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"Enhanced data management techniques for real time logistics planning and scheduling"

Deliverable D8.3: New/Emerging Logistics Business Models

Dissemination level:
☒ Public ☐ Confidential, only for members of the consortium (including the Commission Services)

Version number: 1.0

Submission deadline: 30/11/2018

www.logistar-project.eu

LOGISTAR project has received funding from European Union's Horizon 2020 research and innovation programme under Grant Agreement no. 769142.

DOCUMENT INFORMATION

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Document control

Version	Date	Comment
0.1	16/11/2018	
0.2	28/11/2018	

Document approval

Version	Date	Partners
1.0	30/11/2018	All partners

LOGISTAR project has received funding from European Union's Horizon 2020 research and innovation programme under grant agreement no. 769142.

BASIC PROJECT INFORMATION

Horizon 2020 programme

H2020 - Mobility for Growth- 5-2-2017. Innovative ICT solutions for future logistics operations

Grant Agreement No. 769142

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LOGISTAR project has received funding from European Union's Horizon 2020 research and innovation programme under grant agreement no. 769142.

1. Introduction

LOGISTAR is a Horizon 2020 research project, funded by the European Union (EU). It consists of pan-European partners from academia, the software industry alongside both shippers and forwarders. The key aim of the project is the development of a 'digital tool' to allow:

- Effective planning and optimisation of transport operations in the supply chain;
- Securing horizontal (and vertical) collaboration;
- Real-time decision-making; and
- Real-time visualisation for freight transport.

The main objective of LOGISTAR is as follows is:

> *"To allow effective planning and optimizing of transport operations in the supply chain by taking advantage of horizontal collaboration, relying on the increasingly real-time available data gathered from the interconnected environment. For this, a real-time decision making tool and a real-time visualization tool of freight transport will be developed, with the purpose of delivering information and services to the various agents involved in the supply chain, i.e. freight transport operators, their clients, industries and other stakeholders such as warehouse or infrastructure managers."*

Within this main objective are a set of specific ones related to 3 distinct project areas:

PROJECT AREA	SPECIFIC OBJECTIVES
Real-time decision making tool for planning of logistics operations	To *increase by 10% the load factors of freight vehicles* derived from the optimization techniques applied to freight deliveries planning.
	To *shorten by 10% the delivery routes* thanks to applying planning of optimal routes relying on synchromodality, being continuously updated in case of disruption.
	To *increase the reliability and efficiency of logistics services* by predicting events and incidents affecting the supply chain and by providing alternative routes in real-time to these disruptions.
	To *facilitate the management of logistic operations* by providing real-time supply chain visibility through dashboards not only displaying information but also showing deviations, alerts or recommendations to take actions.
	To *boost horizontal collaboration among logistics agents* focusing on full truck load (FTL) backhaul opportunities, consolidation of less than truckload (LTL) deliveries, supply chain collaboration and synchromodal opportunities.
Real-time information on synchromodal transport	To *increase the visibility of the delivery* derived from the use of sensors to monitor the goods shipped and boosting to share logistic data&information among agents.
Rest of the Implementation of the project	To *promote the sharing of open data in the logistics sector* by promoting the benefits of collaboration and Big Data analytics across stakeholders.
	To *enable new market opportunities* on the logistic information services sector, by developing new business models focused on data and high value service delivery, and exploring concepts such as "sharing" rather than "owning" transport assets. The policy and legal dimension will also be studied.

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This Deliverable 8.3 is the first of three annual reports on new logistics business models which covers the following topics:

- An overview and description of the main logistics supply chain models that have been adopted by both the retail and manufacturing sectors. It identifies the key commercial players involved at the various stages of the supply chain;
- A review of the use of existing technology used for planning and optimisation of transport operations in the supply chain; and
- The extent to which the key players in the logistics industry already collaborate.

The report essentially represents our preliminary thoughts on these topics derived from our extensive knowledge of the logistics sector alongside some primary desktop research. It is intended to inform the early stages of the development of the LOGISTAR 'digital tool'. This position will be further refined through additional primary research that we intend to undertake over the next few months, including compiling a series of case studies of 'real life' supply chains, which can assist in validating (or otherwise) the information presented below. This will be reported on in the next release in Month 18.

2. Overview of Logistics Supply Chain Models

2.1 Introduction

This section of the report provides an overview of the main logistics supply chain models that have been adopted by both the retail and manufacturing sectors. It identifies the key commercial players involved at the various stages of the supply chain.

It should be noted that they are ‘models’ of logistics supply chain; they provide a simplified description of reality in order to assist in explaining how companies organise the movement of goods from producers/suppliers to the end-user, as well as the key commercial players involved. These models are not intended to be a perfect ‘fit’ with an individual organisation’s actual supply chain, though examples of companies which have broadly adopted each model are given. It may be the case that an individual company’s supply chain could be an amalgam of two or more models, or they may have adopted more than one model for different parts of their businesses.

2.2 E-commerce Supply Chain 1

Figure 1 below provides a visual description of this model. As an example, the retailer *Amazon* broadly follows this model in Great Britain.

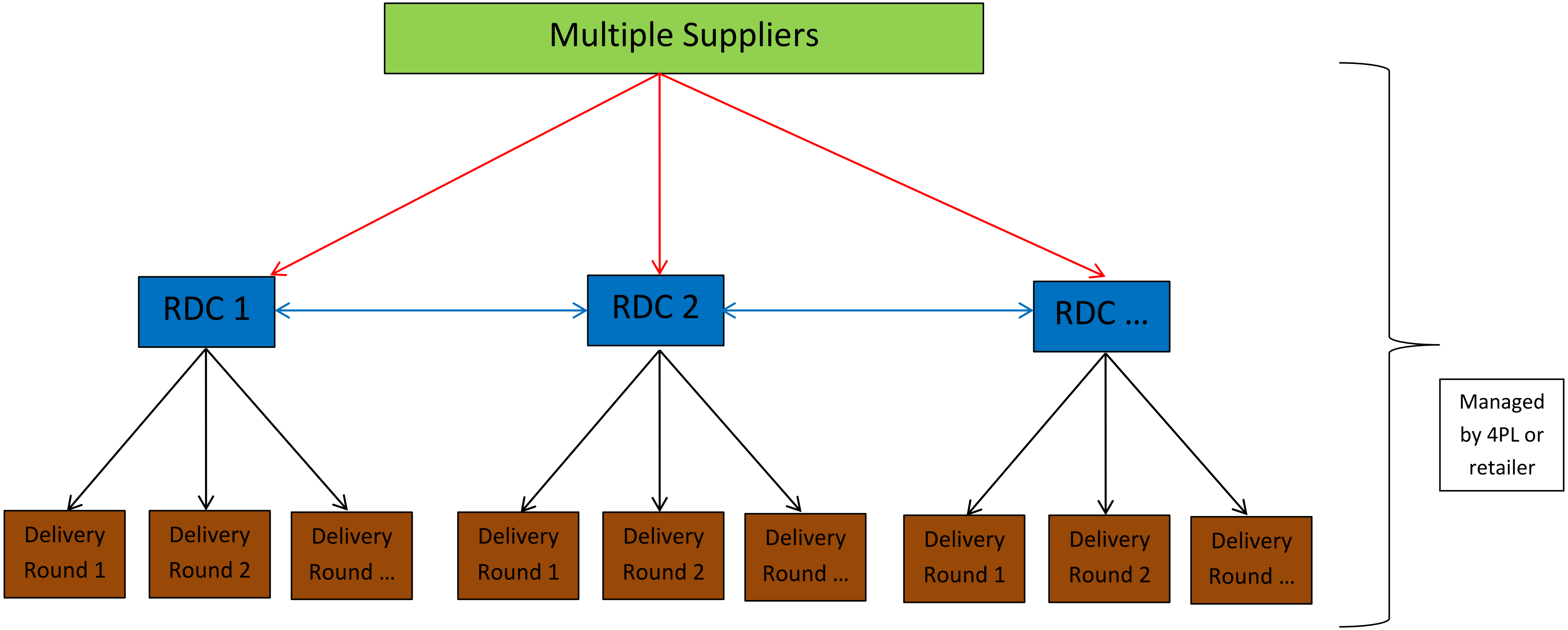

Figure 1: Flow Diagram – E-Commerce Supply Chain 1

In this model, a series of Regional Distribution Centres (RDCs) are located close to major urban conurbations. Each RDC receives inbound deliveries of cargo from the retailer's multiple suppliers (by road or potentially rail if located at a rail-served site); the e-commerce retailer is therefore responsible for holding sufficient inventory at each RDC in anticipation of demand so that customer orders can be fulfilled in a timely manner. Inter-RDC transfers may take place to maintain an appropriate balance of stock-holding at each RDC.

On-line orders placed by end-users and received by the retailer are then picked, appropriately packed and labelled at the RDC, before being loaded onto freight vehicles for delivery to residential and commercial properties. This is normally undertaken on a multi-drop basis (sometimes called 'milk-round' deliveries), where the freight vehicle will depart from the RDC loaded with consignments for multiple end-users, only returning to the RDC once it has visited all delivery locations. Deliveries from each RDC are generally to their immediate urban hinterland. In most cases, deliveries are undertaken by a Light Goods Vehicle (LGV, essentially some form of van up to 3.5 tonnes gross vehicle weight or gvw), though medium-sized goods vehicles (MGVs) up to 7.5 tonnes gvw may also be used depending on the product being handled.

The whole process of stock-holding (inventory management), picking, packing and delivering is often called 'order fulfilment' and the RDCs termed 'fulfilment centres'. RDCs are normally large purpose-built 'warehouse' type buildings designed to receive, store and then despatch goods as described (with multiple loading docks, storage racks, packaging equipment etc.). The actual building may be owned by the retailer or a 3PL, or leased from a landlord, the latter often being an investment fund.

Deliveries to residential and commercial properties from the RDCs may be undertaken on an 'own account' basis i.e. on freight vehicles owned/leased by the retailer (see page 21 below for a full explanation). However, the retailer will often out-source (contract out) this part of the operation to specialist third-party logistics (3PLs – see page 22 below) operators, such as DHL or the main multi-national parcel couriers (e.g. TNT, DPD etc.). In the case of Amazon in the UK, these deliveries are increasingly being handled by self-employed 'driver and van' type operators (the driver is responsible for providing the LGV and is paid per item delivered). Likewise, the operation of the RDCs (covering the inbound receipt of goods from suppliers, inventory management, picking/packaging and loading to LGVS/MGVs for final delivery) may be undertaken in-house by the retailer or again out-sourced to a specialist 3PL.

In the case of some on-line only retailers such as Amazon, the company will often be located (headquartered) in another country to where customer orders are placed, with the order fulfilment then undertaken on behalf of the retailer in the country of delivery. For example, orders placed with Amazon in the UK for UK delivery are actually made with Amazon's European parent company based in Luxembourg, with a UK-based subsidiary company being responsible for the order fulfilment in the UK on behalf of Amazon in Luxembourg. In addition to fulfilling orders for their own products, some on-line retailers will undertake order fulfilment on-behalf of other e-commerce retailers.

Given the proximity of the e-commerce RDCs to the major conurbations, the lead time between receiving the order and fulfilment can be short and will often depend on the price the end-user is willing to pay. As a general 'rule of thumb', next day (or increasingly same-day) deliveries will require the payment of a premium over and above the price of the product ordered. Extended lead times (e.g. 5 days after order) will attract lower deliver charges or may even be free.

The retailer's multiple suppliers are now located both throughout Europe and further afield (predominantly in the Far East). Models describing the supply of goods from suppliers are illustrated further below.

Despite out-sourcing specific operational tasks to 3PLs (as described), the e-commerce retailers can retain overall control and management of the whole supply chain (this might also including inward movements from suppliers – see further below). However, a recent concept in supply chain management is the emergence of *fourth party logistics specialists or 4PLs*. Sometimes referred to as the 'lead logistics provider', a 4PL is contracted by the client (in this case the e-commerce retailer) to manage the entire supply chain on its behalf (potentially including inbound flows from suppliers too). In addition to undertaking some of the supply chain logistics operations itself, the 4PL will 'buy-in' (sub-contract) other specialist logistics activities where relevant from 3PLs such as deliveries and fulfilment centre management. The 4PL will then co-ordinate the various activities along the supply chain, including those of contracted 3PLs, to ensure it operates efficiently.

The key commercial players for Model 1 are therefore:

- The on-line retailer;
- Suppliers to the retailer (see below);
- Contracted 3PLs (including parcel couriers) and 4PLs
- Rail freight and intermodal terminal operators; and
- Commercial property owners/developers of the RDCs.

Own account operations are where a manufacturer or retailer will operate their own transport equipment, employ their own drivers and manage their own transport operation in-house to deliver their own goods to end-users. The transport operation's priority is therefore to service the main core business of the manufacturer or retailer, and hence is not a commercial enterprise designed to make a profit. However such operations are normally set a budget and are expected to operate within it. Warehouses (fulfilment centres) can also be operated on an own account basis. The main reasons why companies operate own account transport operations include:

- The ability to manage the transport operation as an integral part of the core business. The interface between the transport operation and other activities such as warehousing or production is perceived to be better where the transport operation remains in house;
- Perceived management and driver loyalty to the core business rather than to an outside organisation;
- Where strict quality, safety and hygiene standards need to be followed some companies prefer to maintain direct control over the operation rather than allow them to be managed by an outside organisation;
- Transport operations are often the only direct point of contact with customers (the customer will only see the vehicle and driver), and therefore some companies prefer to maintain direct control over this. The presentation and performance of drivers at customer premises has been known to retain and win new business. This is the concept of ‘utility’. While out-sourcing may generate economic efficiencies, retaining the operation in-house is viewed as creating greater value or worth for the business as a whole (such as being able to generate additional sales);
- Management inertia – why change a set up that is perceived to be successful; and
- Some companies have retained parts of their transport operations in-house so as to 'benchmark' the performance of other 'contracted out' transport operations within their business

Own account operators, as well as employing their own drivers, will also employ their own managers and supervisors to run the transport operation. There are consequently other commercial reasons, other than direct profit/cost issues, why freight owners also want to be freight movers.

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Over recent years, however, the trend has been for manufacturers, suppliers and retailers to out-source their transport and other logistics functions to specialist ***third party logistics operators (3PLs).*** The principal reasons driving the use of out-sourced 3PLs includes:

- Perceived or actual cost savings. 3PLs are able to offer lower cost solutions through a mixture of competition to win/retain business, the ability to gain greater discounts on fleet equipment and operating goods vehicles more efficiently (ability to seek return loads and run vehicles full in both directions);
- Perceived or actual quality of service improvements. Competition to win and retain business results in a higher quality of service compared to own account operations; and
- To introduce new ideas and working practices. Competition to win/retain business can result in innovative ideas and solutions being designed and implemented to overcome management inertia to change.

Overall the idea behind employing a 3PL is based on the theory - and recent trends in commerce - that companies improve their performance by focusing on their core activities while out-sourcing activities viewed as peripheral to organisations which specialise in that field. For example, a retailer should focus on retailing, contracting out their distribution activities to companies whose core activity is logistics.

3PLs vary in size and scale. Some very large national and multi-national 3PLs will provide a full range of logistics activities for their clients, including:

- Warehouse operation;
- Stock control;
- Order processing;
- Packaging/labelling/bar coding;
- Removal/disposal of waste packaging;
- Transport operations e.g. road haulage, rail freight, air freight.

In some cases, transport fleets and drivers may be dedicated to a particular client i.e. will only move goods for that shipper. Alternatively, 3PLs may also operate ‘pooled’ transport fleets whereby vehicles will move goods for a variety of the 3PLs’ clients (and likewise ‘shared user warehousing). By their nature, 3PLs are a shared logistics resource in that a single 3PL will be handling cargo for multiple shippers, many of whom will be direct competitors. Some of the very large 3PLs have also expanded into providing 4PL or ‘lead logistics provider’ services for their clients.

Other 3PLs can be more sector, commodity or activity focused; for example, the main parcel couriers focus on moving small individual consignments for multiple shippers.

2.3 Model 2: E-Commerce Supply Chain 2

Figure 2 below provides a visual description of this model. As an example, in Great Britain the on-line retailers *Ocado, Next and ASOS* broadly follows this model.

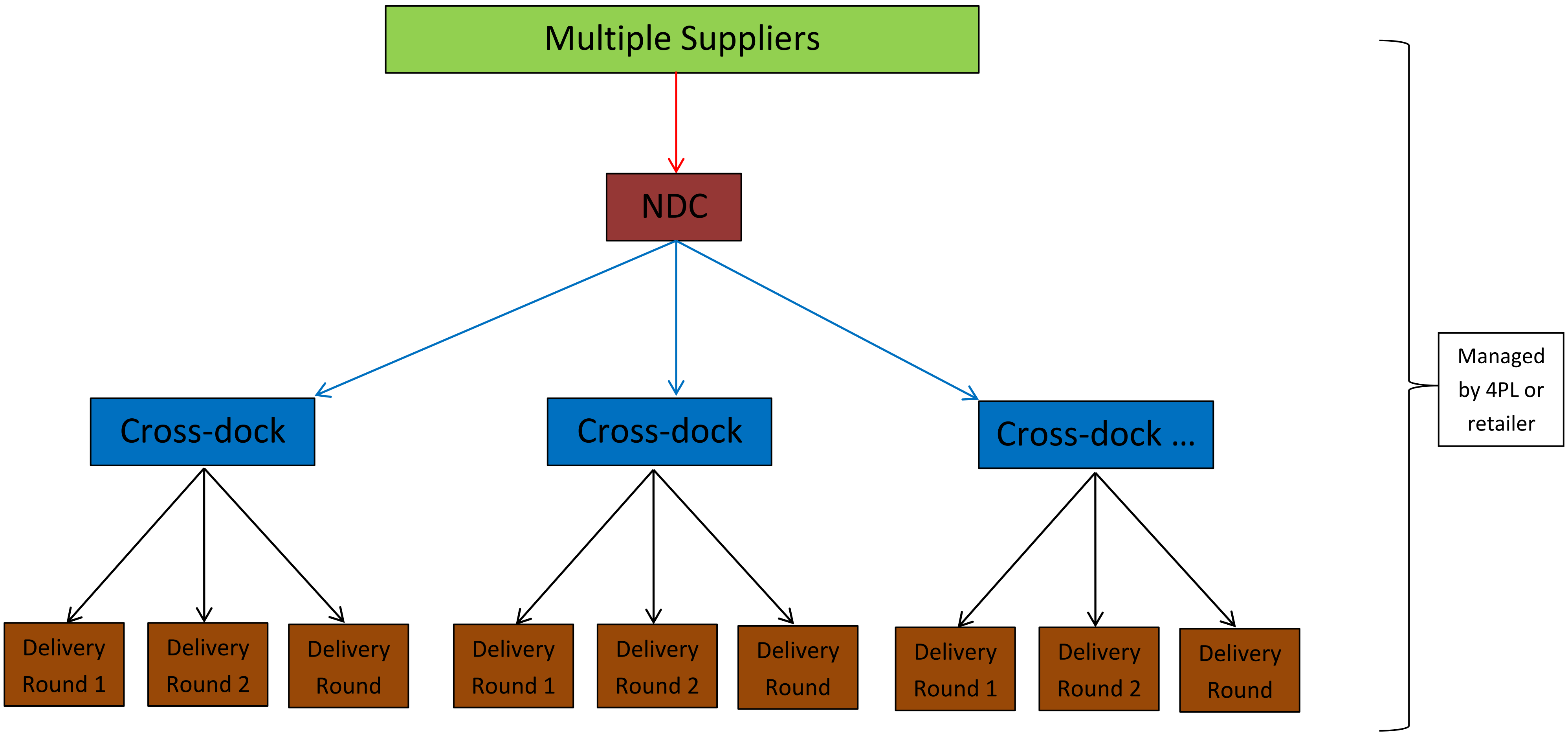

Figure 2: Flow Diagram – E-Commerce Supply Chain 2

In this model, a National Distribution Centre (NDC) receives inbound deliveries of cargo from the retailer's multiple suppliers (by road or potentially by rail if located at a rail-served site). As per Model 1 above, the NDC is performing a stock-holding function, with the retailer being responsible for holding sufficient inventory at the NDC in anticipation of demand in order to fulfil customer orders in a timely manner. As for RDCs in Model 1, NDCs are normally large purpose-built 'warehouse' type buildings designed to receive, store and then despatch goods as described (multiple loading docks, storage racks etc..), albeit they have a national hinterland.

Order fulfilment initially begins at the NDC, where on-line orders received by the retailer are picked, appropriately packed and labelled before being loaded onto freight vehicles for trunking to a series of regional *cross-dock* facilities located close to major conurbations. A *cross-docking* facility is superficially similar to a warehouse but is designed primarily for transferring cargo between freight vehicles i.e. no storage or other fulfilment activities are undertaken. In this case, the trunking operation, which may be over fairly long distances, will generally be undertaken in Heavy Goods Vehicles (HGV) but also by intermodal rail freight services over longer distance flows. At the cross-docking facility, the consignments are subsequently off-loaded from the HGVs and re-loaded onto appropriate freight vehicles for delivery to residential and commercial properties on a multi-drop (milk-round) basis (LGV or MGV as per Model 1 above).

For the NDC to cross-dock trunking operation, this may be undertaken on an 'own account' basis, though generally this part of the operation will be out-sourced to specialist 3PLs. In the case of lighter/small individual consignments such as clothing, this part of the supply chain is often undertaken by the main parcel couriers (e.g. TNT, DHL, Yodel, DPD etc..) via their shared-user trunking networks i.e. vehicles conveying consignments for more than one shipper (see Model 4 below). Likewise, deliveries to residential and commercial properties from the cross-dock facilities may be undertaken on an 'own account' basis or out-sourced to 3PLs (as per Model 1 above). On a similar basis, the NDC operation can be operated in-house or contracted out to a specialist logistics company. In fact, the whole supply chain from the NDC to cross-dock to final delivery may be let as one contract to a specialist 3PL or parcel courier.

As per Model 1, the retailer's multiple suppliers are these days located both within Europe and further afield (predominantly the Far East). Models describing the transport of goods from suppliers are illustrated further below. As per Model 1 above, the whole supply chain might be managed by the retailer or out-sourced to a 4PL. The actual building may be owned by the retailer or the 3PL, or leased from a landlord (often an investment fund).

A number of parcel courier operators also use local agents to undertake the 'final mile' delivery to residential properties (e.g. Hermes). In this case, multiple consignments are delivered by the parcel courier (generally in an LGV or MGV) to the agent's property; the agent will then undertake the 'final mile' local delivery to the end-user shortly after. Agents are often self-employed 'person and car/van' operators paid on a per consignment basis.

More recently, driven by air quality and other environmental impact issues, a number of 3PLs and retailers are testing the use of 'emission free' vehicles when delivering into the centres of major cities. As per the use of agents, multiple consignments are initially delivered to transfer points on the urban fringe, where they are re-loaded into cargo bikes or pure electric vans etc.. before final delivery into the city centre (this could also apply to Model 1 above).

As for Model 1 above, the on-line retailer could be based in a different country to where the order is ultimately fulfilled. Again, lead times between order receipt and fulfilment will generally depend on the price the end-user is willing to pay, however the transfer of goods between vehicles at the cross-docking facilities is normally undertaken in a matter of hours. Where the retailer also operates a network of physical retail outlets, the NDC may also service those stores though the two logistics operations are kept operationally separate.

The key commercial players for Model 2 are therefore:

- The on-line retailer;
- Suppliers to the retailer (see below); and
- Contracted 3PLs (including parcel couriers) and 4PLs;
- Rail freight and intermodal terminal operators; and
- Commercial property owners/developers of the NDCs and cross-dock facilities.

2.4 Model 3: Bricks & Mortar plus E-Commerce from Store Retailer

Figure 3 below provides a visual description of this model. This model is effectively the classic 'bricks and mortar' retail supply chain, but where the retailer has subsequently added an e-commerce 'offer' to their existing retail operations. The retailers *Sainsburys, John Lewis and Argos* broadly follow this model.

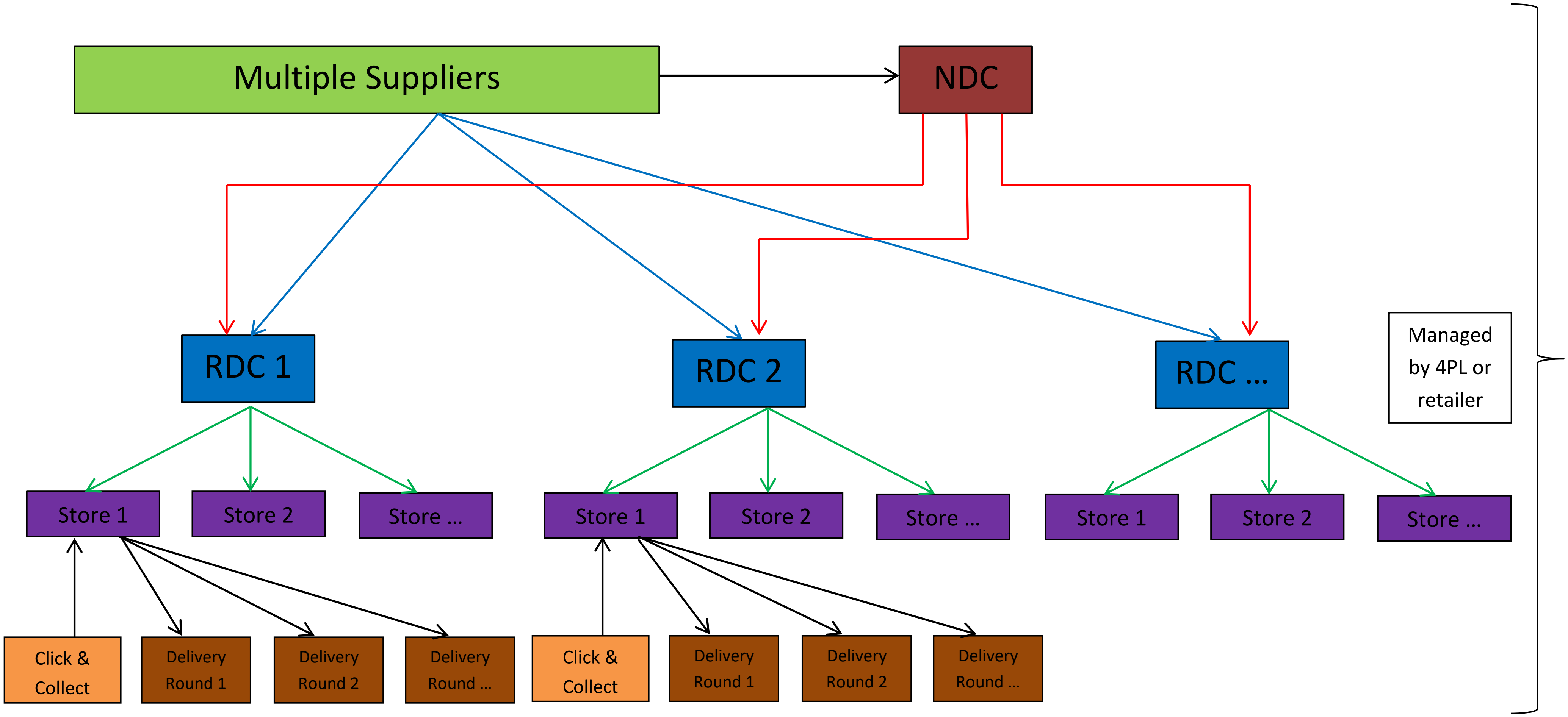

Figure 3: Flow Diagram – Bricks & Mortar plus E-Commerce from Store Retailer

In this model, an NDC receives inbound deliveries of cargo from the retailer's suppliers (by road or rail as per Models 1 and 2 above). In this case the NDC is normally stockholding goods with long lead times (such as from the Far East), slower moving lines and seasonal items ahead of peak demand. When required in-store, goods will then be transported (mainly in HGVs but also intermodal rail freight services for longer distance flows) to a series of RDCs located close to major urban conurbations. Likewise, each RDC will also receive inbound goods direct from the retailer's multiple suppliers, though in this case it is goods which have short lead times (e.g. perishables) or fast moving lines. Goods received at the RDC either via the NDC or direct from suppliers will then be consolidated before onward delivery to the retailer's outlets, normally in HGVs. The NDC-RDC and RDC-store transport operations can be undertaken in-house or (as is generally the case) out-sourced to a 3PL. Likewise, the NDC/RDCs may be operated in-house or out-sourced to 3PLs.

On-line orders received by the retailer are generally picked in-store (from the store's inventory). Fulfilment is completed either by collection directly by the end-user via their own transport (so called 'click and collect') or by delivery to commercial or residential properties on LGVs/MGVs on a multi-drop basis. In most cases, this operation is undertaken on an own account basis though it could be out-sourced to a specialist operator (as per Model 1 and 2 above). A variant of this model is the so called 'dark store'; these are superficially similar to a retail outlet inside, but are designed purely to pick on-line orders for click and collect or home delivery only and so there is no access to the general public.

The advantage of this model is twofold. Firstly, it has allowed the traditional 'bricks and mortar' retailers to distribute e-commerce orders via their established logistics networks which serve existing stores; this means they have not had to undertake significant investment in new infrastructure or supply channels. Secondly, orders rejected by customers can be fed back into the retailer's inventory almost immediately and be available for re-sale; under Models 1 and 2 goods have to be returned to the retailer via a parcel or mail network, which could potentially take up to a month. Model 3 also allows so called 'up-selling'; while a customer is in-store to collect an on-line 'click and collect' order, they may be tempted to make additional purchases.

As per Models 1 and 2 above, the whole supply chain might be managed by the retailer or out-sourced to a 4PL.

The key commercial players in Model 3 are therefore:

- The retailer;
- Suppliers to the retailer (see below); and
- Contracted 3PLs and 4PLs;
- Rail freight and intermodal terminal operators; and
- Commercial property owners/developers.

2.5 Model 4: Shared User Networks

Figure 4 below provides a visual description of this model. It is effectively a ‘hub and spoke’ distribution system that has generally been adopted by the major parcel and mail couriers, and also by 3PLs/road hauliers involved in so called *‘pallet network’* consortia As an example, in Great Britain the parcel couriers TNT, DPD and Yodel broadly follows this model, as do the Palletline, Pallex and Palletways pallet networks.

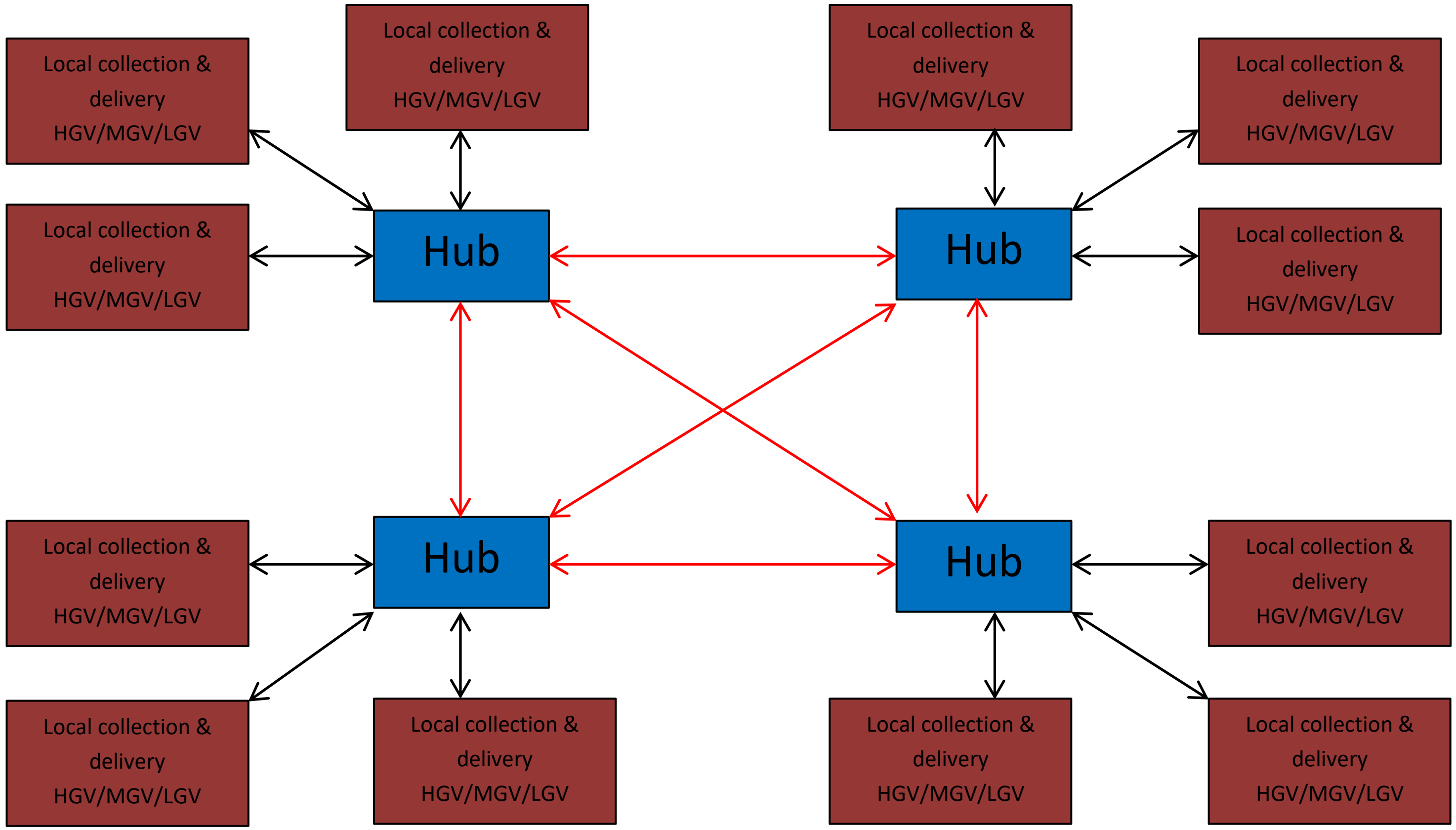

Figure 4: Flow Diagram – Shared User Networks

At each 'hub', freight vehicles (HGVs, MGVs or LGVs) will collect consignments of cargo from shippers in the immediate hinterland. This could be an individual item (e.g. a parcel) through to larger consignments (such as multiple parcels or pallets of goods). The collected goods are delivered into the 'hub', are then sorted and subsequently loaded onto freight vehicles (normally HGVs) for trunking to other hubs in close proximity to the next stage in the supply chain such as a factory or end-user consumer. Hubs may be located in different countries, and for such longer distance and international flows, intermodal rail freight (and air freight) can be utilised (the 'hub' may be an air freight transit shed close to an airport). At the destination 'hub', goods will be discharged from the trunking vehicle freight vehicles, sorted and subsequently reloaded onto other freight vehicles (HGVs, MGVs or LGVs) for delivery to the next stage in the supply chain. In practice, the process of collecting goods from shippers and delivering consignments to end-users may be undertaken from the same freight vehicle.

Shared user network services are therefore attractive to shippers despatching goods in less than full-HGV load quantities in one move (such as single or few pallets of cargo), or where large quantities of individual consignments from one origin have a diverse range of ultimate end-user destinations (such as parcels). Clients consequently range from suppliers to both manufacturers and 'bricks and mortar' retailers. As noted in Model 2 above, the shared user networks of the main parcel couriers are used by e-commerce retailers, and 4PLs may also buy-in their services for particular supply chain activities when managing supply chains on behalf of retailers, suppliers or manufacturers. By consolidating the collected cargo at each 'hub', it generates sufficient volumes of cargo (critical mass) to enable the long distance trunking operation to be undertaken in fully loaded HGVs or intermodal units by rail.

The 'hubs' are normally large purpose-built 'warehouse' type buildings designed to receive, store and then despatch goods as described (multiple loading docks, storage racks etc..). The actual building may be owned by the 3PL, or leased from a landlord (often an investment fund).

The key commercial players for Model 4 are therefore:

- 3PLs;
- Suppliers to retailers and manufacturers;
- E-commerce retailers;
- Rail freight and intermodal terminal operators; and
- Commercial property owners/developers.

2.6 Model 5: Basic Supplier to Receiver

Figure 5 below provides a visual description of this model.

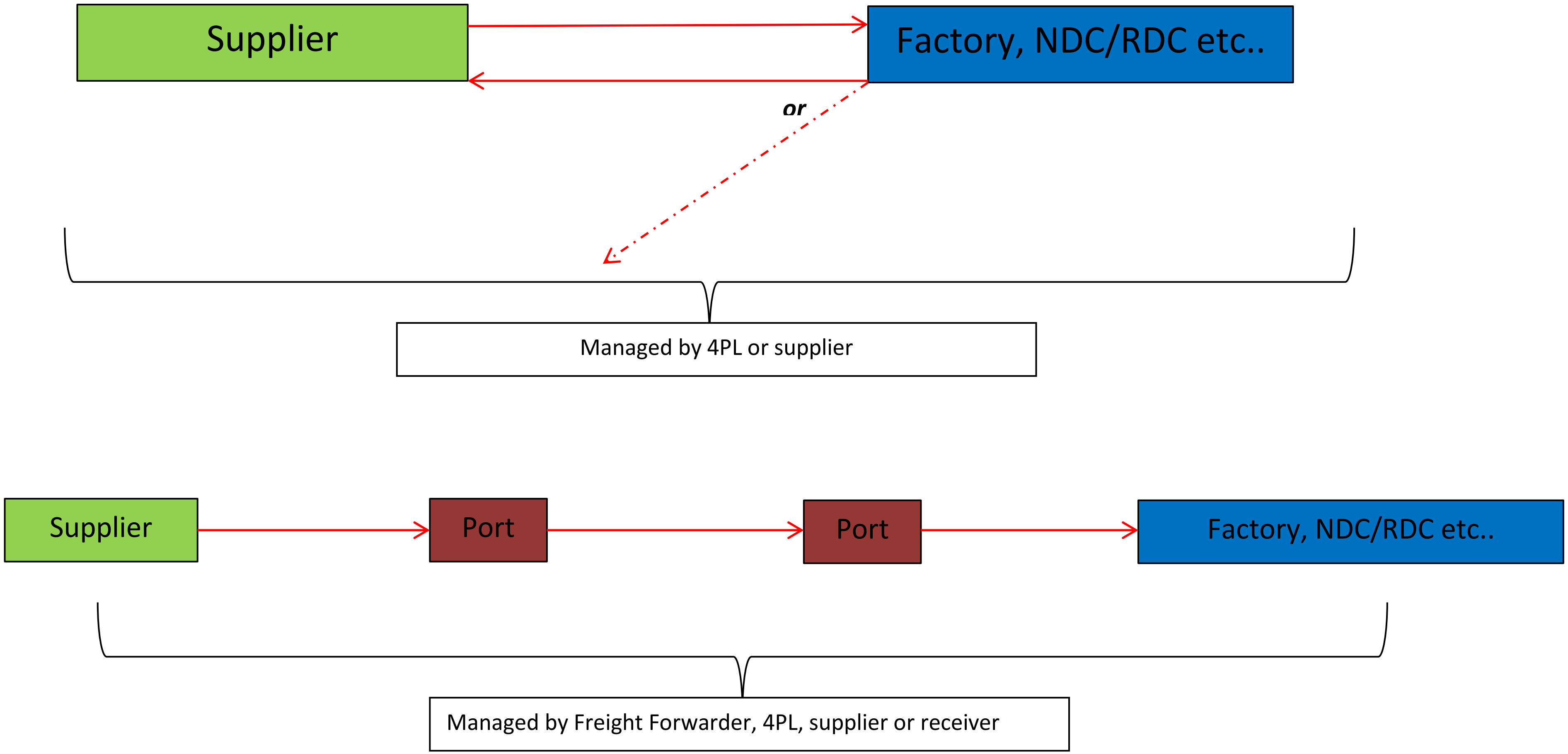

Figure 5: Flow Diagram – Basic Supplier to Retailer

At a simple level, a retailer (as per Models 1, 2, or 3 above) will order finished goods from a supplier. The supplier will be contractually responsible for organising the transport of the ordered cargo to the retailer's NDC/RDCs, to an agreed date and time. The transport may be undertaken on an 'own account' basis, or alternatively suppliers may out-source this transport operation to specialist 3PLs. These flows are most likely undertaken by road transport, though over longer distances intermodal rail freight (and shipping for international flows) maybe used. Once the goods are delivered, the freight vehicle may re-position empty back to the supplier or may travel elsewhere to undertake unrelated logistics work. These arrangements generally operate where the supplier and receiver are located a relatively short distance apart (within the same country or certainly within the EU). The supplier may also be responsible for holding inventory on behalf of its retailer customers, with deliveries being undertaken on a 'just in time' basis when demand requires. In this case, the supplier will operate appropriate storage facilities, which could be at the point of production or potentially located fairly close to the end-user. Such facilities may be operated in-house or out-sourced to a 3PL.

On a similar basis, this model also applies to manufacturers ordering semi-finished goods or components. The supplier will be contractually responsible for organising the transport of the ordered cargo to the manufacturer's production plant, either on an 'own account' basis or via a specialist 3PL (potentially a shared user network as per Model 4).

However, the advent of global manufacturing and sourcing means that this basic supplier to receiver model now often stretches from one side of the world to the other. As noted above, suppliers to both retailers and manufacturers are these days located both within Europe and further afield (predominantly the Far East e.g. China). Multiple transport modes are therefore required in order to move the cargo over very long distances from the point of production to the next stage in the supply chain (intermodal rail, shipping, and HGV). Because of this, 3PLs or a 4PL (or a Freight Forwarder) may be contracted by suppliers to manage the supply chain (from the production plant in the Far East to the NDC/RDC in Europe) and co-ordinate the activities of the multiple contracted transport operators en-route, such as shipping lines and 3PLs (e.g. where the supplier operates multiple sites and has multiple customers).

The key commercial players are therefore:

- 3PLs/4PLs/freight forwarders;
- Rail freight and intermodal terminal operators;
- Shipping lines, ports and airfreight operators;
- Suppliers to retailers and manufacturers;
- E-commerce retailers; and
- Commercial property owners/developers.

2.7 Model 6: Retail Factory Gate Collections

Figure 6 below provides a visual description of this model.

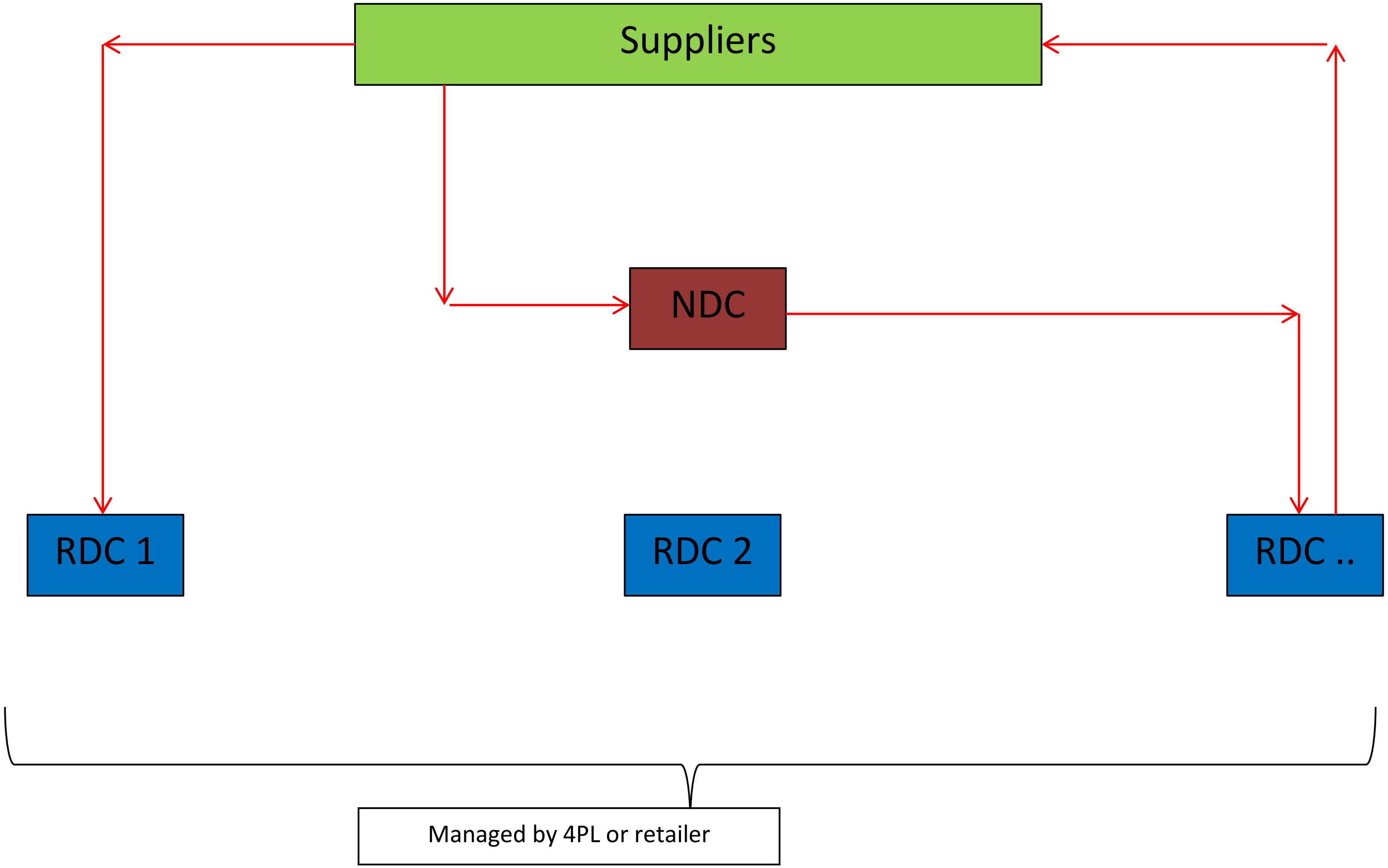

Figure 6: Flow Diagram – Retail Factory Gate Collections

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In a number of cases, principally in the retail sector but also in manufacturing, the ultimate receiver of the goods has taken over responsibility for managing their in-bound supply chains from suppliers. This model therefore effectively replicates Model 5 above, however once goods are ordered from suppliers, the receiving customer (e.g. e-commerce or 'bricks and mortar' retailer) becomes contractually responsible for organising the transport of the ordered cargo to its NDC and/or RDCs. Suppliers consequently charge for the cost of the goods only (under Model 5, the cost of the goods will include the transport from supplier to receiver).

In the case of the classic retail supply chain (Model 3), freight vehicles which are tasked with undertaking trunking operations from NDCs to RDCs will also collect cargo from suppliers for delivery back into those same NDCs and RDCs. As per previous models, this operation may be undertaken in-house or out-sourced to a 3PL (either by the retailer directly or through a 4PL arrangement). Such contractual arrangements now also extend to imports from overseas suppliers. For example, many UK supermarkets import fresh produce from Spain on HGVs operated by 3PLs contracted to the supermarket rather than the grower. Slots on international container shipping services are also being purchased by the retailer direct (or via their 3PLs/4PLs) rather than by the overseas manufacturer.

The key commercial drivers behind factory gate collections are twofold;

- It increases the ability to run freight vehicles fully loaded for most of their journeys – reducing empty running and the associated costs; and
- As retailers are moving significantly larger volumes of cargo when compared with individual suppliers, they are able to negotiate greater (bulk-buying) discounts from 3PLs and shipping lines.

The key commercial players are therefore:

- 3PLs/4PLs;
- Rail freight and intermodal terminal operators;
- Shipping lines, ports and airfreight operators;
- Suppliers to retailers and manufacturers;
- E-commerce retailers; and
- Commercial property owners/developers.

2.8 Model 7: Consolidating Supplies

Figure 7 below provides a visual description of this model. A number of 'high value' manufacturers (such as automotive producers) have adopted this model, albeit some retailers also use it for consolidating supplies before inward transport to their NDCs/RDCs.

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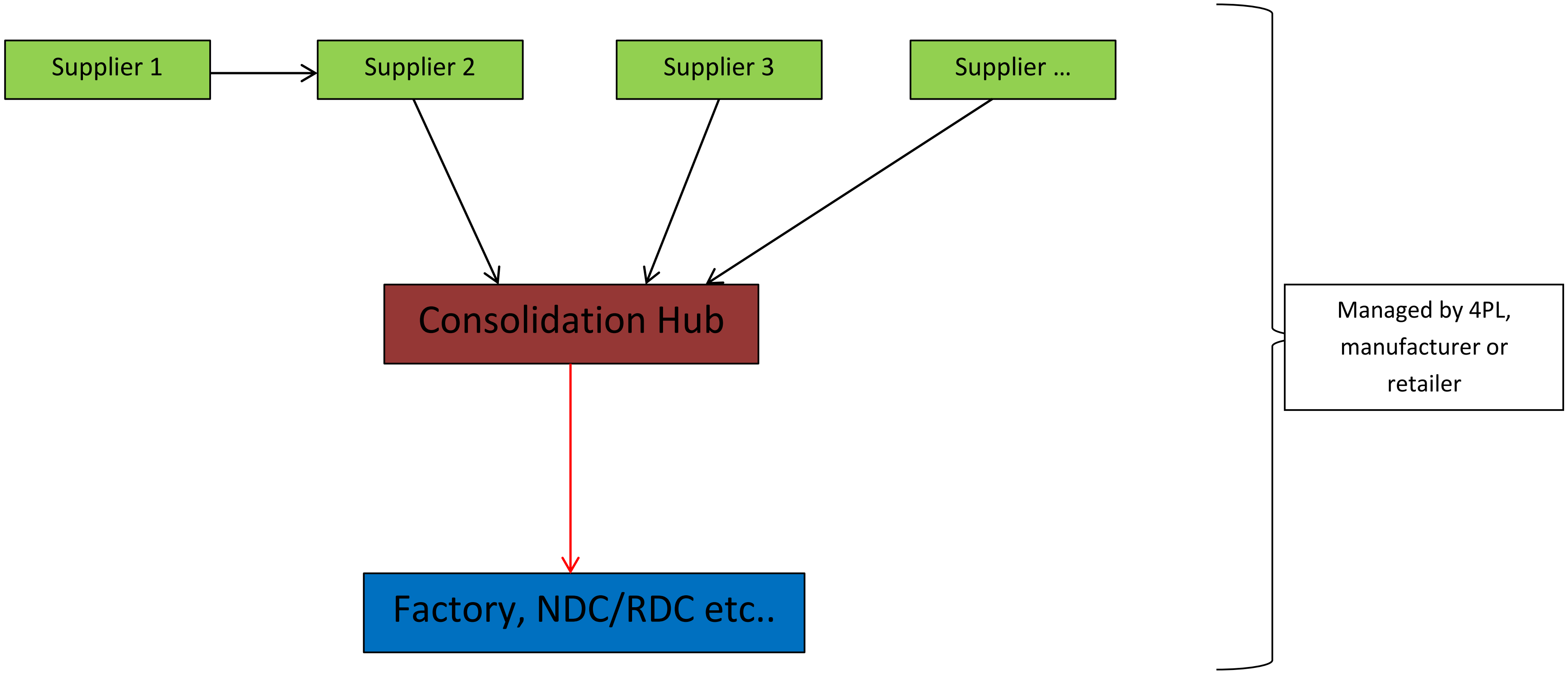

Figure 7: Flow Diagram – Consolidating Supplies

At a simple level, goods (components or finished goods) from multiple suppliers will be collected by freight vehicles and transported initially to some form of consolidation hub. This could be a cross-docking type facility (implying goods are simply consolidated and transferred to onward transport vehicles) or an NDC type warehouse (implying an element of storage). In both cases, following consolidation, goods will be reloaded onto freight vehicles for transport to the next stage in the supply chain. As per previous models, this operation may be undertaken in-house or out-sourced to a 3PL (either by the retailer directly or through a 4PL arrangement). Such contractual arrangements now also extend to imports from overseas suppliers.

In the case of some manufacturers (e.g. automotive), the consolidation hub may be located fairly close to the factory, with onward delivery direct to the production line on a 'just in time' basis. The process is therefore used to consolidate similar types of components from multiple suppliers before onward transport, and also as some form of 'buffer stock' to ensure continued product supply during times of disruption. In other cases, the process enabled small volumes of cargo, but moving frequently, from multiple suppliers to be consolidated into full HGV-loads before long distance trunking to the next stage in the supply chain.

The key commercial players are therefore:

- 3PLs/4PLs;
- Rail freight and intermodal terminal operators;
- Shipping lines, ports and airfreight operators;
- Suppliers to retailers and manufacturers;
- E-commerce retailers; and
- Commercial property owners/developers.

The 'common denominators' in all of the above models are the 3PLs and 4PLs. These are the organisations who are increasingly moving (or managing the movements of) goods on behalf of the other key players in the supply chain i.e. manufacturers, the retailers and their suppliers. A real-time decision making tool is therefore likely to be primarily aimed at these commercial organisations.

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3. Use of Technology and Intra-industry Collaboration

3.1 Technology

There are currently a number of digital software tools on the market that undertake load planning, vehicle routing and optimisation of transport operations in the supply chain. Examples of such products are

- Truckstops;
- Paragon; and
- Transporeon

A short case study of each system is presented below and in Annex 1.

Case Study – Truckstops

Source: Truckstopsrouting.com

Truckstops is a route planning and scheduling optimisation software tool for road-based multi-depot, multi-drop and bulk routing operations. It was developed in the UK by *CACI Ltd*. It can be used by operators of HGVs, MGVs and LGVs (i.e. both 3PLs and own-account operators). In summary, the software allocates consignment loads (at single or multiple locations) with known end-user delivery locations to freight vehicles. Optimised routes and schedules are produced which improve vehicle fill and reduce empty running. Its use should therefore reduce vehicle mileage and increase profits. It is able to interface with other systems, such as e-POD (electronic Proof of Delivery), warehouse management and vehicle tracking.

Truckstops essentially replicates the process that a manual route/schedule planner would undertake when allocating customer consignments to vehicles. Loaded into the software are details on the operator's vehicle fleet (number, capacity, depot location etc.), shift start and finish times and driver availability. The software can also restrict certain types of commodities to particular vehicles on the fleet (e.g. chilled cargo to refrigerated HGVs). Vehicle operating costs are also pre-loaded into the system. Specific details/characteristics regarding each delivery location are also loaded into the software. This includes any time-window requirements or limitations (e.g. when deliveries must or cannot occur) and vehicle size/weight restrictions (e.g. gross vehicle weight, height etc.). Then once delivery information is uploaded into the system (e.g. consignment size, delivery locations etc.), route planning and optimisation is undertaken by carrying out thousands of "what if" scenarios, switching consignments/deliveries between vehicles and recalculating the costs until the cheapest fixed route revision is reached. In addition to route optimisation, use of the software also significantly reduces back-office planning time.

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A number of different revisions and applications are available:

Fixed Route Revision: For operators who deliver to broadly the same locations on a regular basis, but where volumes may vary slightly or where some delivery locations are added or removed. From the Models described in Section 3, trunking operations from suppliers and NDCs to RDCs/cross-docking would be an example of this application.

Daily Scheduling: Routing calls where the delivery volumes and/or destinations vary significantly for day-to-day, so it is not practical to follow the same route each day. Truckstops routing and scheduling can plan large numbers of deliveries with complex criteria every day. Each call may have very different requirements (e.g. restricted entrance, tight time window, chilled food items) and the operator may be using a mixed fleet of freight vehicles that each has different capabilities. Using Truckstops route optimisation software ensures each delivery is allocated to the most appropriate vehicle and in the best sequence to create efficient daily schedules. From the Models described in Section 3, e-commerce deliveries (Models 1 and 2) would be an example of this application.

Collection and Delivery: Where vehicles are also involved in collecting cargo in addition to undertaking deliveries. Truckstops routing and scheduling software optimises collect and delivery routes to find the least cost solution that obeys rules and constraints that can be pre-set, including rules about the sequence in which the pick-ups and drop-offs need to be made (e.g. deliver bulky things first to make space in the truck for collections).

Bulk Movement Planning, Trunking and Tramping: to meet the specific features of the types of bulk delivery trunking and tramping operations often associated with primary scheduling. In addition to standard routing features such as time windows, drivers' hours, multi-temperature compartments and site accessibility restrictions, Truckstops Loads can plan:

- Primary scheduling
- Collections before deliveries
- Multi-day routes
- Changes of driver
- Multi-shifting
- Allowance for cleaning e.g. tankers
- Significant unload times

Truckstops multi-drop: The route planner software can optimise collections and/or deliveries from a single depot or from multiple depots (one at a time or across the whole operation at once). The user can specify where every vehicle starts and ends, or leave the software to suggest locations. Some organisations start and finish routes at a single depot or from specific locations in a multi-depot network. The user can also assign particular orders to specific depots, or compute the most efficient routes across the whole multi-depot network

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Truckstops is able to link with other internal business systems. For example, details of the orders you need to fulfil in one system can be automatically passed to Truckstops to allocate to vehicles, route and sequence the stops. Truckstops can also be linked a Warehouse Management System (WMS) to ensure goods are picked and loaded on the appropriate vehicle for the planned routes.

Truckstops developers work closely with tracking system suppliers to integrate tracking and route planning software. This enables operators to compare the planned routes with those actually driven. Links with vehicle tracking facilitates immediate plan vs actual analysis. Information from the tracked routes can then be fed back into the Truckstops models (e.g. call times) to make the next planned routes even more tailored to actual fleet operation.

At a more strategic level, Truckstops allows customer and location site analysis and depot area planning.

A series of screen-shots in Annex 1 shows how Truckstops operates.

Overall, the software would appear to be a 'plan day 1-deliver day 2' type tool'. It is a static rather than dynamic tool, and once the plan is produced it is then executed as produced. It would also appear to be a tool for use within a single shipper or 3PL operation (albeit over many depot locations), rather than a system which can work across multiple shippers and 3PLs simultaneously. However, for many 3PLs or own-account operators, it would appear to be a useful tool that aids route optimisation and reduces the time taken to produce efficient schedules. It does not appear to have any kind of real time capability that would facilitate the constant re-planning of loads as vehicles become empty and 'available' following deliveries, or as consignments are ready for despatch and effectively seek a transport provider.

Case Study – Paragon

Source: paragonrouting.com

Paragon is a route planning and scheduling optimisation software tool for road-based transport operations. It was developed in the UK by *Paragon Software Systems plc.* Functionally it is broadly similar to Truckstops; it can be used by operators of HGVs, MGVs and LGVs, and by both 3PLs and own-account operators. Optimised routes and schedules are produced which improve vehicle fill and reduce empty running. As per *Truckstops*, *Paragon* essentially replicates the process that a manual route/schedule planner would undertake when allocating customer consignments to vehicles. The paragon software contains details on:

- The operator's vehicle fleet (number, capacity, depot location etc.);
- Shift start and finish times and driver availability;
- Which commodities can be conveyed on specific vehicles on the fleet (e.g. chilled cargo to refrigerated HGVs);
- Vehicle operating costs;
- The characteristics and restrictions regarding each delivery location, such as time-window requirements or limitations (e.g. when deliveries must or cannot occur) and vehicle size/weight restrictions (e.g. gross vehicle weight, height etc.). .

Once customer delivery information is uploaded into the system (e.g. consignment size, delivery locations etc.), route planning and optimisation is undertaken. The software will allocate consignments/deliveries to vehicles and depots in such a way to generate the most optimum solution overall (lowest cost, maximum vehicle fill etc..).

Three core products are offered, namely:

- Single Depot – routing and scheduling solution to plan vehicles based at one location;
- Multi Depot – planning vehicles across multiple depots;
- Integrated fleets – the most advanced routing and scheduling software module for planning deliveries and collections, multiple warehouses and production sites, or numerous distribution operations;
- Paragon HDX – designed for home delivery operations. It can manage the whole order fulfilment process, from order capture through to delivery of consignments to home addresses. Delivery routes can be dynamically scheduled as orders are taken. It can also manage product returns from customers.

Clients of Paragon include Sainsbury's, John Lewis and DHL Supply Chain.

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Optional Paragon modules include:

- Mapping tools, including down to street level for home deliveries;
- Consignment tracking;
- Link to vehicle tracking systems, thereby allowing accurate arrival time information to be generated in real-time;
- Electronic Proof of Delivery; and
- Strategic modelling and analysis, including the production of KPIs.

As per Truckstops, the software would appear to be a 'plan day 1-deliver day 2' type tool', though the link to vehicle tracking systems suggests it is able to update running times as routes are executed or delays occur. It would also appear to be a tool for use within a single shipper or 3PL operation (albeit over many depot locations), rather than a system which can work across multiple shippers and 3PLs simultaneously. However, for many 3PLs or own-account operators, it would appear to be a useful tool that aids route optimisation and reduces the time taken to produce efficient schedules. Like Truckstops, it does not appear to have any kind of real time capability that would facilitate the constant re-planning of loads as vehicles become empty and 'available' following deliveries, or as consignments are ready for despatch and effectively seek a transport provider.

Case Study – Transporeon

Source: transporeon.com

Transporeon is a global cloud-based platform for intelligent transport logistics. Through a series of software solutions, it aims 'digitise' the connection between shippers (manufacturers, suppliers, and retailers) and carriers (covering 3PLs, freight forwarders, brokers, and drivers), thereby achieving smarter, transparent and more cost-effective movement of goods around the world. It also seeks to enable real communication and collaboration between shippers and carriers on a global basis.

The main software products available are described briefly below.

Transport Assignment: Designed for shippers and their carriers, this is intended to be some form of electronic market place for shippers seeking transport services. Shippers place consignment orders with their carriers, who in return respond with their 'offers' (cost, lead times etc..). Offers can be contractually fixed for the long term or submitted with the latest prices for that very day.

Time Slot Management: Designed for operators of distribution centres and intermodal terminals. In order to avoid congestion (i.e. all collections and/or deliveries arriving at the same time), distribution centres and intermodal terminals generally operate a time-slot system. Carriers either arriving to deliver inbound cargo or collect outbound goods will be allocated a time-slot; depending on the distribution centre or terminal in question the time-slot could be fairly tight (e.g. +/- 10 minutes) or slack (e.g. within a specified hour). This software solution enables carriers to book their time-slots digitally, meaning they can schedule their routings around the time-slots available (and booked).

Transport Visibility: Software which enables shippers to seamlessly track goods from the time they are picked up until they are delivered to the consignee. Delays are reported automatically to the shipper. Each step in the supply chain is documented, with carriers using this information to prove deliveries have been made and shippers to measure performance or evaluate suppliers.

Mobile Order Management: An app that links drivers' smartphone's with shippers, enabling end-to-end real-time processes, paperless dispatch and visibility right up to the end customer. Changes to orders and re-routing can be sent directly to the app. On delivery, the recipient is asked to sign on the device screen as proof of delivery.

The Transporeon software is able to link with other management systems such as SAP and Oracle.

3.2 Intra-Industry Collaboration

There is already a significant degree of collaboration within the logistics industry, both at the domestic level (i.e. within countries/territories) and internationally. Collaboration generally revolves around the sharing or ‘joint use’ of some form of logistics capacity; in most cases it is the sharing of transport capacity (e.g. HGVs, rail wagons etc..), but it can also involve the joint use of storage (warehouse) and production capacity. The key driver behind collaboration is economic efficiency. Collaboration generates economic efficiencies, thereby enhancing competitiveness. For example, collaboration between shippers can maximise vehicle fill and reduce/eliminate empty running, thereby lowering transport costs. This is then reflected in the form of lower product costs, higher profitability or a combination of both.

Collaboration may come about through agreement between two or more shippers/3PLs to share or jointly use their logistics capacity. This could be termed *‘active collaboration’* in that the shippers/3PLs will actively seek out collaborators and subsequently enter into collaborative partnerships in order to gain economic efficiencies. In theory, it should be easier to establish collaborative partnerships where shippers are distributing complementary products rather than being direct competitors, albeit competing shippers and 3PLs are also active collaborators. Active collaboration often comes about through the commercial knowledge or personal contacts of logistics industry professionals, though in some cases it may simply be a case of an ‘accident of geography’.

In other cases, the collaboration is more coincidental than by design, principally because shippers (often competitors) happen to contract with the same 3PLs and 4PLs (including the main parcel couriers). This could be termed *‘passive’* or *‘accidental’ collaboration*, in that shippers do not directly set out to collaborate with other shippers (including both competitors and complementary companies), but at some point in the supply chain their goods will be handled by a common carrier and share the same logistics capacity. By their very nature, 3PLs/4PLs are a shared transport (logistics) resource; a single 3PL will have multiple clients, with that 3PL’s transport fleet being effectively pooled to move goods for those multiple clients (and likewise ‘shared user’ warehousing). The key commercial players driving this form of collaboration are therefore the 3PLs (including the main parcel couriers). It is these organisations who are actively seeking to combine loads from multiple shippers and between multiple origins and destinations, or are simply re-positioning empty freight vehicles and collecting return loads, thereby maximising vehicle fill and reducing/eliminating empty running.

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Case Study – Kellogg's and Kimberley Clark

Breakfast cereal producer *Kellogg's* operates a factory and a National Distribution Centre (NDC) on the Trafford Park Industrial Estate near Manchester. Tissue manufacturer *Kimberley Clark*, which has a number of manufacturing locations in Great Britain, required a distribution facility in the Manchester area. Neither manufacturer is a direct competitor, however both companies are major suppliers to the main grocery retailers in Great Britain and Ireland. Their products are essentially being delivered to the same end-users (i.e. the grocery retailers' distribution centres) from broadly the same origins. As a consequence, both *Kellogg's* and *Kimberley Clark* actively collaborate and jointly operate a combined NDC in Trafford Park. The warehouse capacity is occupied by both cereals and tissue products, and a 3PL contracted to both companies undertakes deliveries to the major retailers' distribution centres, with both companies' products moved on the same delivery vehicles. The warehouse operating costs and transport costs are therefore shared.

Case Study – Nestle and Pladis

Confectionary, snack food and coffee manufacturer *Nestle* operates a factory in York (amongst other facilities located in Great Britain). They also operate a NDC at Bardon Hill, near Coleville in Leicestershire, which receives and then stores product from the afore-mentioned manufacturing sites before re-distribution to the next stage in the supply chain. Likewise, *Pladis* (formerly *United Biscuits*), is a producer of snack foods in Great Britain, primarily under the *McVitie's* and *Jacob's* brands. Pladis also operates a NDC near Ashby-de-la Zouch in Leicestershire (a short distance from Nestle's facility), which also receives and then stores product before re-distribution to the next stage in the supply chain. This includes grocery retailer distribution centres in the Yorkshire area.

Previously, HGVs from Nestle's York factory would deliver into its Bardon Hill NDC before returning empty to York (i.e. loaded southbound, empty northbound). In a similar manner, Pladis' HGVs would deliver into retailers' distribution centres in the Yorkshire area before returning empty to Leicestershire (i.e. opposite to Nestle's flows). Despite being considered as competitors, both companies now actively collaborate by sharing HGV capacity on the Yorkshire-Leicestershire corridor. Following delivery in the York area, Pladis' empty HGVs will re-position into Nestle's York factory and collect a return-load (backload) of product destined for the Bardon Hill NDC. Likewise, Nestle's HGVs will also collect return-loads from Pladis' Ashby distribution centre destined for the York area. The active collaboration has virtually eliminated empty running between York and Leicestershire.

One of the issues which needed to be addressed before collaboration could begin was the potential for recognised competitors to see what each other was moving (in terms of type of products, volumes etc..). This has been avoided by sealing the HGV trailers (out of sight of the drivers) before the return-load is despatched. The driver therefore has no knowledge of what is being delivered on behalf of the 'competitor'.

With reference to the logistics models set out in section 3 above, examples of where collaboration already occurs is described below.

Model 1:

- Deliveries from RDCs to end-users – it was noted that while these can (and sometimes are) undertaken solely in-house, the retailer will often out-source (contract out) this part of the operation to specialist 3PL operators, such as DHL or the main multi-national parcel couriers. In this case, the delivery vehicles despatched from the RDCs may also be conveying deliveries for other shippers/distributors i.e. the freight vehicle's capacity is being shared by consignments for two or more shippers (passive collaboration);
- It was also noted earlier that in addition to fulfilling orders for their own products, some on-line retailers will undertake order fulfilment on-behalf of other e-commerce retailers i.e. sharing of storage and transport capacity (active collaboration).

Model 2:

- Trunking from NDCs to cross-dock facilities – again while this may be undertaken on an 'own account' basis, generally this part of the operation will be out-sourced to specialist 3PLs. In the case of lighter/small individual consignments, this part of the supply chain is often undertaken by the main parcel couriers (e.g. TNT, DHL, Yodel, DPD etc.) via their shared-user trunking networks (passive collaboration). In other cases, a 3PL might trunk goods on HGVs for the e-commerce retailer from the NDC to the cross-dock facility. The 3PLs' vehicles could then re-position and seek a return loads from other shippers, meaning that the transport capacity is shared and runs fully loaded in both directions (could be both active and passive collaboration);
- The cross-dock facilities are often operated by the main parcel couriers, and are receiving inbound deliveries from the couriers' shared-user networks. They are therefore handling consignments for multiple shippers through the same cross-dock capacity (passive collaboration).
- As per Model 1, the outbound delivery vehicles will also be conveying deliveries for other shippers/distributors (passive collaboration).

Model 3:

- Home delivery operations may out-sourced to a specialist operator (as per Model 1 and 2 above), and could therefore be conveying deliveries for other shippers/distributors (passive collaboration).

Model 4:

- Shared user networks are, by their very nature, a shared transport resource attractive to shippers despatching goods in less than full-HGV load quantities in one move e.g. single or few pallets of cargo, or where large quantities of individual consignments from one origin have a diverse range of ultimate end-user destinations. Consolidating the collected cargo at each 'hub', it generates sufficient volumes of cargo (critical mass) to enable the long distance trunking operation to be undertaken in fully loaded HGVs or intermodal units (passive collaboration);

- The decision by some 3PLs/road hauliers to form pallet networks consortia (active collaboration).

Model 5:

- Suppliers moving goods to retailers' NDCs/RDCs or to manufacturing plants – while this may be undertaken on an 'own account' basis, generally this part of the operation will be out-sourced to specialist 3PLs. The 3PLs' vehicles could then re-position and seek a return loads from other shippers, meaning that the transport capacity is shared and runs fully loaded in both directions (could be both active and passive collaboration);
- Alternatively, non-competitive suppliers could share storage and transport capacity if serving the same retailers/manufacturers, as per Kellogg's/Kimberley Clark (active collaboration);
- Suppliers located overseas may be contracting with the same 3PLs/4PLs, using the same container shipping lines etc. (passive collaboration).

Model 6:

- Moving goods to retailers' NDCs/RDCs from suppliers – the retailer managing the collections will generally out-sourced this operation to specialist 3PLs. The 3PLs will have the ability to seek and combine loads from multiple shippers and between multiple origins and destinations, or simply through re-positioning empty freight vehicles and collecting return loads (passive collaboration).

Model 7:

- Suppliers moving goods to consolidation hubs – generally this part of the operation will be out-sourced to specialist 3PLs. The 3PLs' vehicles could then re-position and seek a return loads from other shippers, meaning that the transport capacity is shared and runs fully loaded in both directions (could be both active and passive collaboration);
- Alternatively, non-competitive suppliers could share storage and transport capacity if serving the same retailers/manufacturers, as per Kellogg's/Kimberley Clark (active collaboration);
- Suppliers located overseas may be contracting with the same 3PLs/4PLs, using the same container shipping lines etc. (passive collaboration).

It is perhaps worth reiterating the economic concept of 'utility'. This is used to model worth or value to a business, rather than the simple cost-revenue-profit analysis. It means that commercial players will sometimes organise their activities in a way which, while recognised to be less economically efficient than other methods, is nevertheless undertaken in that way because it is judged to generate greater value or worth.

It was noted above that as transport operations are often the only direct point of contact with customers (the customer will only see the vehicle and driver), some companies prefer to maintain direct control over this by undertaking deliveries on an own-account basis. This method of delivery is believed to generate greater worth or value for the business (such as being able to generate additional sales or maintaining brand loyalty), even though out-sourcing the transport operation would generate economic efficiencies. Collaboration in this situation is therefore unlikely.

Given that there is already a significant degree of collaboration within the logistics industry, the development of new digital tools is therefore likely to be evolutionary in nature rather than revolutionary. Active collaboration often comes about through the knowledge or personal contacts, meaning that new technology is less likely to be useful. However, new tools which further facilitates the sharing (passively) of transport capacity are likely to be welcomed in the logistics sector.

4. Conclusions and Next Steps

The main objective of this report was to:

- Provide an overview and description of the main logistics supply chain models that have been adopted by both the retail and manufacturing sectors;
- Review of the use of existing technology used for planning and optimisation of transport operations in the supply chain; and
- Set out the extent to which the key players in the logistics industry already collaborate.

4.1 Overview of Logistics Supply Chain Models

An overview of the main logistics supply chain models that have been adopted by both the retail and manufacturing sectors has been set out. It identified the key commercial players involved at the various stages of the supply chain. Overall, seven models were identified, namely:

- E-Commerce supply chain 1;
- E-Commerce supply chain 2;
- Bricks & Mortar plus E-Commerce from Store;
- Shared User Networks;
- Basic Supplier to Receiver;
- Factory Gate Collections; and
- Consolidating Supplies.

It is worth reiterating that these are ‘models’ of logistics supply chains; they are not intended to be a perfect ‘fit’ with an individual organisation’s actual supply chain. However, they do provide a simplified description of reality in order to assist in explaining how companies organise the movement of goods from producers/suppliers to the end-user alongside the key commercial players. It was noted that many of the actual logistics functions undertaken along the supply chains are now out-sourced to 3PLs rather than provided in-house. So called ‘lead logistics providers’ or 4PLs are increasingly being contracted by shippers to manage the entire supply chain on their behalf.

The ‘common denominator’ in all of the above models are the 3PLs and 4PLs. These are the organisations who are increasingly moving (or managing the movement of) goods on behalf of the other key players in the supply chain i.e. manufacturers, the retailers and their suppliers. A real-time decision making tool is therefore likely to be primarily aimed at these commercial organisations.

4.2 Use of Technology and Intra-industry Collaboration

There are currently a number of digital tools on the market that undertake load planning and optimisation of transport operations in the supply chain. Examples of such products (Truckstops, Paragon and Transporeon) were presented as case studies. While Paragon can be linked to vehicle tracking systems, thereby offering real-time ETA information to generated and updated frequently, both systems do not appear to have any kind of real-time capability that would facilitate the constant re-planning of loads as vehicles become empty and ‘available’ following deliveries, or as consignments are ready for despatch and effectively seek a transport provider.

There is already a significant degree of collaboration within the logistics industry, both at the domestic level (i.e. within countries/territories) and internationally. Collaboration generally revolves around the sharing or 'joint use' of some form of logistics capacity; in most cases it is the sharing of transport capacity, but it can also involve the joint use of storage (warehouse) and production capacity. The key driver behind collaboration is economic efficiency. It was noted that collaboration can be 'active' (i.e. players actively seek partners in order to share transport/logistics capacity) or *'passive'*, in that shippers do not directly set out to collaborate with their competitors, but at some point in the supply chain their goods will be handled by a common carrier. The role of the 3PL as a shared resource was noted.

4.3 Key Challenges & Next Steps

Two key challenges emerge from the above analysis:

1. The need for the LOGISTAR digital tool to provide added value over and above the current load planning and optimisation software that is available in the market; and likewise

2. The need for the LOGISTAR digital tool to further enhance or facilitate industry collaboration.

It is our intention to address these key questions in the next phase of the study. The proposed next steps are therefore to:

- Further refine the above analysis by undertaking additional primary research, including compiling a series of case studies of 'real life' supply chains. These will assist in validating (or otherwise) the information presented above and, it is hoped, provide answers to the two key challenges outlined above;
- The production of a further report for Month 18 of the project to set out the results.

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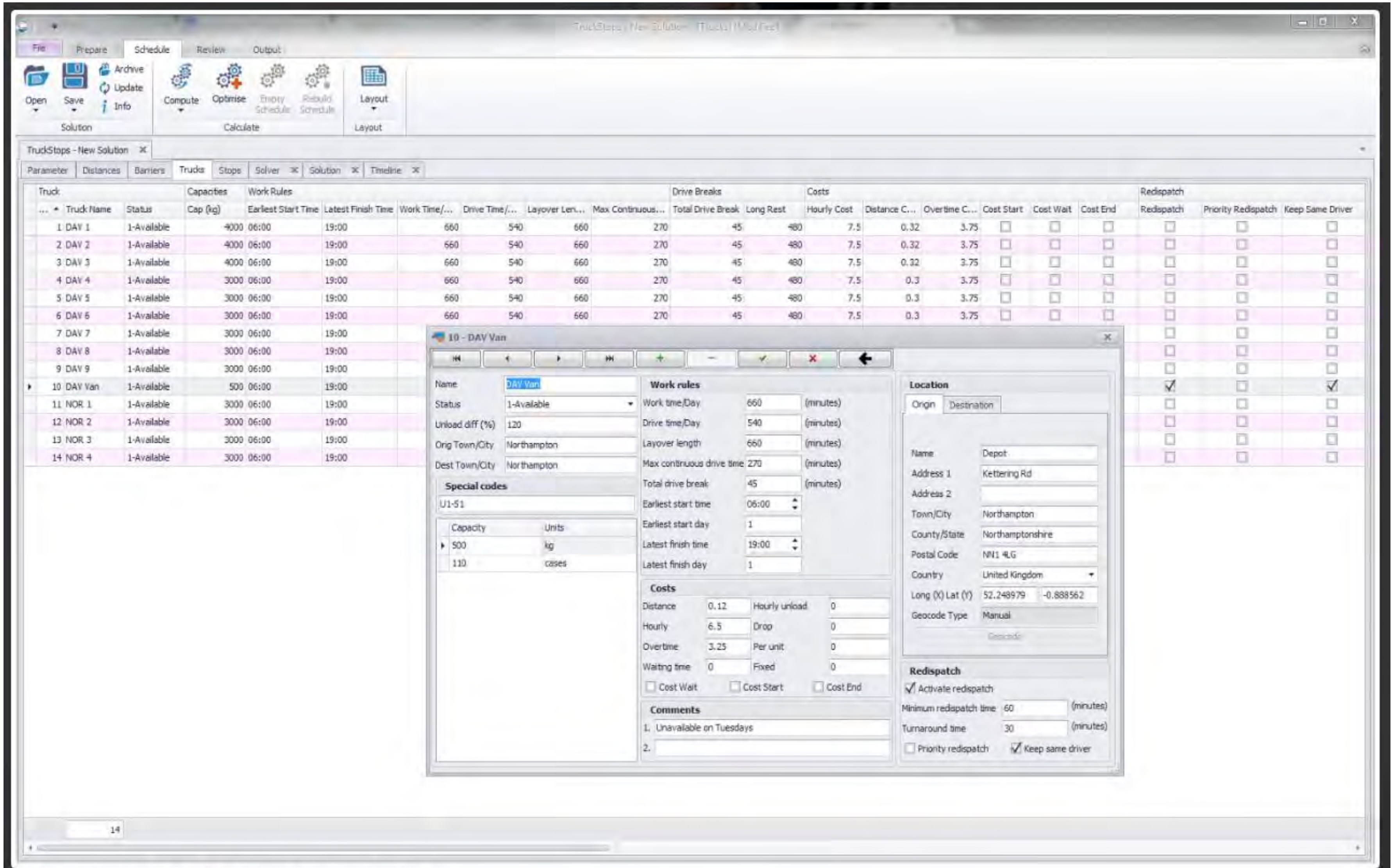
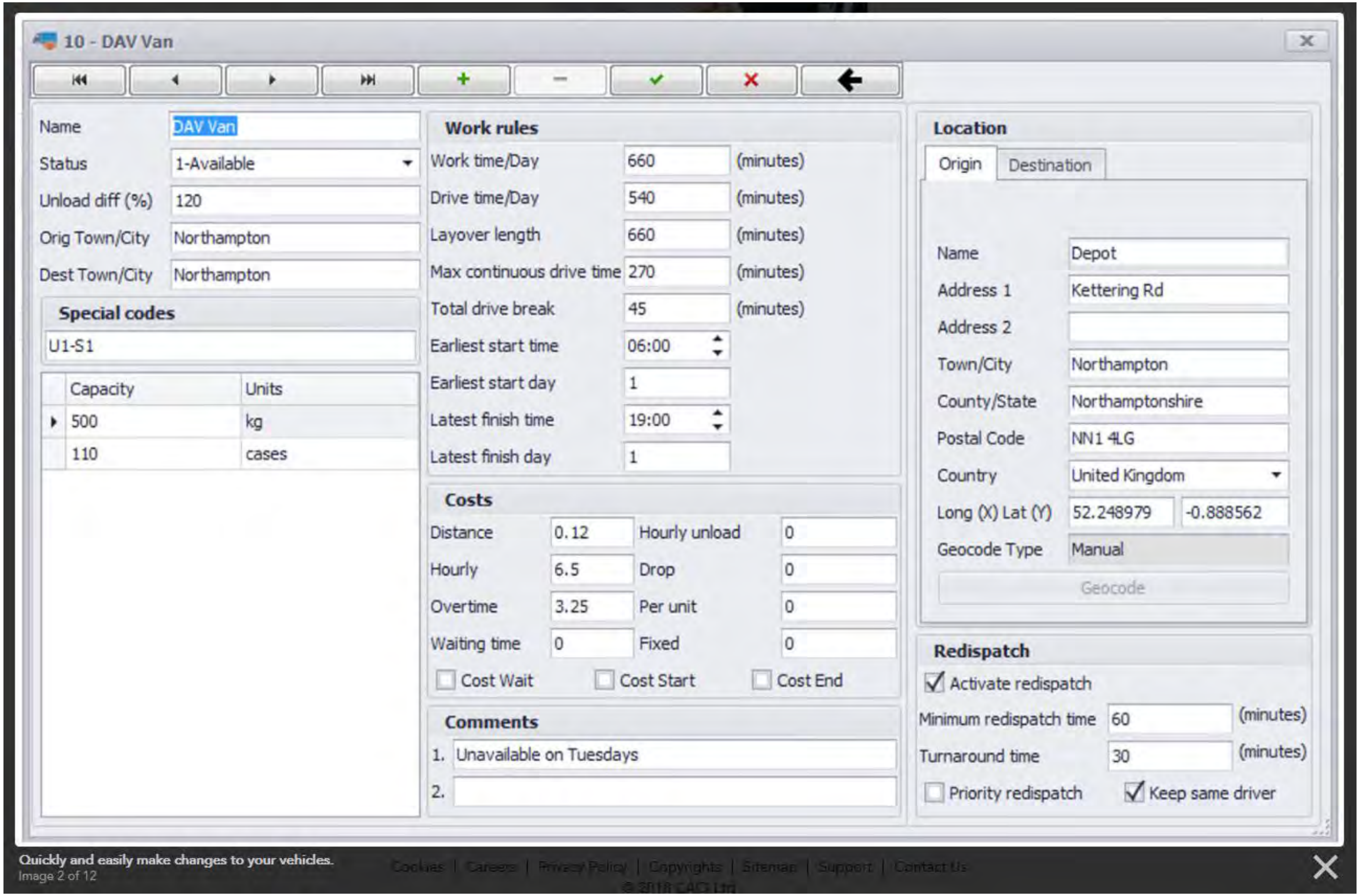
List of abbreviations and acronyms

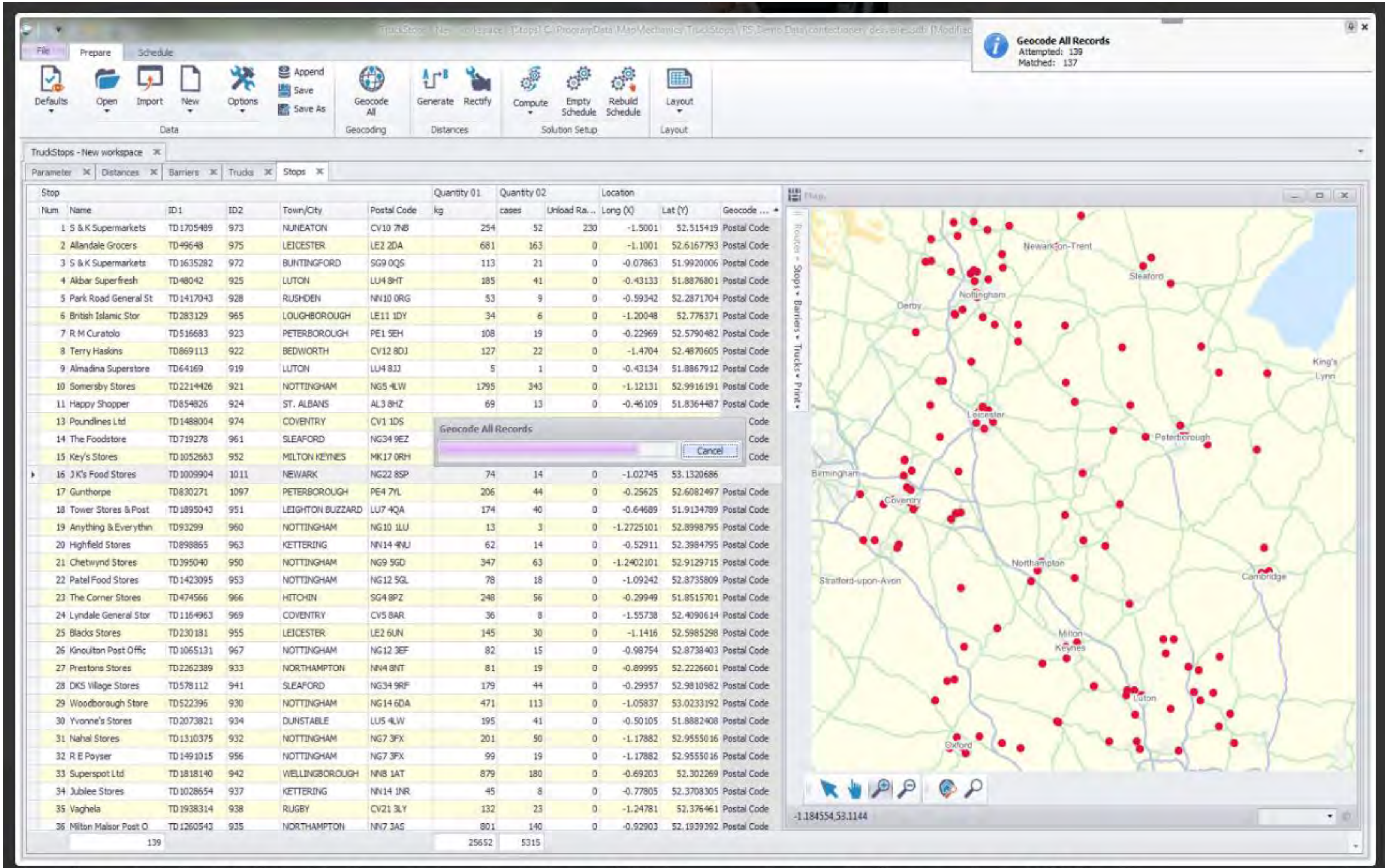
RDC	Regional Distribution Centre
NDC	National Distribution Centre
HGV	Heavy Goods Vehicle
MGV	Medium-sized Goods Vehicle
LGV	Light Goods Vehicle
3PL	Third Party Logistics provider
4PL	Fourth Party Logistics provider
GVW	Gross Vehicle Weight
ETA	Estimated Time of Arrival

Annex 1 – Truckstops Screen Shots



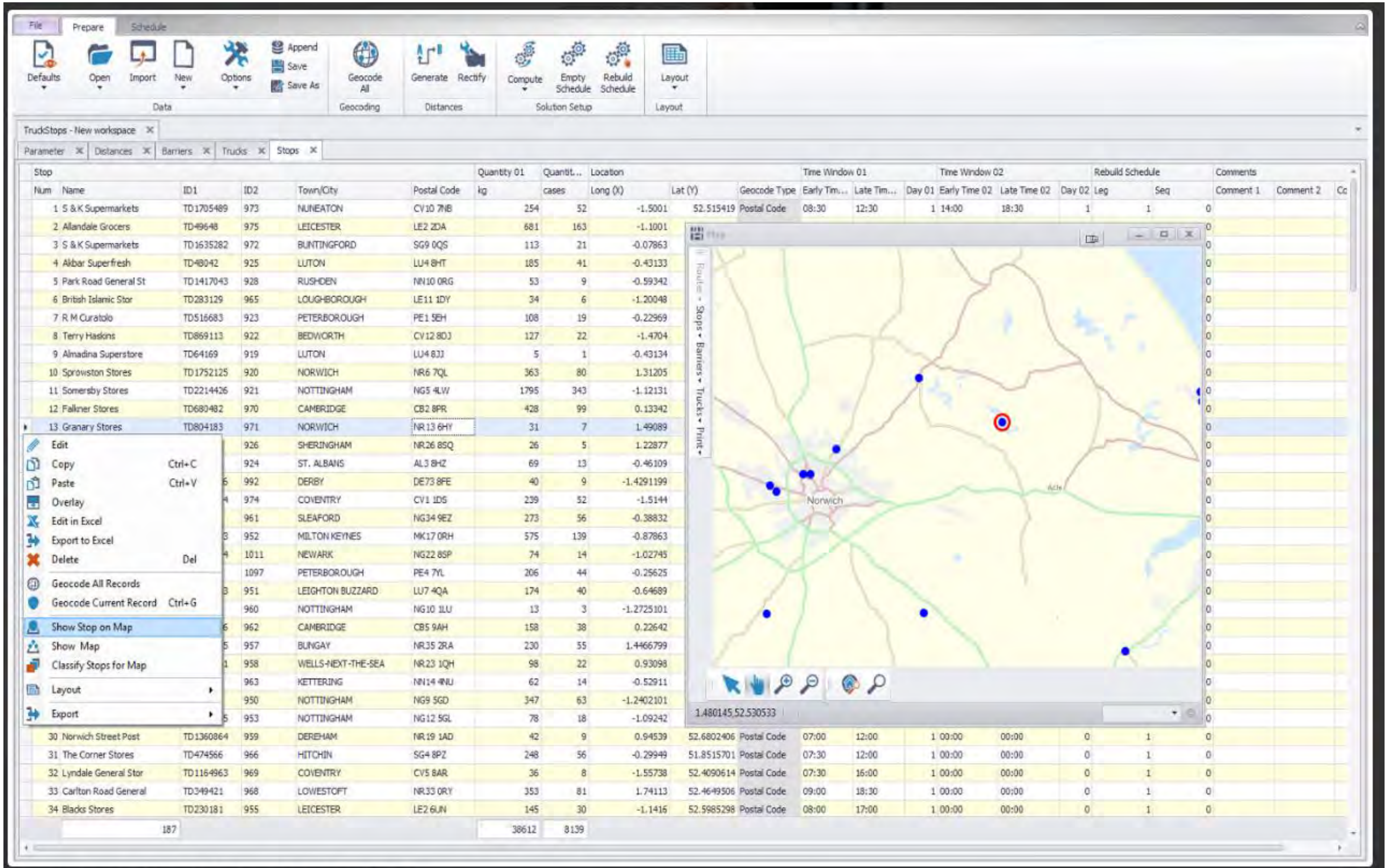
With Truckstops you can see the details of each of your vehicles.
Image 1 of 12


10 - DAV Van
Name DAV Van
Status 1-Available
Unload diff (%) 120
Orig Town/City Northampton
Dest Town/City Northampton
Special codes
U1-S1
Capacity Units
500 kg
110 cases
Work rules
Work time/Day 660 (minutes)
Drive time/Day 540 (minutes)
Layover length 660 (minutes)
Max continuous drive time 270 (minutes)
Total drive break 45 (minutes)
Earliest start time 06:00
Earliest start day 1
Latest finish time 19:00
Latest finish day 1
Costs
Distance 0.12
Hourly unload 0
Hourly 6.5
Drop 0
Overtime 3.25
Per unit 0
Waiting time 0
Fixed 0
Cost Wait
Cost Start
Cost End
Comments
1. Unavailable on Tuesdays
2.
Location
Origin
Destination
Name Depot
Address 1 Kettering Rd
Address 2
Town/City Northampton
County/State Northamptonshire
Postal Code NN1 4LG
Country United Kingdom
Long (X) Lat (Y) 52.248979 -0.888562
Geocode Type Manual
Geocode
Redispatch
Activate redispatch
Minimum redispatch time 60 (minutes)
Turnaround time 30 (minutes)
Priority redispatch
Keep same driver
Quickly and easily make changes to your vehicles.
Image 2 of 12



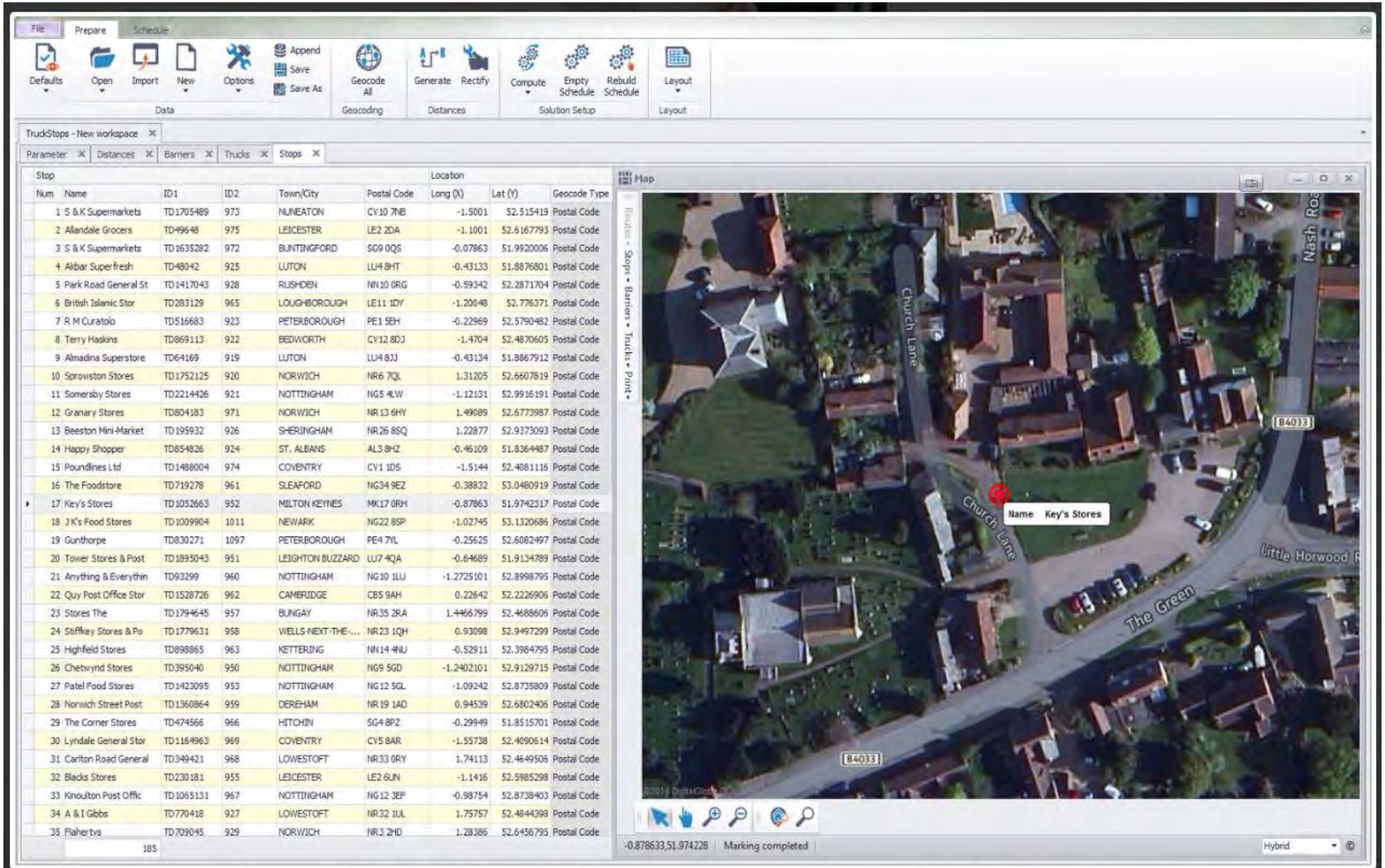
In order for your destinations to be displayed visually, your database will need to be geocoded. Truckstops can use local geocoding files, or geocode using the HERE location platform – returning co-ordinates and a description of its accuracy.

Image 3 of 12

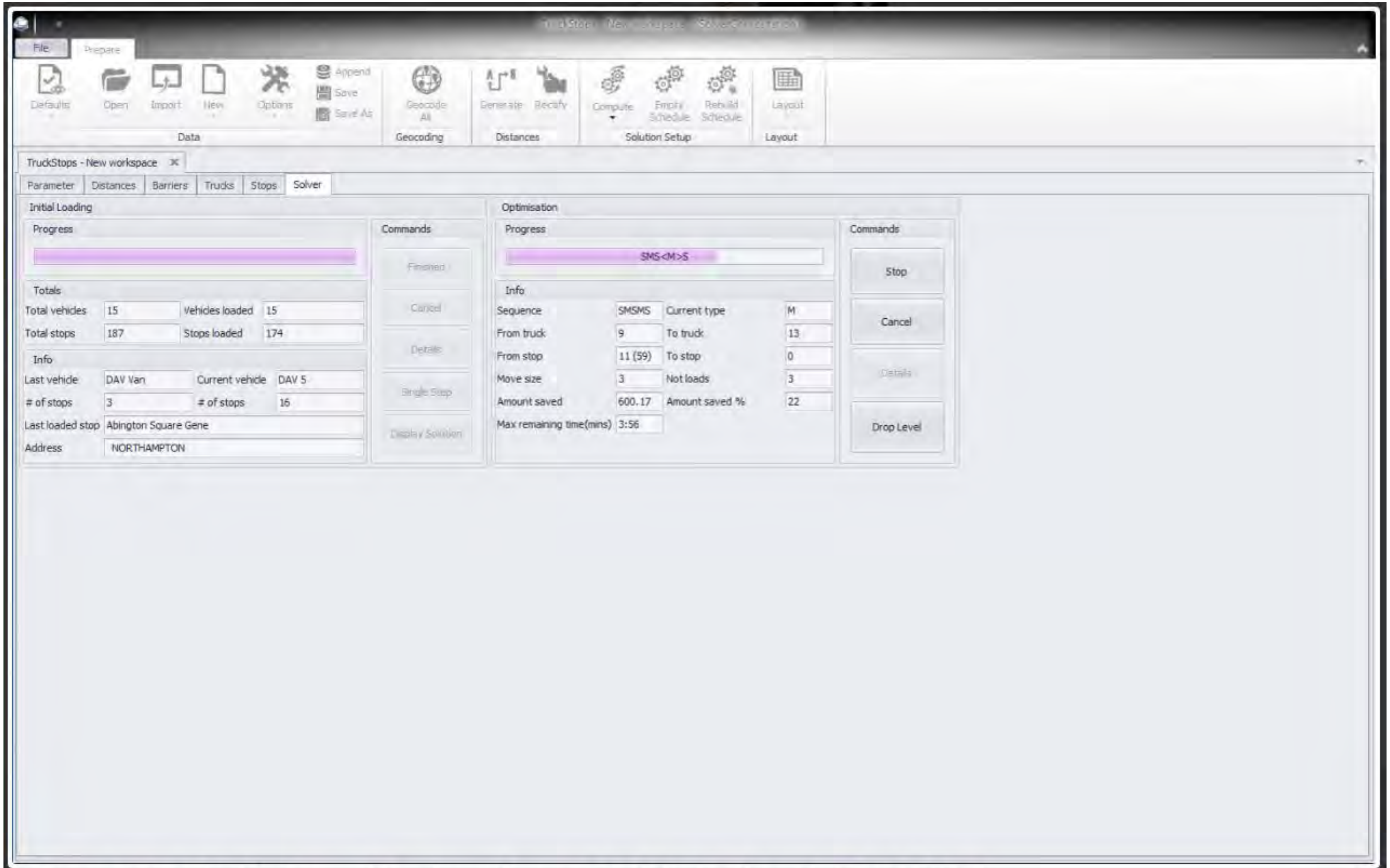


Geocoded stops are placed on the map for easy identification.

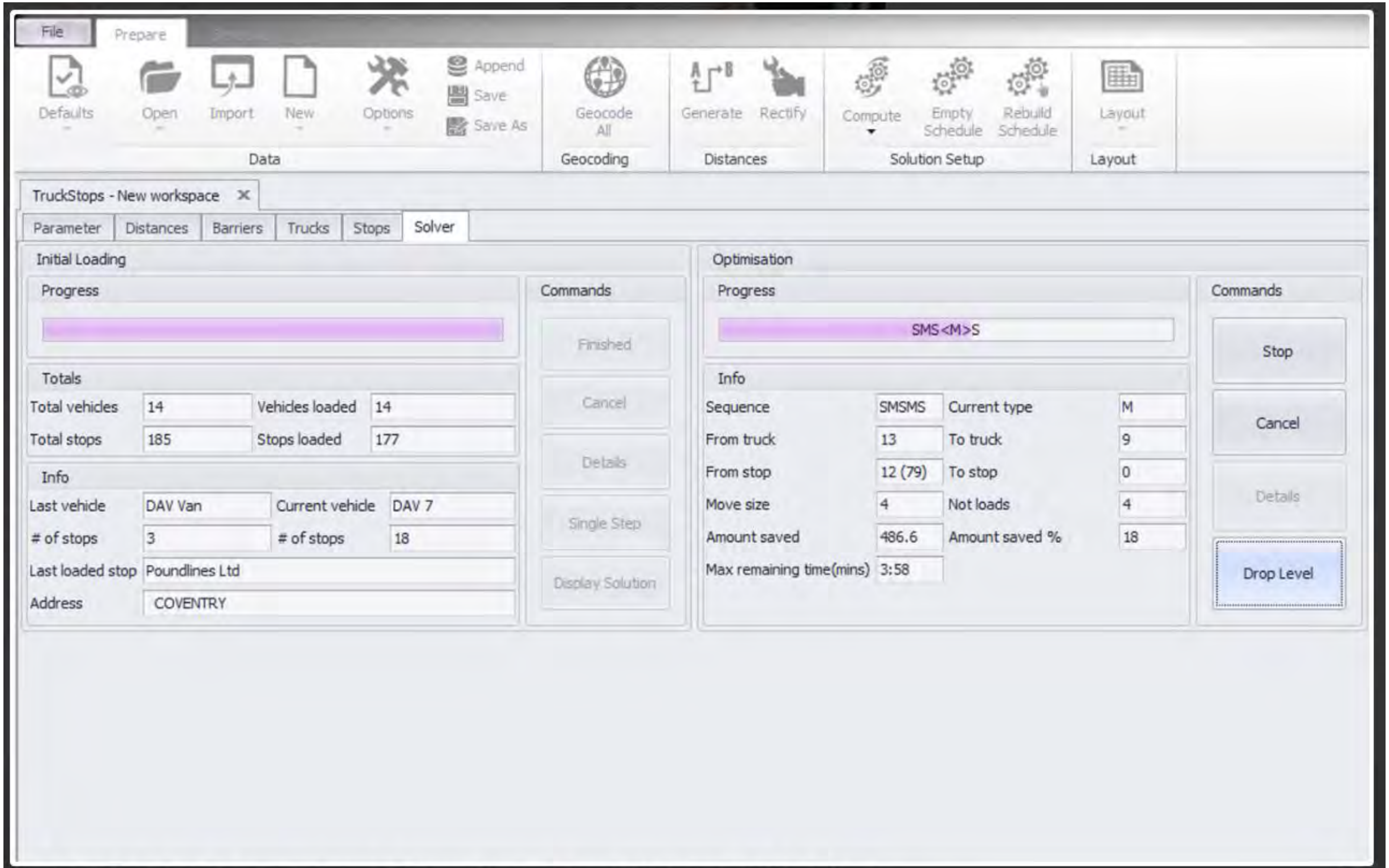
Image 4 of 12



Geocoded records are accurate to the premise level, depending on the health of your database. You can manually drag and drop geocoded points, for example moving the point to the entrance of a farm or to the delivery building.
Image 5 of 12

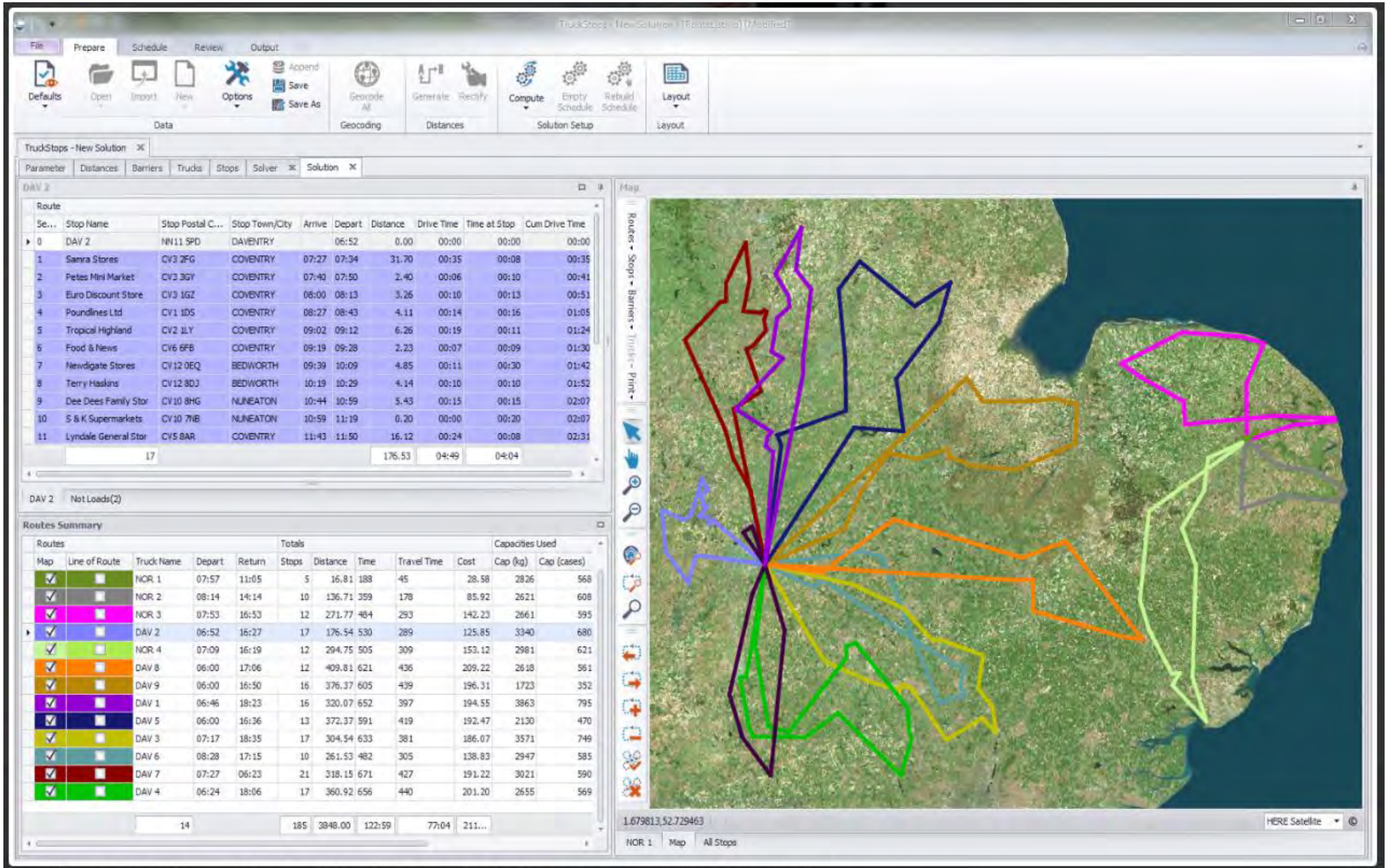


Truckstops optimises routing by calculating every possible route between all your stops. It then displays the total potential savings (typically 10-30%).
Image 6 of 12

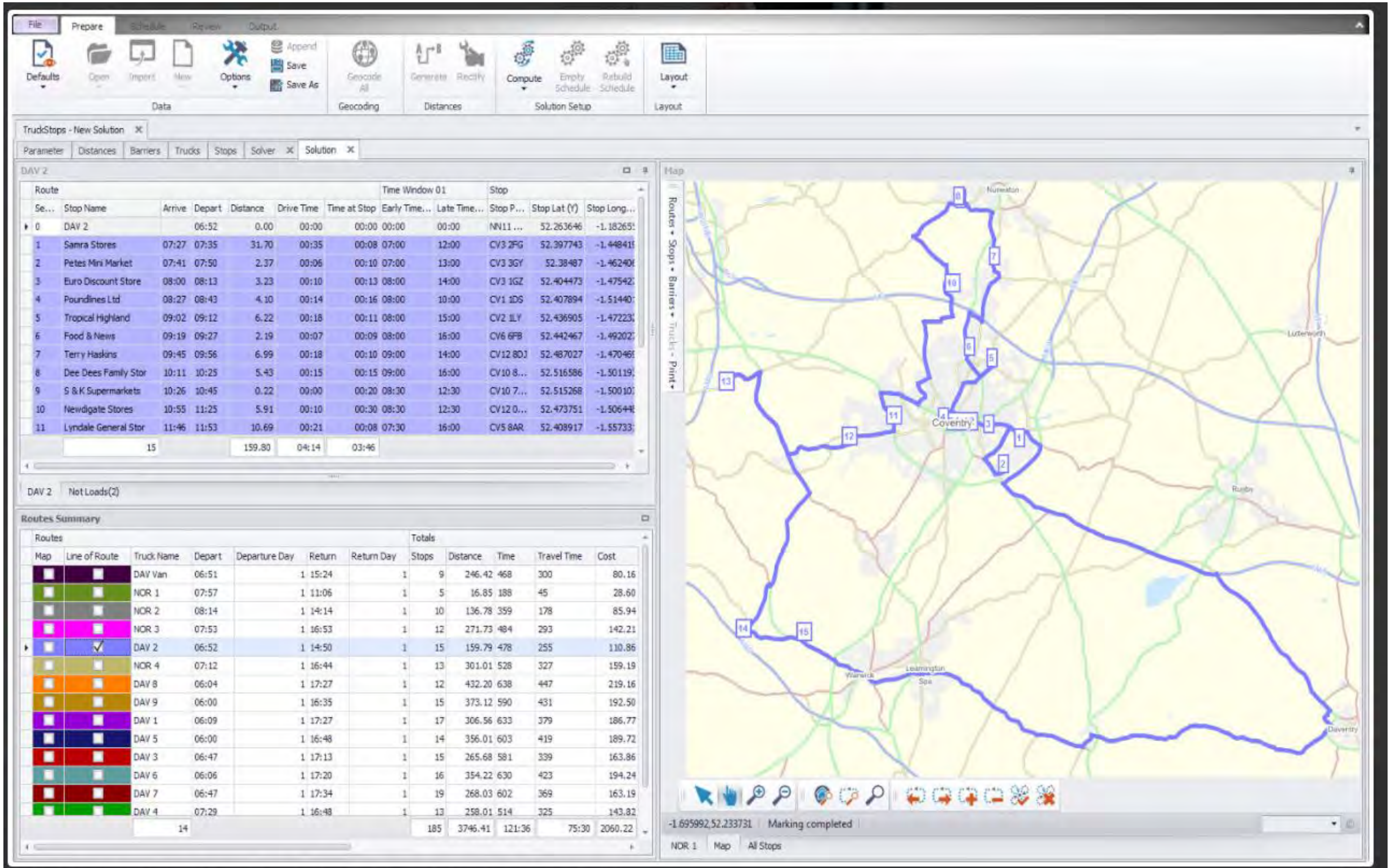


After the initial loading phase the optimisation process can be stopped when you are happy with the savings, or left to run for longer.

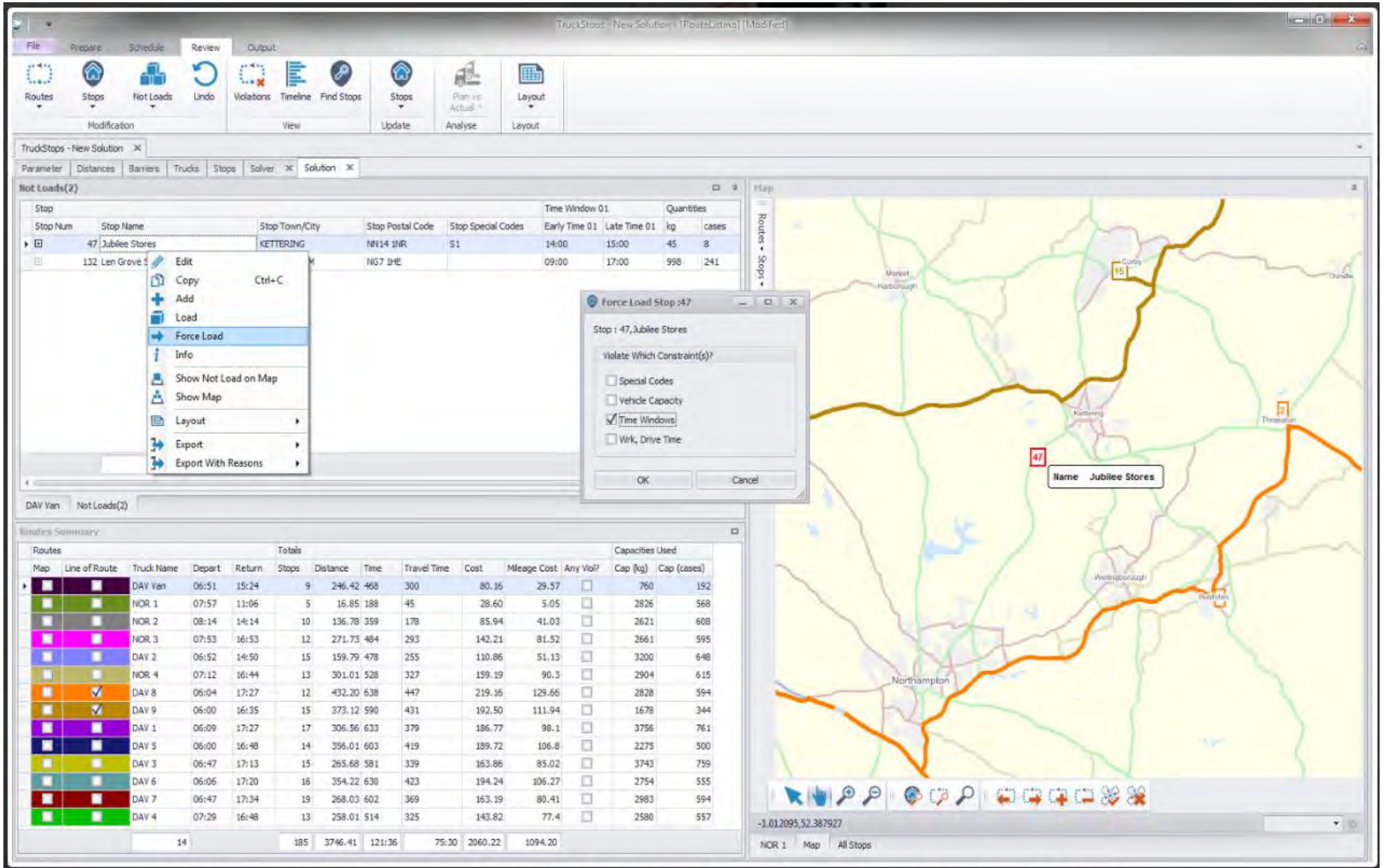
Image 7 of 12



The solution displays each route on the map which can be distributed to the drivers, as well as summaries of distances and costs.
Image 8 of 12

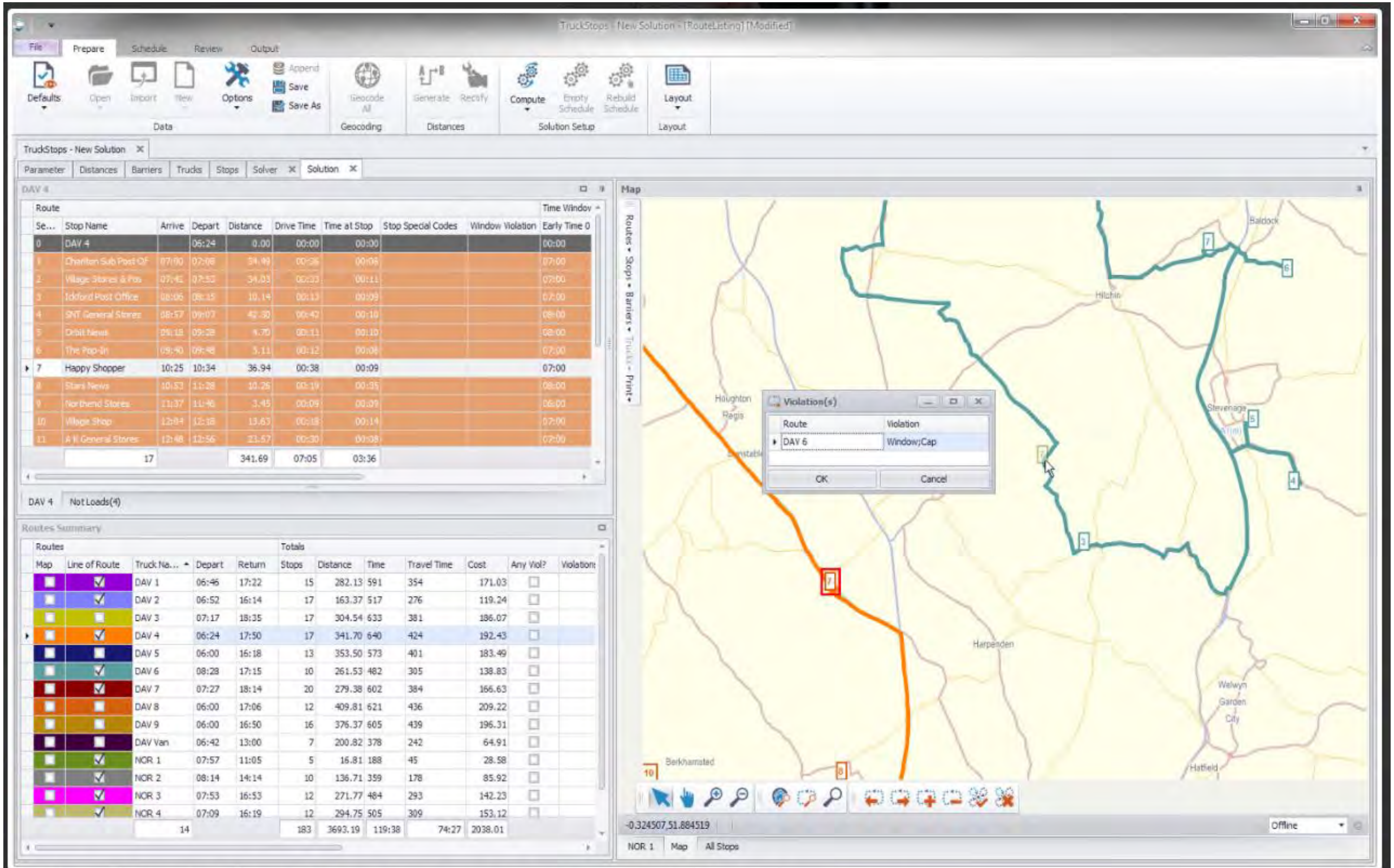


Routes are colour-coded and hovering over any stop on the map will display the stop details.
Image 9 of 12

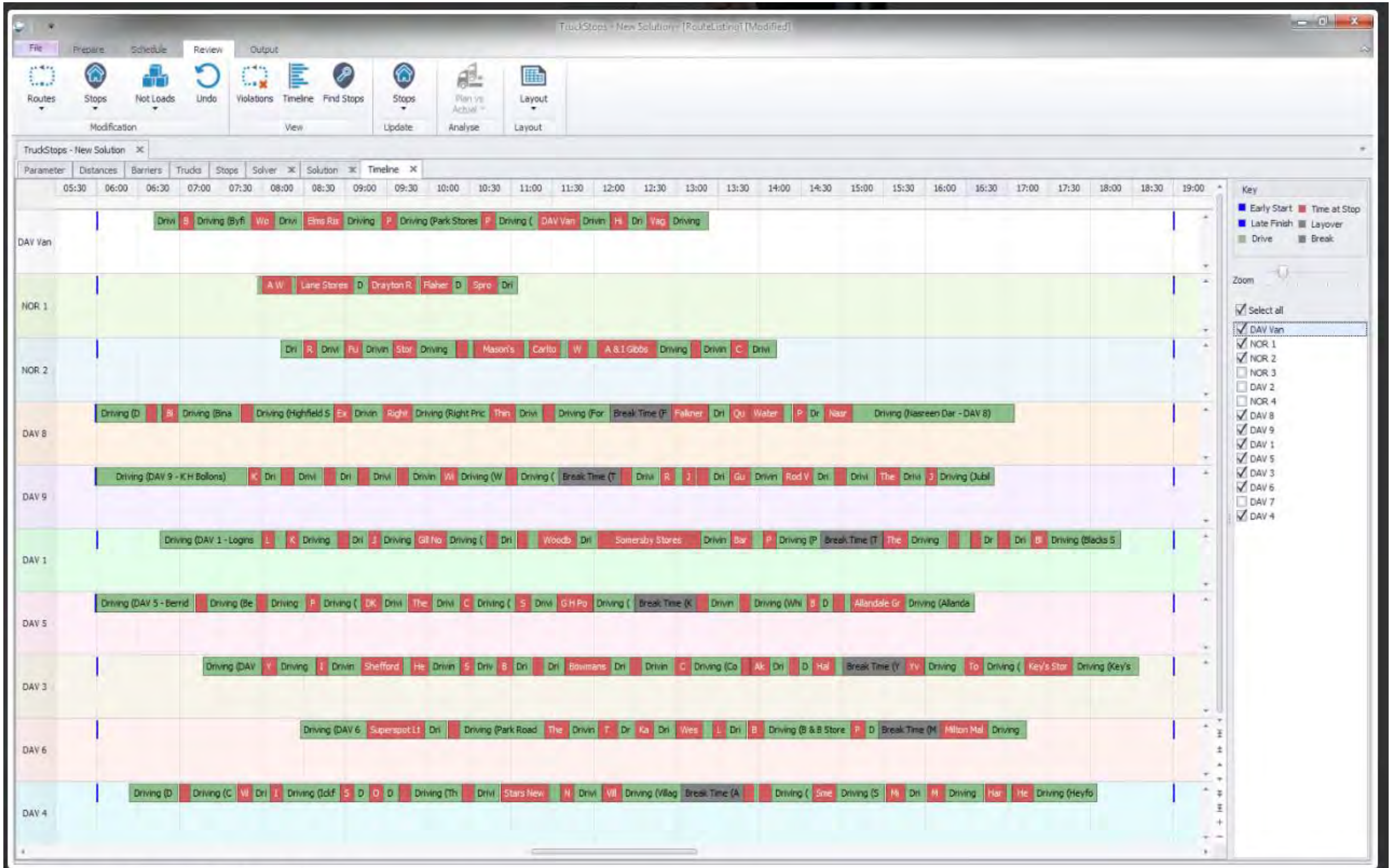


Truckstops generates realistic scheduling, meaning it may not be possible to reach all destinations in one day. These can be forced on to the route by extending working hours etc., or passed to the next day's schedule.

Image 10 of 12



Stops that would violate rules for the vehicle (e.g. drivers' hours, missing a time window) are automatically flagged up.
Image 11 of 12



Timelines provide a breakdown of a vehicle's day.
Image 12 of 12