Reverse Logistics on Construction Sites
Modelling the potential benefits of back-hauling

Background
WRAP (Waste & Resources Action Programme) is investigating the potential benefits to UK construction sites of efficient logistics planning in a range of tailored support projects.

Efficient use of logistics has the potential to reduce carbon emissions from transport (and social, environmental and efficiency impacts caused by many vehicles visiting sites). It also has the potential to reduce waste by over-ordering through delivery of materials only when needed, and directly to the areas on site where they are needed (this is not considered within this case study but will be assessed in an upcoming trial).

This project has looked at a specific opportunity for logistics, the potential use of vehicles supplying materials to also collect unused or wasted product and packaging to take back to the supplier. This would enable materials to be reprocessed by manufacturers or reused by builder’s merchants; utilising empty vehicles leaving site and reducing the requirement for waste vehicles to visit a site. Maximising the utilisation of the vehicle by delivering to (and collecting from) the same location and maintaining 100% vehicle fill makes the most of this opportunity.

In order to investigate the scale of the opportunity, WRAP commissioned Entec UK Ltd to create a model that would allow users in the construction industry to determine the benefits of reverse logistics on their site. The information from this model can then be used in negotiations between the contractor and material supplier to determine the appropriate details for their site.

It is estimated that 80% of vehicles delivering to a construction site leave empty. Utilising these vehicles can reduce your environmental impact.
Reverse logistics

The Model

The model was developed with input from both Jewson (Builder’s Merchant) and Laing O’Rourke (Building Contractor), and based on a live site operated by the latter. It was designed to look at two scenarios – a base case (i.e. what the standard material supply and waste management method would be) and a future scenario (i.e. what the potential benefits of reverse logistics are). The objective was to show a business case for offering a take-back service. It was designed to report on the following parameters:

- miles travelled – for all potential legs of the journey;
- carbon – the carbon dioxide from vehicle movements, taking into account the type of vehicle, the fill levels and the distance travelled;
- vehicle movements – the total number of individual vehicle visits to site;
- cost – the potential balance of costs for material purchase (including that wasted), waste management and any charges for backhauling; and
- waste recycled – the proportions of material that is wasted, recycled and backhauled for reuse and recycling.

The model is created as a spreadsheet, and allows the user to model up to eight key individual material streams, reporting on the above parameters. It contains a level of pre-defined information on certain materials to help the user should they have limited data.

The Site

The model was developed around a specific construction site in Staffordshire – the North Staffs University Hospital Private Finance Initiative (PFI) site managed by Laing O’Rourke.

The University Hospital of North Staffordshire serves a population of around 500,000 in the Stoke-on-Trent / Newcastle-under-Lyme area. The hospital is in need of new facilities to enable it to meet the needs of a growing population. This means demolition of the existing facilities and re-building of new blocks in phases to allow the hospital to continue to function alongside the construction. In some cases, new buildings can be built whilst those that they are to replace are still standing, but in others some demolition will be required before construction can take place.

Laing O’Rourke is the main contractor on site, and employs a wide range of sub-contractors for various aspects of the build. The main pressure that Laing O’Rourke face is meeting deadlines, as their contracts stipulate major financial penalties should the construction not meet deadlines. The total cost of the build is budgeted to be in the region of around £350 million, with the project running from 2007 until 2013.

Laing O’Rourke agreed to provide specific material quantities to the modelling, allowing both a base case and potential future scenario to be created for them. These were provided for a distinct phase (phase 2) of the project, the ‘hubs and wards building’, which was the largest building on site.
The Results
From the cost plan for phase 2, data was collected for 4 key material streams, namely:

- plasterboard;
- flooring;
- bricks; and
- ceiling tiles

Assumptions were made regarding some of the aspects that were unknown (such as material costs which had to remain confidential). Where possible, site data such as current waste management practice and costs were used.

The opportunities were limited for both bricks (where the little wastage produced was used as back-fill on site) and ceiling tiles (where little wastage is produced). However, both vinyl flooring and plasterboard generated large quantities of waste which have the potential to be back-hauled.

Discussions with the plasterboard manufacturer suggested that the vehicles that delivered plasterboard were often used for other duties on the backward leg of the journey, the impact of which was not considered within this study. Two extremes are therefore presented below – one that utilises the return journey by collecting elsewhere and one representing a vehicle which returned to the supplier empty.

The results are presented for two scenarios:

- scenario 1 – where plasterboard vehicles would normally be used for other duties after dropping-off plasterboard at the site; and
- scenario 2 – where plasterboard vehicles would normally return to site empty.

The results in the table above show the variation in scope of benefits for reverse logistics on the North Staffs site for key materials in their phase 2 work, representing potential material purchase costs in excess of £3M.1

<table>
<thead>
<tr>
<th>Scenario 1</th>
<th>Scenario 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance travelled (miles)</td>
<td>Reduced 4%</td>
</tr>
<tr>
<td>CO₂ (kg)</td>
<td>Reduced 2%</td>
</tr>
<tr>
<td>Vehicle visits to site</td>
<td>Reduced 29%</td>
</tr>
<tr>
<td>Cost (£)</td>
<td>Increased 0.1%</td>
</tr>
<tr>
<td>Waste recycled and backhauled (tonnes)</td>
<td>Increased 5%</td>
</tr>
</tbody>
</table>

* It is worth stating that as land fill taxes increase at a rate of £8/t per annum, take-back schemes for re-use and recycling will become increasingly financially beneficial

The results show that there is a range of environmental benefits available to the North Staffs site through implementing reverse logistics. Depending on the current efficiency of the plasterboard delivery vehicles there is the potential to reduce the carbon emissions associated with logistics by between 2% and 11%, reduce the number of vehicles visiting site by 29% and increase the amount of wastes recycled and backhauled (mainly through targeting packaging waste for back-hauling) by 5%. The majority of the benefits are gained through targeting plasterboard, with this material representing 90% of the carbon benefit in Scenario 1, and 99% of the benefit in Scenario 2.

In addition to these savings are the carbon benefits from recycling the individual material and packaging streams.

1 Costs supplied by manufacturers, used for indication only and not the actual costs experienced by the contractor
**The Opportunity**

The results show that reverse logistics has the potential to offer savings to contractors. The greatest of these are the diversion of waste from landfill (21 tonnes of wasted material and 4 tonnes of packaging) and the reduction in vehicles visiting site. The carbon savings vary depending on the efficiency of supplier logistics, but where there is an opportunity to use vehicles leaving site and returning to the supplier empty, there is a potentially greater carbon benefit to be realised. In addition, the reduction in vehicles visiting site will give improved safety in terms of reduced risk.

The costs modelled for this site were similar for both scenarios, however, better opportunities may be available where there is a closely located supplier. In addition to this, with the escalating cost of landfill, opportunities that involve recycling wastes will become increasing more financially attractive in the coming years.

Following the modelling, the material suppliers for vinyl flooring and plasterboard were contacted to discuss the potential opportunities on the North Staffs site.

This presented two distinct opportunities:

- **vinyl flooring** - off-cuts of flooring generated during fitting provide a ‘quick win’ in terms of recycling and avoiding landfill. The manufacturer will (in most cases) arrange to back-haul this material free of charge and will offer this service to the North Staffs site; and

- **plasterboard** – the scale of opportunity depends on the efficiency of logistics already operated by the manufacturers. However, the quantities produced on site present a clear opportunity for the vehicles to back-haul this material to either the manufacturing site or a local recycling plant as the first part of a return journey. The manufacturer currently offers an independent waste collection service for this material – and has researched (and successfully trialled) a potential reverse logistics offering for the future. Both builder’s merchants and material distributors have the potential to offer this service independently, bulking plasterboard at their depot for bulk collection / onward transport.

2 See http://www.wrap.org.uk/construction/plasterboard/ for further information