrangements. The system supports the ‘what goes out, stays out’ approach to planning and operating.

7.6 G & P Batteries Improves Transport Efficiency and Increases Capacity

G & P Batteries is a Midlands-based business that collects batteries for recycling. The business operates over the whole of the UK, including the islands, and holds a substantial share of the UK market. The company has approximately 500 customers, ranging from small independent companies to major blue chip organisations, with around 20,000 collections being made each year from around 12,000 sites. Around 30,000 tonnes of batteries of all types are collected each year, although the majority are lead acid batteries from cars, fork-lift trucks, stand-by power supplies etc. Batteries are all returned to the main depot, where they are sorted before being transported to recycling plants.

The company has to comply with a wide range of safety and environmental regulations, both at its site and in the operation of its vehicles. The in-house fleet comprises 19 vehicles, including a 44-tonne articulated vehicle, a 38-tonne drawbar combination, 26, 18 and 3.5-tonne gross weight rigids and a number of vans. All except one of the fleet are based in the West Midlands.

G & P Batteries’ routing and scheduling requirement is unusual in many ways. Once customers make a request, a collection will be made within ten working days, and customers are not restrained by a ‘normal’ collection day. A typical ‘order pool’ of 900 - 1,000 collections exists, in a very wide range of sizes, which can be built up into routes.

The planners therefore have a good deal of flexibility, but they must ensure that the service commitment is met at the same time as ensuring the efficient use of vehicles. The business is low margin, so it is critical to achieve a good vehicle fill. To help the company meet its diverse needs, Roadnet CVRS software was introduced. The system gives orders an increasing priority rating as the ten days elapse, ensuring that no one remains at the back of the queue for ever.

G & P Batteries sees the benefits of CVRS as significant. The critical 90% vehicle fill is achieved and daily planning time has been reduced by around five hours a day. Transport management and administration have also improved, and management are confident that the current four planning staff will be able to handle the expected doubling of throughput.
Roadnet is also providing good management information, including forecasts of the cost of future routes, and is being used for strategic planning.

G & P Batteries is now looking at the use of vehicle telematics which, in conjunction with portable weigh beams, will enable live recording of transactions at customer sites and also enable tracking and recording of the company’s containers that are left with customers.
Appendix 1  CVRS in Detail

This section explains in more detail the way that CVRS systems work and the way that they are controlled. More technical information and specific information on individual software packages can be obtained from system suppliers or through their websites. A list of the main system suppliers in the UK is given in section 6.

A1.1 Data Assembly

Accurate data are essential in any CVRS system. Without them, accurate and reliable routes and schedules cannot be guaranteed.

Data must be assembled during the implementation process, with various stages covering data gathering, checking, cleansing and rechecking. Wherever possible, data should be imported electronically from external sources to minimise manual data entry and therefore minimise the risk of introducing errors.

The following sections describe the basic data required for most CVRS systems.

Order and Product Volumes

For most businesses, a lot of work will have to be done to define product or order size (dimensions and weight), so that the CVRS system can work out the best fit on a vehicle when orders are being processed. For organisations that supply or collect goods in neat rectangular boxes, this will not prove difficult. Data will simply have to be checked for accuracy regarding product dimensions and weights, filling in any gaps, perhaps for new products.

For goods dispatched or collected in a range of shapes and sizes, more work will be required. Goods which can, but don’t always, fit inside each other or nest will probably be the most difficult to define.

Customer Details

A set of fixed customer data is needed, to enable the CVRS to locate premises on the map and define the parameters within which deliveries must be made.

Most companies now store good customer details as part of their customer management process, including the full address and postcode. However, data entry may not be straightforward. Most businesses find a number of errors arise when a set of addresses and postcodes is entered into a CVRS system, ranging from simple typographical errors to invalid or incorrect postcodes.

For example, customers may be listed by the head office address, whereas deliveries are made to another place. Any errors will take time and patience to resolve.

Similar difficulties can arise with data on customers’ delivery parameters. Where comprehensive data are already recorded, the process of uploading the details into the CVRS system should be fairly simple and problem-free. However, many records are incomplete. Often, restrictions exist that schedulers are aware of, and working to, and yet they remain unrecorded. Likewise, records may show restrictions that schedulers know can be ignored. All of these issues need to be resolved when data are input, as the CVRS system can only act on the parameters stored, and routes and schedules will be planned accordingly.

Customer details need to include:

- A unique reference number, by which the system can identify the customer
- A name, which can be the company name, delivery town or customer reference number
- The full address for the delivery, using postcode, town name or grid reference
- The specified delivery day, where applicable - if customers must receive deliveries on particular days of the week this must be entered, otherwise the system will use the most economic day
- Any specified time windows for deliveries
- Any specified vehicle types where, for example, customer site access is restricted by height, length or weight restrictions

Verification of Addresses

Address verification varies from system to system. Some systems use an internal address verifier to pinpoint customer locations accurately, whereas others
require users to verify customer addresses before importing the data. Either way, verification should not cause too many problems. Many organisations that deal with different customers every day, such as those involved with home deliveries, successfully use CVRS to plan their operations.

Address information can be imported in several ways:

- **Postcode** - this is the most popular method and offers the most accurate, readily available location reference. Most users will know the postcodes for their collection and delivery points. If not, systems are available that can ascertain postcodes from address data, or locations without postcodes can be fixed on the digital map. Many vehicle scheduling systems can interpret postcode information down to full postcode level. Those that are only capable of locating to postcode sector level (e.g. TN4 9) do not provide such a level of accuracy, but for many users this will be accurate enough.

- **Grid Reference** - identifying location by grid reference or by latitude and longitude is extremely accurate, particularly for deliveries and collections in the agricultural sector. However, errors in grid references are difficult to detect without supporting address information.

- **Gazetteer** - in the context of CVRS, a gazetteer is a pre-prepared list of place names together with their physical location in latitude and longitude and x and y co-ordinates. Although this offers a reasonably accurate method of identifying call point locations, problems can arise from:
  - Ambiguous place names
  - Incorrectly spelt place names
  - Vague locations within large cities

Further information on establishing locations is contained in section A.2.

**Customer Order Data**

Details of each order to be planned are required. In most cases, these data will be downloaded electronically. The following data will be required:

- A unique reference number, which must be cross-referenced to the customer reference number, and must be unique to each fresh order for a particular customer
- The order size, in a measure which matches that used to define vehicle capacities, i.e. weight, cube, number of pallets or roll cages, etc
- Whether the call is a delivery or collection, because the systems will only plan collections if there is room on the vehicle at that point on the route

**Vehicle Parameters**

Details are required of all vehicles that can be used by the CVRS system in the routing process. Systems can use either a fixed or a variable number of vehicles, but in either case will need details including:

- The number of vehicle types, such as tractor units, semi-trailers, rigidos, trailers, etc
- The number of vehicles of a particular type
- The total capacity of each vehicle type in the appropriate measure i.e. tonnes, cubic metres, pallets, litres, cartons, cages, stillages, roll cages, etc
- The number of compartments on each vehicle and their capacity, including details as to whether compartment size is variable
- The length of time for which vehicles are available for work
Driver Details
Data must be stored in the CVRS system detailing:

- The number of drivers available
- Their hours of work
- Their rest and break requirements

Other Data
To exploit the full capability of a CVRS system, other data may be stored including the following.

The Sequence of Delivery
Orders can be scheduled in a particular sequence on pre-allocated routes, provided that a sequence number is attached to each order. This feature can only be used in conjunction with pre-planned routes.

Priority
In most systems, orders can be assigned different priorities. Some systems automatically update the priority of orders remaining undelivered at the end of each day.

Booked Time
Specifying a booked delivery or collection time enables the system to plan routes that meet all requirements for timed calls.

Loading and Unloading Time
All systems allow the user to make allowances for loading and unloading times. Different times can be set according to product type or vehicle type, or to allow for a vehicle with a crew. Some systems also permit different times to be set for different days of the week.

A1.2 Mapping

Digital Maps
All CVRS systems use some form of digital map as the basis for calculating routes.

In recent years, the sophistication of digital maps has increased significantly, and they are now available in various levels of detail. These detail levels correspond to the levels of paper maps or atlases with which we are all familiar. At the higher level, maps contain details of motorways, trunk roads and many A roads, equivalent to the sort of paper map that might be used to plan a journey to a major city in France.

The next level down will, in addition, contain details of all A roads and many rural B roads and country lanes, but only the most major routes in towns. In paper terms, this might equate to a general road atlas that many people carry in their car for everyday use.

The third level of detail includes street level mapping for all roads within a given area, including street and road names. At the finest level of detail, the street level maps will include information of one-way traffic flows, prohibited left or right turns, weight, width or length restrictions and perhaps the height of low bridges.

Establishing Locations
Geocoding, the process of locating buildings, sites, addresses etc, on digital maps, involves various methods, although in practice most use postcodes or addresses, or a combination of the two.

The Post Office has its own data file (Postzon) that relates postcodes to map co-ordinates. The degree of accuracy is not the same for all addresses, because the average number of addresses within each postcode is fifteen. Postzon covers the UK in 100-metre square grids, with co-ordinates for each grid taken from a point in the bottom left-hand corner of each square. Each square covers 10,000 square metres, and generally includes a number of postcodes and many different addresses, particularly in densely populated areas. Each of these addresses will be assigned the same co-ordinate.

The Ordnance Survey has a data file called Codepoint which creates a grid co-ordinate for each postcode, based on the position of an actual property near the centre of the postcode area. A further level of detail is also available that provides a co-ordinate for each property.

Identifying the Operational Need
As expected, the higher the level of detail on the maps, the higher their cost and perhaps the higher the cost of the computer needed to process the data. It is therefore important to know what level of detail is required from the CVRS system, so that the system supplier provides only the required level of detail.

For example, an operation that runs 200 - 300 miles between delivery points will not be unduly affected if the geocoding places a customer hundreds of yards from its actual location. However, a parcel carrier may need to know on which side of the road an address is located, particularly if the road is an urban dual carriageway, and the routing process will need to take account of one-way streets.
A1.3 Optimising the Use of Resources with a Vehicle Scheduling System

Anyone thinking of implementing CVRS should be aware that the system will not replace scheduling staff. While a CVRS system is a very sophisticated tool that substantially reduces man-hours of effort to produce routes and schedules, it still requires input from knowledgeable routing and scheduling staff to optimise the solutions.

Making Manual Adjustments to Computer-generated Solutions

CVRS users can normally modify routes by:

- Changing the dispatch day
- Inserting, deleting or resequencing calls, generally using ‘drag and drop’
- Inserting depot visits and additional deliveries
- Modifying the resources used (e.g. depot, vehicle and driver shift)

Most systems have the facility to re-optimise routes once interactive modifications have been made.

Identifying Calls Not Routed

Occasionally, a CVRS system will fail to schedule some calls. Reasons for this include:

- Resources may not match demand, for example, there may not be enough vehicles of the correct type
- Booked time constraints or time windows may conflict for calls planned on the same fixed routes
- There may be insufficient time (duty or driving) to complete certain calls within a shift

Users must be able to establish the reasons for any failures quickly. Some systems will display the reasons for any calls not planned, allowing the user to make adjustments to routes and display any constraints broken as a result of manual alterations. At this point, the user can decide whether breaking constraints is acceptable: often this will involve a call to the sales team or to customers themselves.

Adding Calls to Existing Routes

Dynamic daily routing is a valuable feature supported by many CVRS systems. Users can insert additional last-minute orders into routes planned earlier in the day, and then rapidly re-evaluate the routes planned.

Merging Routes

Occasionally, a CVRS system produces routes that make poor use of a driver’s time, vehicle capacity or both. Systems enable users to merge routes, to improve use of resources.

A1.4 Specialised Scheduling Applications

Specialised applications are available for more advanced routing and scheduling tasks.

Determining the Optimum Location for Depots

Separate modules are available from principal system suppliers that enable users to work out the optimum locations for depots. Some of these modules zone the delivery points and find the best location for a depot to serve each zone, taking into account the road network and the distribution of customer locations within a given area.

Integrated Scheduling of Fleets from Several Depots

Some operators need to plan routes and schedules for a number of vehicles operating from different centres, in order to achieve optimum utilisation of the resources available at each centre.

CVRS systems are available that can plan routes centrally for a number of regional operations. These systems can achieve optimum vehicle utilisation across all the sites as a whole, and operations may benefit from having a centralised scheduling team. Alternatively, initial schedules can be created from a single central point before being optimised locally by individual depots.

Multiple Compartments

The capability to distinguish multiple compartments is widely available and is used for scheduling vehicles, such as tankers or multi-temperature vehicles. Capacities are assigned to individual compartments on vehicles, for use when routes and schedules are planned. If applicable, compartments can be assigned variable sizes (and therefore product carrying capability), which is particularly useful on temperature-controlled vehicles with movable bulkheads. Compartments can also be assigned to specific products or ranges of product, ensuring that goods remain segregated on the same vehicle.
Trunking and Transhipment

Trunking and transhipment work have particular scheduling difficulties, but modern CVRS systems are now able to manage these particular operations more successfully.

Many systems can plan local delivery routes from locations remote from the central depot (including stockist depots and motorway car parks), and can also plan inter-depot trunking routes.

Product Incompatibility

Modern CVRS systems include the capability to manage incompatible products. This is, however, a complex field and potential users must be careful to ensure that suppliers are fully aware of their requirements when finalising system requirements.

Bulk Products

Some CVRS systems enable orders larger than the largest capacity vehicle to be assigned to several vehicles of appropriate sizes. This feature can be particularly useful in organisations that regularly receive individual orders of very large quantities.

Appendix 2 Journey Planners

The typical journey planner is in some ways a simple version of a CVRS system. The principal purpose is to calculate time and distance for individual journeys, and in some cases the cost of those journeys. They are particularly useful where the number of vehicles is relatively small and the complexity of the routing problem does not justify investment in a full CVRS system.

Journey planners do not generally take account of customer loading and unloading constraints (e.g. time windows, booked time or vehicle size) or vehicle capacities, and do not attempt to schedule vehicles across any given period of time. Nevertheless, they can prove a useful, and usually relatively inexpensive, tool for many organisations operating vehicles, whether they be LGVs, vans or service or sales staff transport.

A2.1 Applications

Typical applications for journey planners are:

- Calculating the time, distance and cost of manually generated routes
- Checking distances on tachograph charts or haulage invoices
- Establishing the daily driving range of certain types of vehicle
- Checking the time and distance ranges from given operating centres

A2.2 Operation

Journeys planners electronically locate all points of call on a journey, plot the distance between node points and display the suggested route on the digitised map. The user can sometimes choose whether the route is calculated according to:

- Least time
- Least distance
- Least cost

The user can also choose whether journey time should be calculated based on a pre-determined departure time or a pre-determined arrival time.

A2.3 Data Input

In a journey planner, call points for each route are selected manually. Consequently, this type of system is not ideal for planning a large number of routes, or routes with numerous call points, as the planning process will be very time-consuming. They can, however, help organisations to improve efficiency, reduce energy
consumption and cut costs without a major investment in sophisticated software.

When building journeys, each call point must be identified (by postcode, town name or grid reference) and entered into the system. Planning time can be reduced if regular routes are stored electronically and later recalled for modification. Individual call points can be added, deleted or edited on individual routes.

A2.4 Parameter Settings

Most journey planners allow the user to define a number of operating parameters, although care must be taken to avoid using unrealistic settings that could result in unachievable journey times. Typical parameters include:

- Type of vehicle to be used
- Running speeds by road category for each vehicle type
- Percentage reduction in speed over selected sections of roads or whole roads
- Length of rest periods and breaks
- Any roads or sections of roads not to be used
- Duration of stop time (for individual deliveries or collections)
- Fixed and variable costs for each vehicle type

Any changes to these settings normally affect all routes.

A2.5 Screen Mapping Features

Individual journeys can be displayed on screen against a background of the road network. If required, the user can choose to display parts of a route in more detail, by enlarging smaller areas of the map on screen.

A2.6 Other Features

The following features are normally available on journey planners:

- Finding the nearest place or road, by placing the cursor on the map
- Optimising the sequence of points within multiple stop journeys. This feature is particularly helpful when the user is unsure of the best sequence for a particular journey or there are added call points as orders have been received throughout the day. It is also useful for quickly reorganising journeys to accommodate last minute orders.
- Defining drive time zones i.e. the area within a specified drive time of a location

A2.7 Outputs

Journey planners generally allow users to:

- Save individual journeys to file, for later printing, re-use and/or amendment
- Print route maps (in colour or black and white)
- Print detailed journey itineraries, for issue to drivers, etc
- View and/or print a summary of journeys, showing total time, total miles and total cost
Appendix 3  Vehicle Telematics

A3.1 Introduction
The use of vehicle telematics is not essential for successful introduction of CVRS. However, many organisations consider introducing telematics at the same time, because of the additional benefits that can result. Before deciding to introduce CVRS and/or telematics, organisations need to carry out a careful analysis of their current transport operations and determine the future needs of the business.

Telematics has been defined as ‘the remote use of computers to control and monitor remote devices or systems’. Current vehicle telematics systems and equipment offer the transport industry an unprecedented opportunity to manage its main assets - the vehicle and the driver - far more effectively than ever before. This, in turn, will enable the operation to reduce operating costs, improve customer service, or both.

A3.2 Telematics in Use

Hardware
The exact configuration of on-board equipment will vary, but typically consists of a number of distinguishable modules:

On-board Computer
Usually the heart of the system, this small, electronic box contains hardware and software that receives and stores data from vehicle systems and a global positioning system (GPS), and controls communications equipment.

Global Positioning System
This electronic box passively receives signals from a number of satellites in geostationary orbit (i.e. their position remains the same relative to the Earth’s surface). The GPS calculates its position on the Earth’s surface based on receipt of these signals. Positional accuracy can be as good as a few metres.

Communications Module
This electronic box transmits data gathered on the vehicle and receives external data, usually from the vehicle’s base.

Controller Area Network (CAN)
Perhaps the least visible element, the CAN is a standard part of the electrical equipment built into most large goods vehicles in recent years. It provides a high speed communications network, designed to support control functions between electronic devices on the vehicle.

Driver Terminal and Keypad
These portable data terminals with a screen and keypad often take the form of a unit similar to those increasingly used by warehouse operatives. They enable systems and drivers to communicate with one another, and are often mounted in a cradle within the cab. This position enables the unit to be linked into the communications module, and also places it near a source of power for battery recharging.

Navigation Module
This small in-cab display provides the driver with a visual map-based indication of the vehicle’s position and turn-by-turn directions to a destination.

Vehicle and Driver Data
At their simplest, driver data enable an individual driver to be identified and recorded using either a simple PIN number or an electronic identity card. Identification can be used to authorise fuel dispensing, for instance. In the near future, the introduction of the digital tachograph will enable telematics systems to record and analyse drivers’ hours and help drivers understand and comply with ‘Drivers’ hours rules’ requirements.

Vehicle data can be virtually anything the business needs. Vehicle efficiency applications currently in place include fuel use (which, with links to other systems, can be converted into miles per gallon information), engine idling time, engine revs and heavy braking. Other possible data streams include doors or valves being opened and closed, and the temperature of chilled or frozen compartments.

For operations with high-risk cargo, such systems can also provide a panic button that sends a message to the vehicle’s base and enables assistance to be summoned.

Vehicle Tracking Systems
Vehicle tracking systems take the positional data from a GPS system and send it back to a base point, where it is usually linked to digital map data. The vehicle position can then be displayed on a roadmap on a computer screen, enabling the operator to know, with a good degree of accuracy, where vehicles are and whether
they are on the move. This information can be compared with a route or load schedule to determine whether the vehicle is running ahead of or behind time, and gives transport operators the opportunity to take action. For example, they may choose to contact a customer to warn of a late delivery or to re-book a delivery slot.

As an extra element of customer service, that data may also be used to trigger messages to customers, letting them know when a vehicle is perhaps five or ten minutes from arrival.

Tracking systems also allow transport operators to highlight deviation from a planned route, or movement when none is expected, perhaps due to vehicle theft. Such systems may also be fitted to trailers.

Proof of Delivery or Proof of Collection

Perhaps one of the most common uses of telematics is the provision of real-time Proof of Delivery or Proof of Collection (POD or POC). Using a portable data terminal, the driver can obtain a customer signature for delivery or collection, which is transmitted back to base as soon as the driver fits the terminal back into its cradle within the cab. Linking these processes to vehicle tracking confirms the position of the vehicle when the delivery or collection took place.

POD or POC units can also be used for gathering and processing other information, such as barcodes, perhaps of delivered goods or containers, details of the tank into which a load is discharged, or even for payment transactions. They can also record quantities of goods collected, where this is not known ahead of time.

If required, drivers can be equipped with a small printer, for customers who require paper confirmation of transactions.

Planned versus Actual

By linking vehicle tracking systems to a CVRS system, together with a suitable display or reporting methodology, it is possible to compare actual performance with that planned. At its simplest, this may replace or supplement driver debriefing. More usefully, the link can enable re-routing of vehicles within a planned schedule, perhaps changing delivery sequences so that customers with critical delivery time windows receive their delivery on time, and it can allow customers to be warned of anticipated late deliveries.

On-board Navigation

These navigation systems generally provide an in-cab display which, based on the vehicle’s current location and destination, gives the driver junction-by-junction instructions to the next call point.

Care must be taken with the use of such systems in single manned vehicles to ensure that the driver’s attention is not distracted whilst driving. Modern systems are available where the instructions are spoken to the driver rather than relying on a pictorial representation on the screen.
Appendix 4 Supplier Questionnaire

The following tables of questions are intended to help organisations looking to evaluate the characteristics and capabilities of potential systems. The lists are not exhaustive and should be used as a guide only.

Additional questions will be needed to determine the suitability of a system to meet an individual company’s requirements.

For additional help, Section 6 of this guide contains answers to these questions as received from the main suppliers of CVRS systems within the UK.

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<td>1.2</td>
<td>Which data elements are entered into the system manually?</td>
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<td>2.3</td>
<td>What is the maximum number of customers and calls?</td>
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<td>2.4</td>
<td>How does the system accommodate vehicles of different types and capacities (e.g. multiple compartment, temperature controlled)?</td>
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<td>2.5</td>
<td>Can the system accommodate customer restrictions on vehicle types and collection/delivery times?</td>
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<td>2.6</td>
<td>What range of different driver and vehicle shifts can be accommodated by the system (including double shifting)?</td>
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<td>2.7</td>
<td>What scope is there for variations to road speeds?</td>
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<td>3.9</td>
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<td>3.10</td>
<td>Does the system allow for vehicles to commence a new trip part way through a working shift?</td>
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<td>Can the system show reasons for orders not routed?</td>
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<td>Can the system ensure all deliveries are done on the first day of a multi-day route?</td>
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<td>3.13</td>
<td>Can the system schedule ‘tramping’ (i.e. collecting from one point on a route and delivering to another point on the same route)?</td>
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<td>4.2</td>
<td>Can the system spread deliveries at specified intervals (e.g. weekly/fortnightly) over an extended schedule period?</td>
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<td>4.3</td>
<td>Can the system schedule nearest calls first?</td>
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<td>Can the system prioritise orders for delivery?</td>
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<td>Can calls be manually selected from a map and routed?</td>
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<td>4.6</td>
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<td>4.7</td>
<td>Can the system split large consignments across a number of vehicles?</td>
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<td>5.2</td>
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<td>5.4</td>
<td>Can route paths be displayed?</td>
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<tr>
<td>5.5</td>
<td>Can individual trips be displayed?</td>
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<th>6</th>
<th>Modelling</th>
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<td>6.1</td>
<td>What is the system’s capability for modelling (e.g. strategic or operational schedules)</td>
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<tr>
<td>6.2</td>
<td>What address/mapping level does the system route down to?</td>
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</tbody>
</table>
### Management reports

#### 7.1 What management reports are produced by the system?

#### 7.2 Can the user generate customised reports?

#### 7.3 What other transport management software can be interfaced with the system (e.g. telematics, fuel management, GPS)?

#### 7.4 Can data and reports be exported electronically?

### Support/training/technical support

#### 8.1 What is the typical frequency of software updates?

#### 8.2 What is the typical frequency for map updates?

#### 8.3 What is the training time required for an average operator?

#### 8.4 What are the system’s hardware requirements?

#### 8.5 Is there a help desk? What are its hours of availability, and how many staff support it?

#### 8.6 What arrangements exist for on-going software development?

### Cost

#### 9.1 What is the budget cost for a single user system?

#### 9.2 What is the budget cost for additional copies?

#### 9.3 Do these costs include any training?

#### 9.4 What is the cost of annual updates?

### Market

#### 10.1 How many UK companies use the system?

#### 10.2 What is their approximate range of fleet sizes?

#### 10.3 What sort of transport operations are considered to be the product’s target market?
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This guide provides information on the basic ingredients of telematics systems, highlights how to use this technology, the information obtained from it and how to select the right system for your needs.

### Operational Efficiency

**Reducing the Environmental Impact of Distribution**
This Case study shows how Transco National Logistics reduced costs, mileage and CO2 emissions with alternative fuels, stepframe trailers and improved vehicle routing.

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