Case study: Construction logistics

Material Logistics Planning in a railway project
Illustrating how good logistics planning can reduce waste and carbon emissions

In December 2010 Network Rail’s £370 million Airdrie – Bathgate rail link project, funded by the Scottish Government, will reconnect communities between Airdrie (east of Glasgow) and Bathgate (west of Edinburgh) not served by rail for more than 50 years.

This study looks at how good logistics planning can reduce waste and carbon emissions, focusing mainly on the non-operational civil engineering part of the project. This large infrastructure project had up to 40,000 tonnes of aggregate being delivered to site each week with an average of 52 lorry movements per hour peaking at between 70-80 lorry movements.

Areas of good practice are highlighted along with focus areas for continuous improvement.

Performance indicators and environmental controls
On the Airdrie to Bathgate Rail Link Project (A-B project) Network Rail required each main contractor to develop and maintain a Site Waste Management Plan, and report monthly on a number of Environmental Performance Indicators (EPI).

At the point of writing 82% of waste was diverted from landfill in the non-operational civil engineering works.

Key Facts

- Client: Scottish Government.
- Delivery agent: Network Rail.
- Main civils contractor: Carillion plc.
- Route: Glasgow Queen Street to Edinburgh Waverley: 47 miles. New section, Airdrie and Bathgate: 15 miles.
- Double track electrified line.
- Construction of three new stations, relocation of two stations and upgrading of three stations.
- 36 bridges: some new, some replaced and some modified.
- Just-in-time material deliveries to point of use.
- Stock control system for aggregates and excavated materials, linked to route map, facilitating reuse.
- Lightweight cable troughing made from recycled polymers saved 800 tonnes of waste and reduced transport related carbon emissions by over 80 tonnes.
- Off-site manufactured (OSM) bridges allowed accelerated programme, in some cases reducing installation time from 16 weeks to two weeks.
Contract structure
Network Rail divided the overall scope of work into five main work packages and appointed main contractors:
- Carillion plc – non-operational civil engineering including all associated ground works and track formation;
- Balfour Beatty Rail Projects – rail infrastructure, track and overhead lines;
- Bam Nuttall – operational civils;
- C Spencer Ltd – construction of a light maintenance depot in Bathgate; and
- Invensys Rail (Westinghouse when appointed) – signalling and controls.

Accelerating bridge construction through Off-Site Manufacture (OSM)
Carillion Framework provided specialist knowledge of efficient bridge construction to radically shorten the on site construction programme. This became the template for subsequent bridge replacements.

Bridge construction
- The original programme was 16 weeks based on a conventional process with on site construction; using Off Site Manufacture (OSM) this programme was reduced in some instances to as little as two weeks.
- Everything was pre-cast, including concrete and metal beams.
- There was minimal in-situ concrete pouring.
- Preparation, placement and fixing of the bridge structure took one week. Waterproofing and masonry required a further two days.
- Significant waste reduction through OSM.
- No on site material storage through just-in-time deliveries.
- Faster programme makes for easier workforce planning.

Controlling aggregate stocks on site
Carillion maintained an up-to-date database of all material stockpiles on a route layout specifying volume and quality. This allowed the section managers to locate available aggregates of any specific quality anywhere along the route before acquiring new deliveries from a quarry.

Just-in-Time deliveries
Materials were taken directly to any of the compounds along the route, as close as practicable to the point and time of use.

Troughing design
Railways conventionally use concrete troughing to enclose trackside cabling. These are heavy and difficult to handle, and installation invariably results in high wastage – typically 30%.

Together with supplier Trojan Services Ltd Network Rail incorporated a new combined cable trough and walkway made of recycled polycarbonates. This product is light and strong, and wastage on site was almost entirely eliminated.

Over the 22 km route the weight of new duct is 3,000 tonnes less than the concrete product. This reduced the required number of deliveries by 145 resulting in an estimated carbon emission reduction of 84 tonnes.

A cautious estimate of waste based on just 20% for the concrete troughing shows a waste reduction of 805 tonnes.

The new material brings further benefits. It is easier to handle and faster to install. Its light weight allows a “one person lift” and improves H&S. It can be cut with hand tools, reducing the noise pollution associated with concrete cutting and eliminating dust and smoke.
Focus areas for continued improvement

- Logistics planning should begin at the design stage and include consulting logistics experts, locating suitable material sources, sites for disposal and reuse of materials.
- Network Rail could derive benefit from introducing operational logistics control for large projects which has the potential to pay for itself in increased efficiency and exploitation of return logistics opportunities.
- Overall logistics efficiency could be improved if the transport system was backed up by on-board communications and GPS. These systems allow the controller to know where each vehicle is at any time, its destination, estimated time of arrival and what load it is carrying. The systems provide useful reporting on mileage, carbon impacts, empty driving, waiting time, speeds and speed limit violations etc. This could be complemented by using delivery management systems to control deliveries. Such systems have been used to good effect on projects such as the M1 widening scheme – also a linear project.
- Network Rail currently maintains a national database of EPIs. Together, the EPI and Site Waste Management Plan data it already collects could help build KPIs and targets and implement these good quality benchmarks into contracts.

All of the above points would be captured if Network Rail were to implement an adapted Material Logistics Plan.

WRAP's Material Logistics Plan would provide a starting point which can be adapted to address the issues specific to Network Rail, in a similar way to the work on Construction Logistics Plans developed by Transport for London. See: www.tfl.gov.uk/microsites/freight/construction_logistics_plans.aspx

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