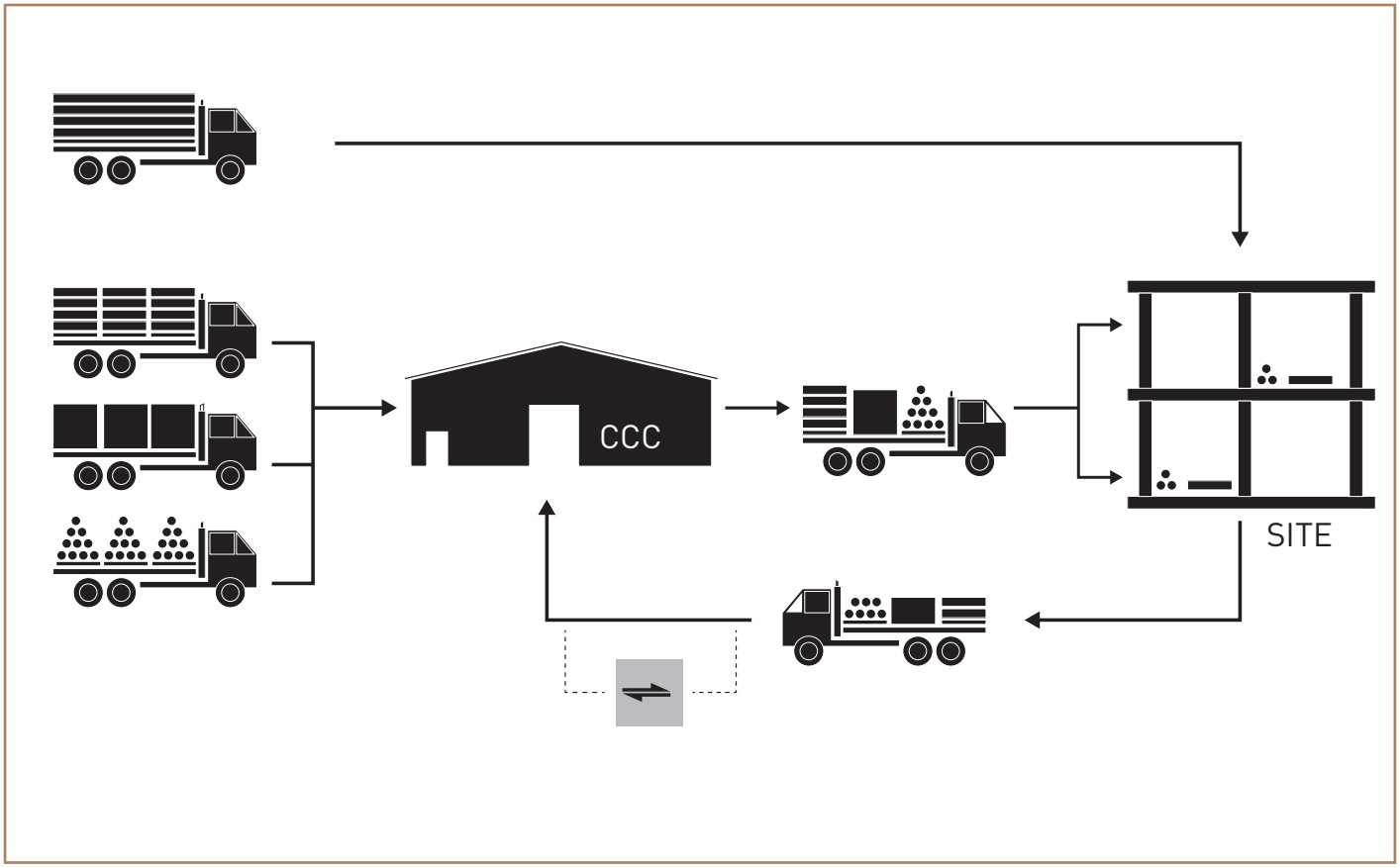
Working together for a world without waste

Guidance: Construction Logistics

Using Construction Consolidation Centres to reduce construction waste and carbon emissions



A guide demonstrating the costs and benefits of using a Construction Consolidation Centre and how it can reduce waste and carbon

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Our vision is a world without waste, where resources are used sustainably.

We work with businesses, individuals and communities to help them reap the benefits of reducing waste, developing sustainable products and using resources in an efficient way.

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Front cover photography: An overview of a typical Construction Consolidation Centre process

Executive summary

A Construction Consolidation Centre (CCC) is a distribution facility through which material deliveries are channelled to construction sites. The material is handled with appropriate equipment and stored in dry, secure locations. On call off from the site, the CCC operator makes up consolidated loads and delivers them on a Just-In-Time basis. This process is often combined with on-site logistics specialists delivering materials to the point of use and provides an excellent opportunity to improve the overall resource efficiency of a construction project.

Benefits

The direct benefits of a CCC relate to the reduction in construction traffic both on site and particularly relevant in city centre locations. Traditional transport to construction sites is often uncoordinated, with many separate deliveries and various peaks of congestion at the site. The vehicle utilisation is poor with vehicles often travelling half-empty to site and empty from site, leading to excessive traffic flow and carbon emissions out of proportion to tonnage handled.

The environmental benefits of reducing construction traffic are obvious, i.e. a reduction in congestion, noise, pollution and carbon emissions, while the utilisation of reverse logistics ensures that journeys from site can be used for waste removal, the return of unused material and packaging for reuse and recycling, and the return of pallets and reusable packaging.

In addition to the environmental benefits, fewer and more productive vehicle journeys mean cost savings for main and trade contractors, suppliers and clients, and faster turnaround times benefit the haulier. Several studies also show that the way a CCC enables effective Just-in-time delivery to site leads to waste reduction, productivity improvements and improved programme certainty.

While data varies from project to project, some notable statistics have been:

- a reduction in freight traffic to site by up to 70%;
- increased productivity of site labour by 30 minutes per day leading to a 6% productivity gain; and
- a waste reduction of 7-15% from reduced damage and shrinkage through loss of material.

Project size

Project size is not necessarily decisive as to whether a CCC should be used or not, so long as there is an ongoing business volume to maintain the operation. The CCCs that were studied varied between 650 m^2 of warehouse space with one warehouse operative, two drivers and an administrator and 10,000 m^2 warehouse space plus yard area. There are, however, advantages in shared user as opposed to single user CCCs; for example, small projects can tap into services that are already in place, the costs of operating a CCC will be spread more efficiently and a permanent operation will allow experience and expertise to develop.

Location

The locating of CCCs should take into account the proximity of the motorway network and major roads, to both lessen the impact on local roads of incoming deliveries and minimise hauliers' turnaround times. Ideally, a CCC should be situated where a cluster of construction sites can be reached in under 30 minutes' drive time. With these guidelines in mind, we have modelled what coverage could be provided near major population centres throughout the UK.

The challenge

Currently there are limited examples of CCCs in operation in the UK and despite the benefits, there are a variety of reasons why they are not taken up so readily.

It is normally up to the main contractor to take the decision to use a CCC and to carry the cost. However, it is not only the main contractor who benefits from the use of a CCC. Subcontractors, suppliers and hauliers all benefit, and ways needs to be found to spread the cost among these other participants in line with the savings they make. The fixed cost of setting up one CCC for one site may be prohibitive.

Contents

1.0 Introduction

This guidance document has been developed to give construction clients and contractors an overview of when they should consider a Construction Consolidation Centre (CCC) and an indication of some of the costs and benefits associated with opening this. The guidance document is intended to review how the operation of a CCC impacts on a supply chain and typical barriers to setting one up.

The purpose of this guidance document is therefore to raise awareness of opportunities and benefits through the use of a CCC to improve resource efficiency in construction. Previous WRAP studies have looked at resource efficient operations benefitting from effective logistics strategies which are often combined with the use of a CCC.[1] This includes delivery to site and the collection of waste from site.

Included in this document are:

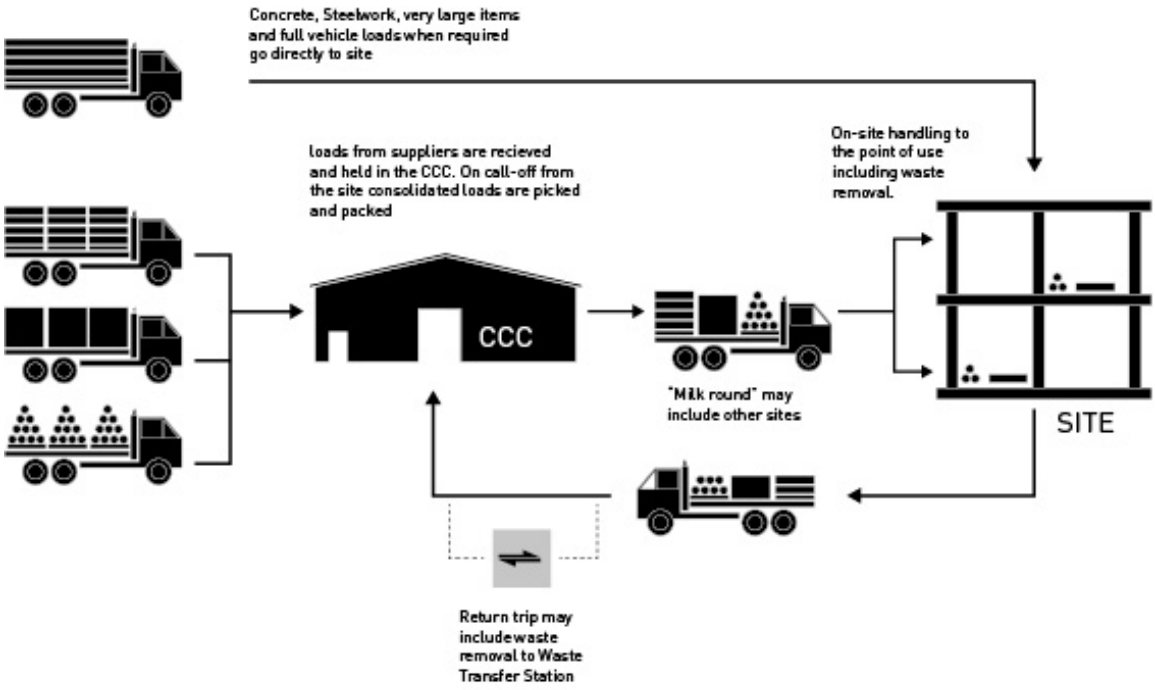
- a summary of a CCC;
- an overview of some current examples of a CCC;
- tangible benefits of using a CCC;
- benefits in terms of which part of the supply chain benefits;
- details on where a CCC could be conveniently located currently; and
- considerations of setting up a CCC.

2.0 What is a Construction Consolidation Centre?

Traditional transport to construction sites is often uncoordinated with many separate deliveries and a great risk of congestion at the site entrance and unloading points. Many vehicles travel half-empty to site and empty from site leading to carbon emissions out of proportion to tonnage handled. Alternatively, full loads lead to excessive material stocks on site, which result in a congested work environment and excessive material damage and waste.

A Construction Consolidation Centre (CCC) is a distribution centre through which material deliveries are channelled (see Figure 1). This is a small warehouse equipped for material handling where vehicles can be off-loaded and turned around quickly. Volumes that allow sensible vehicle loading can be accommodated, the exception being very large items such as steel work and heavy plant where a full vehicle load is required and should therefore be taken directly to site.

Figure 1 The principles of a Construction Consolidation Centre



[1] http://www.wrap.org.uk/constructionlogistics

On arrival at the CCC all items are checked and booked in either on a simple spreadsheet or on a Warehouse Management System. The material is handled by appropriate equipment and stored in dry and secure locations, to avoid damage.

Contractors on the site call off material from the CCC. At the CCC operatives pick and make up consolidated loads and deliver to site on a Just-in-time basis. This way full vehicle loads serving several contractors in one delivery can be made up without delivering excessive quantities for any one contractor.

Figure 2 Off-loading a delivery from the London Construction Consolidation Centre at the Quadrant project in central London

3.0 Examples of CCC

The consolidation centre has been used in other sectors for many years such as distribution centres. Within construction, it is a relatively new concept. In 2001 the Heathrow Consolidation Centre (HCC) was set up to serve the ongoing construction work at Heathrow's terminals 1-4. At the same time a well publicised CCC was in operation in Stockholm[2] to support a large residential project called Hammarby Sjöstad. A few years later in 2005 the London Construction Consolidation Centre (LCCC) began operation in Bermondsey, London. The HCC was set up by Mace and continues to be run by Wilson James for BAA, while the LCCC was created for a pilot study in a partnership between Transport for London, Stanhope PLC, Bovis Lend Lease and Wilson James (who also operated the facility). After the pilot study Wilson James carried on the activity on a commercial basis and it has now relocated to Silvertown just south of City of London Airport.

All these early examples of CCCs were studied in some depth, and generally regarded as successful. The benefits of using a CCC based on these experiences and some other more recent examples will be set out in the following chapter. Following the early, much publicised experiences of CCCs one would have expected strong growth in this approach to construction logistics. To date this has not happened, and in the final chapters of the report some of the reasons for this are discussed.

There are however a number of CCCs currently in operation. For instance, logistics company Wincanton have, at the time of writing this report, three CCCs in operation:

- Greenford - a shared multiuser site with about 60 clients. At the moment it supports three central London construction projects. It is a bonded warehouse and very secure – a critical factor in one of the construction projects.
- Cardiff – also shared user facility, some smaller construction projects
- Portbury near Bristol - also shared user facility, some smaller construction projects

Overall, Wincanton has some 420 locations across the country and the business concept is to use shared facilities rather than have exclusive construction consolidation sites. Wincanton feels that using an existing network is more cost effective than setting up dedicated CC for construction only use. This approach allows them to switch the CC on and off as and when it is required.

Another approach is where a company establishes its own CCC for supporting its own construction projects. This is the approach of house builder Taylor Wimpey.[3] Taylor Wimpey Logistics operates a warehouse facility in Newmarket that consolidates material supply for over 120 sites across England and Wales. This is a similar strategy to that followed by Sainsbury's which is covered in more detail below.

[2] *This overview on Freight consolidation centres has Stockholm as one of its studies: http://www.sestran.gov.uk/uploads/Freight%20Consolidation%20Centre%20Study%20-%20Final%20Report.pdf*

[3] *http://www.wrap.org.uk/constructionlogistics*

To illustrate how viable and successful CCCs operate and how they can vary, but also to give an idea of common features, three CCCs are presented below:

	The London CCC, Silvertown	**The Nine Elms CCC, London**	**Sainsbury's consolidation, reuse and recycle centre, Park Royal, London**
Operator	Wilson James	MLogic (part of Mace) – Site is owned by DHL.	Sainsbury's in partnership with Fit Out (UK) Ltd
Size and throughput	10,000 m^2 warehouse space plus yard area. 50,000 pallets per year throughput (Pallet equivalent Unit – PEU).	650 m^2 fully secure warehouse area (at peak), including an extra secure caged area contained within. About 6,000 PEUs. Approximately 4,000 bins of 660 litre capacity removed from site in reverse logistics operation, back to CCC from where waste company collects.	6,000 m^2 warehousing space and 1,500 m^2 mezzanine area. Yard area. 12,000 PEUs (first two years of operation).
Staffing	Eight employees; manager, administrator, warehouse operatives and drivers.	Four employees; manager, administrator, one warehouse operative and two drivers.	A manager and a consolidation coordinator. Six warehouse operatives shared with other activities and seven drivers also shared with other activities. Note this is a 24/7 operation.
Vehicles and materials handling at CCC	1x26 tonne flatbed with crane 2x18 tonne flatbed 1x18 tonne curtain sided with tail lift 1xLWB Transit 4xforklift trucks The fleet is regularly adjusted to demand.	1x rigid flatbed lorry 1x18 tonne curtain sided lorry with tail lift 1x large Transit van 1xforklift truck	1x18 tonne curtain sided lorry Articulated lorries hired in as and when required for larger loads 1x forklift truck
Construction projects	The LCCC supports between three and six projects. Current projects include Barts Hospital phase II with Skanska as main contractor and the Quadrant III run by Sir Robert McAlpine.	Single user facility for One Hyde Park where Laing O'Rourke are the main contractor.	Predominantly within the M25 – has now delivered as far afield as Leamington Spa. Has delivered to 29 projects over the first two years' operation.
Comments	It also serves as a London based storage facility for a number of trade contractors.	Only a one-hour delivery slot to site allowed each day – therefore consolidation the only option.	This facility is shared with other Fit Out (UK) activities such as manufacture and delivery of fit out materials. There is also refurbishment (deep cleaning) of refrigeration equipment and serves as a store for returned equipment available for reuse.

Figure 3 Loading at the LCCC

Figure 4 Warehouse with racking at Sainsbury's consolidation centre which is operated in partnership with Fit Out (UK) and which also serves as reuse and recycling centre

Figure 5 The air-conditioned secure area at Nine Elms with caged high-security zone

4.0 The benefits of using a CCC

The direct benefits of using CCCs relate to the reduction in construction traffic – and this is the main reason that CCCs have been promoted by authorities as in the case of Transport for London and City of Stockholm. The environmental effects are obvious, i.e. a reduction in congestion, noise pollution and carbon emissions. However, the way a CCC enables effective Just-in-time delivery to site creates a host of other equally important benefits such as waste reduction and productivity improvements that can reduce costs and improve the overall resource efficiency of a project. The table below sets out the areas where CCCs can bring benefits – quantified in many published case studies.

Category	Benefit	Reference
Environ-mental	Traffic reduction	CCCs successfully reduce traffic in the zones they serve and this is well documented, for instance the LCCC demonstrated the following benefits[4]: ■ Reduction in the number of construction vehicles entering the City of London and delivering to sites served by the LCCC, of 68% ■ Reduction in supply journey times, by going directly to the LCCC rather than driving into the City of London (including loading/unloading time), of an average of two hours ■ Achievement of delivery performance of 97% of goods delivered right first time ■ Reduction of CO_2 emissions, as a direct result of the reduction in vehicles highlighted above of c.75% The objectives for the Hammarby Sjöstad consolidation project in Stockholm[5] were: ■ decreasing the number of small direct deliveries (fewer than four pallets) to the site by 80% through co-transportation ■ less traffic congestion on the construction site ■ improved living conditions at site for new inhabitants ■ improved working environment; and ■ reduced energy use, emissions of CO2, nitrogen oxides and particulate matter On all these counts the project was deemed a success following evaluation by the City of Stockholm.

[4] *Interim and Final reports on the LCCC by Transport for London, Bovis Lend Lease, Constructing Excellence, Stanhope and Wilson James*

[5] *Civitas Trendsetter report no. 2005:7 - Evaluation Report – New Concepts for the Distribution of Goods (WP 9)*

<table>
<tr><th>Category</th><th>Benefit</th><th>Reference</th></tr>
<tr><td></td><td></td><td>
The LCCC also demonstrated a variety of benefits from a freight perspective.[6]
Several key performance indicators (KPI) were studied:
<table>
<tr><th>KPI</th><th>Target</th><th>Currently achieving</th></tr>
<tr><td>Reduction in freight journeys</td><td>40%</td><td>70%</td></tr>
<tr><td>Reduction in journey time of supplier deliveries to contractors</td><td>30-60 minutes</td><td>2 hours</td></tr>
<tr><td>Delivery reliability</td><td>95%</td><td>97%</td></tr>
</table>

Other KPIs included reduction in vehicle mileage, reduction in number of vehicles used, back-loading of pallets and stillages and reduction in waste. The LCCC report also looked at the congestion charge savings per annum:
<table>
<tr><th></th><th>No of vehicles</th><th>Cost of congestion charges (at £8 per vehicle per day)</th></tr>
<tr><td>Without LCCC</td><td>4,099</td><td>£32,792</td></tr>
<tr><td>With LCCC</td><td>1,461</td><td>£11,688</td></tr>
<tr><td>Minimum saving (£)</td><td></td><td>£21,104</td></tr>
</table>

In conclusion, the report endorses construction consolidation centres as an effective way of reducing vehicle mileage (and associated fuel consumption and emissions) and of reducing traffic congestion in urban areas.

WRAP case studies on Barts Hospital and Central St Giles, December 2009 show a reduction of vehicle journeys into central London of 74% and 75% respectively.
</td></tr>
<tr><td></td><td>Traffic reduction through reverse logistics</td><td>
A WRAP report on Reverse Logistics on construction sites estimated that 80% of vehicles delivering to a site leave empty.[7] Using a CCC greatly facilitates reverse logistics as has been shown in the case studies for Barts Hospital and Central St Giles as mentioned above.

The three examples of currently operating CCCs mentioned in this report also fully utilise the reverse logistics opportunities. The reverse journeys are used for:

Waste removal – typically where bins rather than skips are used on site, or for compacted and banded packaging waste and timber
Returning unused materials and packaging for reuse and recycling
Returning pallets, reusable packaging, cable drums etc.
Equipment as in the case of refrigeration equipment returned for cleaning during Sainsbury's store refurbishments
Construction equipment

</td></tr>
<tr><td></td><td>Waste reduction</td><td>
Several studies testify to significant waste reduction through the improved storage and handling in a CCC operation:

The refurbishment of Unilever House in London was covered in a WRAP case study of 2007:

In all, some 13,200 pallets (or pallet equivalent) were handled by the LCCC over a two-year period.
90% of all delivered pallets were returned to the LCCC for collection by suppliers.
The project also provided an excellent illustration of over-ordering in the industry, and of the waste-reducing effect of using a CCC. At the end of the project 38 full 26-tonne lorry loads of unused materials worth approximately £200,000 remained at the CCC rather than ending up in waste skips.

A WRAP case study showed that at Barts Hospital the plasterboard waste was 10% lower than at The London Hospital being constructed at the same

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[6] *Freight Best Practice, 2007, Department of Transport*
http://www.freightbestpractice.org.uk/london-construction-consolidation-centre-tool
[7] *http://www.wrap.org.uk/constructionlogistics*

<table>
<tr><th>Category</th><th>Benefit</th><th>Reference</th></tr>
<tr><td></td><td></td><td>time and by the same contractor (Skanska). Barts Hospital used the LCCC and had the plasterboard delivered by plot and just-in-time, reducing storage and handling.The London Construction Consolidation Centre, Interim Report – May 2007 evaluating the LCCC found a reduction of materials waste of up to 15% resulting from less damage and reduced shrinkage.
■ At Sainsbury's first project using the CCC, 33 pallets of bricks/blocks were returned and available for reuse. Without the CCC and its inbuilt return logistics facility it is possible that these would have been wasted. There have been similar experiences at other projects involving terrazzo tiles, ceiling tiles and lighting equipment.</td></tr>
<tr><td>Social</td><td>Health and safety</td><td>Virtually all studies point to a positive effect on the work environment and a reduction in incidents on site as a result of lower stocks on site, reduced vehicles on site[8] and material handling by dedicated logistics contractors. For instance studies at Barts and Central St.Giles[9] show significant reductions (c.75%) in vehicle traffic to site: at Barts the number of vehicles accessing the site over a 17-month period was reduced by 2,239 and at Central St.Giles there was a reduction of 956 vehicles over a six-month period.</td></tr>
<tr><td rowspan="2">Product-ivity and prog-ramme certainty</td><td>Reduced on site handling</td><td>The LCCC increased productivity of the site labour force by up to 30 minutes per day.[10] On a site employing 500, this is up to 250 hours per day saved, equating to 30 workers if working an eight-hour shift.</td></tr>
<tr><td>Fewer shortages</td><td>At the HCCC, delays (tasks incomplete) due to materials not being available reduced from 6% to 0.4% - a factor of 15.[11] This enhances overall programme certainty as well as ensuring that the workforce is being used with enhanced productivity.</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td colspan="2">Business case</td><td>A recent study (not in the public domain), modelling the logistics costs in some detail for the establishment of three new regional CCCs, and also drawing on many of the above-mentioned earlier studies, made the following financial assessment:

<table>
<tr><th>Attribute/cost</th><th>% of construction cost</th><th>Potential benefits of effective logistics</th></tr>
<tr><td>Profit</td><td>5%</td><td>+8%</td></tr>
<tr><td>Overhead</td><td>7%</td><td>-2%</td></tr>
<tr><td>Preliminaries</td><td>13%</td><td>-5%</td></tr>
<tr><td>Subcontractors</td><td>Up to 80%</td><td>-10%</td></tr>
<tr><td>Labour</td><td>40%</td><td>-10%</td></tr>
<tr><td>Material</td><td>40%</td><td>-15%</td></tr>
</table>

An overall saving of up to 8% will have to be offset against the cost of operating the CCC. It must be noted that the savings apply to different members of the supply chain and therefore a transparent method of sharing benefits and costs must be found.

The business case for using a CCC was then summarised:
▪ Environmental: if 75% of material were delivered via the CCC there would be a 50% reduction in local traffic and emissions.</td></tr>
</table>

[8] http://www.hse.gov.uk/construction/safetytopics/vehiclestrafficmanagement.htm

[9] www.wrap.org.uk/constructionlogistics

[10] *The London Construction Consolidation Centre, Interim Report (May 2007)*

[11] *Managing Construction Logistics (2010), Gary Sullivan, Stephen Barthorpe and Stephen Robbins*

Category	Benefit	Reference
		■ **Productivity of construction workforce:** several studies show that operatives save 30 min per day through better logistics which gives a 6% productivity improvement and 3% cost reduction. ■ **Productivity of hauliers:** a 10-20% reduction in delivery cost is achievable. ■ **Material waste:** if just one half of material waste were eliminated material costs would reduce by 7.5% and construction cost by 3%. The report suggests that depending on the form of construction the cost of the CCC is in the region of 0.5% to 3% of the construction value. With potential savings of up to 8% it would appear easy to make a business case. It should be noted however that this business case depends not only on using a CCC but also on engaging a logistics specialist to integrate the CCC operation with on site handling in order to achieve the productivity increase. Sainsbury's identified strong incentives for using the CCC: ■ A superstore trades at about £1 million per week so fast construction processes are essential. ■ Space savings are also very important e.g. on refurbishment projects when stores remain open, car parking space often has to be used for lay down and waste handling. As availability of parking spaces is essential for customer access there is a strong incentive to minimise space use on site.

Figure 6 Packaging waste returned from site to Sainsbury's CCC

5.0 When is a CCC the right choice?

In most cases a CCC is used when the main contractor is forced down that route by specific constraints. Those constraints are normally space restrictions on site (limiting storage and/or access via gates) or restrictions limiting vehicle access such as narrow time windows. While these are good reasons for using a CCC, the advantages identified above – environmental benefits, productivity gains, programme certainty and cost savings that can outweigh the cost of using a CCC - mean that CCCs should be considered much more widely as a construction logistics strategy.

Before discussing some specific aspects of CCCs we should ask if there are situations when a CCC is not the right choice. There are two main factors to consider:

- What are the material supply characteristics of the project? If the most efficient material supply, depending on the usage on site, is to send predominantly full vehicle loads directly from suppliers/manufacturers then there is little demand for consolidation.
- If the construction site itself is in a favourable location for inbound transport (see Chapter 5 on CCC locations) and can offer very good conditions (dry, secure, accessible) for material storage then an external CCC is not needed. However, in such a situation it is still advisable to manage the on-site storage area on similar principles to a CCC and to control the flow of materials into the workplace on a Just-in-time basis. In their book Managing Construction Logistics, Sullivan, Barthorpe and Robbins call such an arrangement a concealed consolidation centre.

5.1 Is there a minimum project size for using a CCC?

There are two sides to this question:

- Is there a minimum critical size of a CCC below which you cannot run a viable CCC operation?
- If you have access to a CCC in operation, is there a minimum size of project which could benefit from its use?

Dealing with the first question first. There clearly is a minimum viable size; typically you need some warehouse space, a warehouse operative, a driver, and an administrator for stock control and communication with site and suppliers. However, a smallest size defined this way is surprisingly small. Among the CCCs studied the smallest operation had only 400 m^2 of warehouse space and exactly the minimum staffing level just mentioned. Continuity is desirable; if you only operate for a single year the costs of setting up and closing down a facility would be prohibitive. The practicality of setting up a small operation means that it is most readily done in conjunction with an existing distribution facility. This way, backup can be organised for any resource shortages, absence etc. One thing is clear however – you don't need a very large project to justify a CCC.

To estimate the handling volumes that are generated by construction projects, a study by Peter Brett Associates for Transport for London developed a guide related to square metres of commercial property constructed[12]; a further report by Peter Brett Associates has updated to include apartments and houses (the full report is not in the public domain):

- Commercial – 0.45 PEU/m^2 (PEU-Pallet Equivalent Unit)
- Apartments – 1.0 PEU/m^2
- Houses – 1.5 PEU/m^2

This can give an indication of volumes that may be required at a CCC.

The second question - Is there a minimum size of project below which you will not benefit from using a CCC, given that one is available? Construction managers with no experience of using a CCC will normally claim that it is a relevant logistics solution for very large projects only, such as the Olympics; but those with experience of using CCCs say that very small projects can benefit as much as large projects. Wilson James quotes the convenience store in London where during an eight-week installation two deliveries were made three days per week; and Sainsbury's states that the CCC works just as well in supporting its convenience store developments as the super stores. These are small projects with a programme of just five weeks. Because these projects are small there is pressure on them to be extremely fast. Consolidation, often in combination with off site manufacturing or some level of pre-assembly, makes possible the streamlining of processes required for fast turnaround projects.

[12] *Peter Brett's "Construction Consolidation Centres - An Assessment of the Potential for London-wide use" for Transport for London, May 2007*

In conclusion: we should not think of project size as decisive for whether a CCC should be used or not. Small projects can be supported by a CCC within a shared facility as long as there is enough volume for the CCC to maintain its profitability.

5.2 Shared user versus single user CCC

There is a variety of benefits in shared user CCCs:

- More projects and higher material throughput mean that the fixed costs of operating the CCC will be spread more efficiently leading to a lower cost per unit handled.
- Small projects that would otherwise not consider using a CCC can tap in to the service as the warehousing, labour, equipment and administrative systems are already in place, and the costs are shared by several parties.
- Set up costs for each individual project are minimised.
- There are greater opportunities to optimise resource utilisation; delivery milk rounds can cover more than one site if consignments are small and reverse logistics opportunities are maximised.
- A permanent operation rather than one set up for an individual project will allow expertise to develop.

A special category of sharing is where the CCC, supporting one or more projects, share resources within a distribution centre that operate in other sectors, such as the Wincanton examples mentioned earlier. A separate area can be partitioned in a warehouse and experienced warehouse administrators and operatives are already on hand and can be allocated to the CCC operation on full or part time depending on requirements. This can be a flexible solution with low start-up costs.

There are not many arguments in favour of single user CCCs, but the one most often put forward concerns security. Where the security demands are extreme, a single user facility can make whatever arrangements are required whereas fencing off special areas and controlling staff access may be more difficult to achieve in a shared facility. Having said that, the major distribution companies with large existing depot networks are used to setting up customer-specific operations within the physical confines of a general warehousing operation – in effect, a single user CCC within a shared facility.

A special case of single user facility is where there is a high level of integration between the construction consolidation and other activities. A good example of this is Sainsbury's consolidation, reuse and recycle centre operated in partnership with Fit Out (UK) Ltd. At the site, Fit Out (UK) Ltd manufactures fit out equipment (counters, vanity units, etc.) for the stores. Large volumes of equipment such as refrigeration units are returned for cleaning and overhaul so there is a level of activity over and above conventional construction consolidation that is integrated with the CCC operation. This tailoring of activities to suit Sainsbury's requirements would probably be hard to achieve in a shared facility and there may also be issues around competitive sensitivities. However, while serving just a single customer, in one sense a single user facility shares some characteristics with shared CCCs in that it supports many projects in parallel.

6.0 Where should CCCs be located?

Studies using traffic modelling show that the distance between CCC and site is critical for the reduction of carbon emissions and transport costs.

A practical consideration is that delivery vehicles should be able to complete at least two return trips within one shift – otherwise the result is a lot of vehicle under-utilisation and waiting time. With a 30-45 minute drive to the site and a load/unload time of between 30 minutes and one hour, each vehicle can do two to three journeys per eight-hour shift**.**

6.1 Every road freight mile is not the same

CCCs should be easy to reach for incoming supplies, wherever they originate. The negative impact of traffic differs depending on which roads are used. This is well illustrated by Freight Mode Shift Benefit Values (MSB values); from 1st April 2010 these replaced the Sensitive Lorry Miles (SLM).[13] These are values attached to all roads by the Department for Transport to calculate the benefit of reducing a road mile by shifting the freight to rail or waterways. The MSB values represent marginal external costs that freight imposes on other members of

[7] *http://www.dft.gov.uk/pgr/freight/railfreight/modeshiftben/*

society (apart from the freight operator who naturally assesses his own cost) and include congestion, accidents, noise, climate change, air pollution and infrastructure costs.

The MSB values are:

Motorways	High value*	£0.86
	Standard	£0.07
All A-roads		£0.74
Other roads (all B, C and unclassified roads)		£1.43

High value motorways are those sections with particularly heavy traffic such as the M25, and identified sections of other motorways.

As consolidation reduces traffic from the CCC to the sites and the sites are normally in urban or city areas, it is clear that the traffic reduction created by the CCC is on the roads that matter most for a whole range of environmental and social reasons. The table shows that each drive mile eliminated on local (other) roads is worth 20 miles on a standard motorway or about twice that of a high value motorway or A-road. Were such environmental values taken into account as part of the project costs, a truer value of using a CCC would be demonstrated in terms of internal and external costs to the contractors and society at large.

6.2 Locating the CCC

A good set of rules for the location of CCCs:

- CCCs should be located where a cluster of construction sites can be reached in under 45 minutes' drive time
- CCCs should be close to the motorway network or major roads so that the impact on local roads of incoming deliveries is minimised
- CCCs should be close to the motorway network or major roads so that hauliers' turnaround times are minimised
- If there is a reasonable number of construction projects it is better to have two smaller CCCs (that can each be closer to the respective sites) than one large CCC which will incur a higher mileage on local roads - on condition that both CCCs can be reached by incoming deliveries via major trunk roads or motorways

6.3 Mapping locations

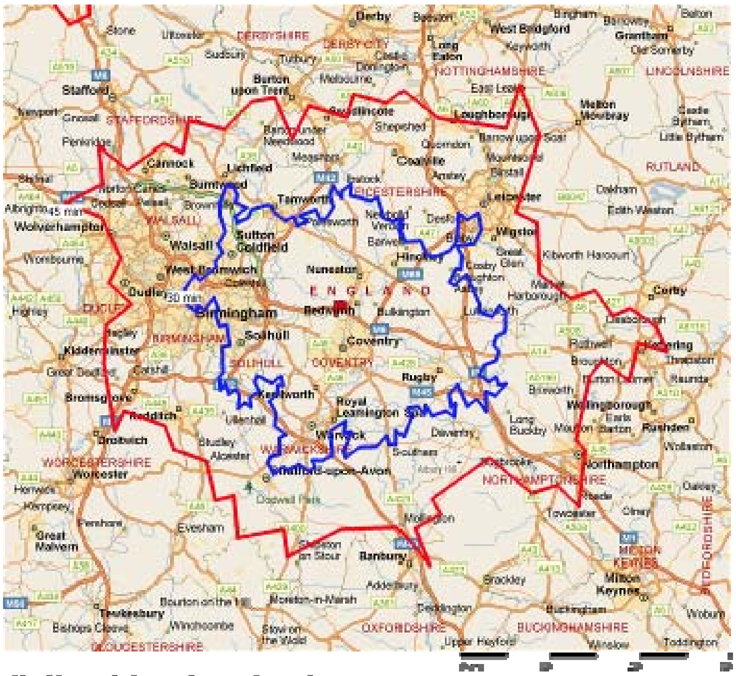
The maps below indicate coverage that could be provided by applying these rules and locating CCCs near major population centres. The flag indicates the CCC location, the blue line represents 30 minutes' and the red line 45 minutes' drive time. Note that a well-placed CCC will cover both Bristol and Bath within the 30-minute zone.

6.3.1 Bristol region

Bristol Region Drive Time Map

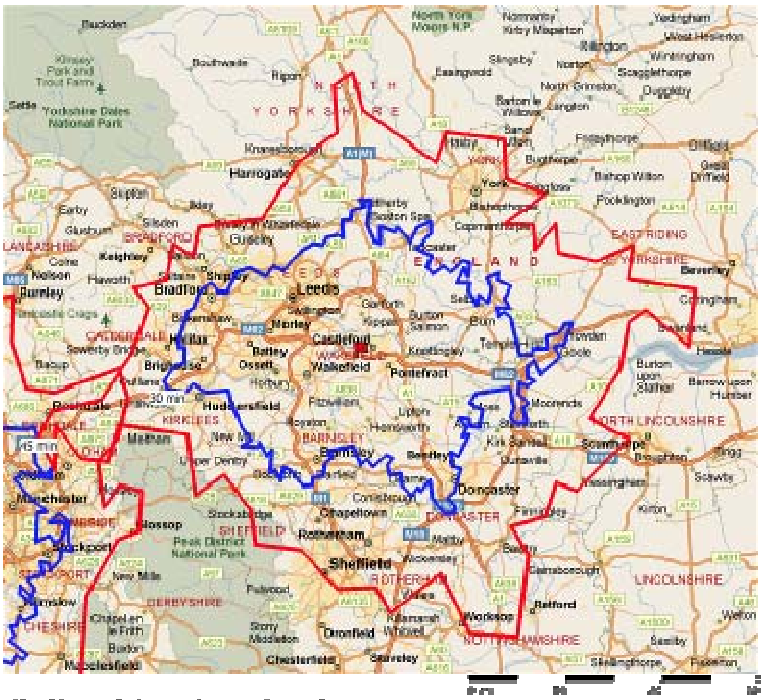
6.3.2 Midland region

Midlands Region Drive Time Map



6.3.3 Leeds region

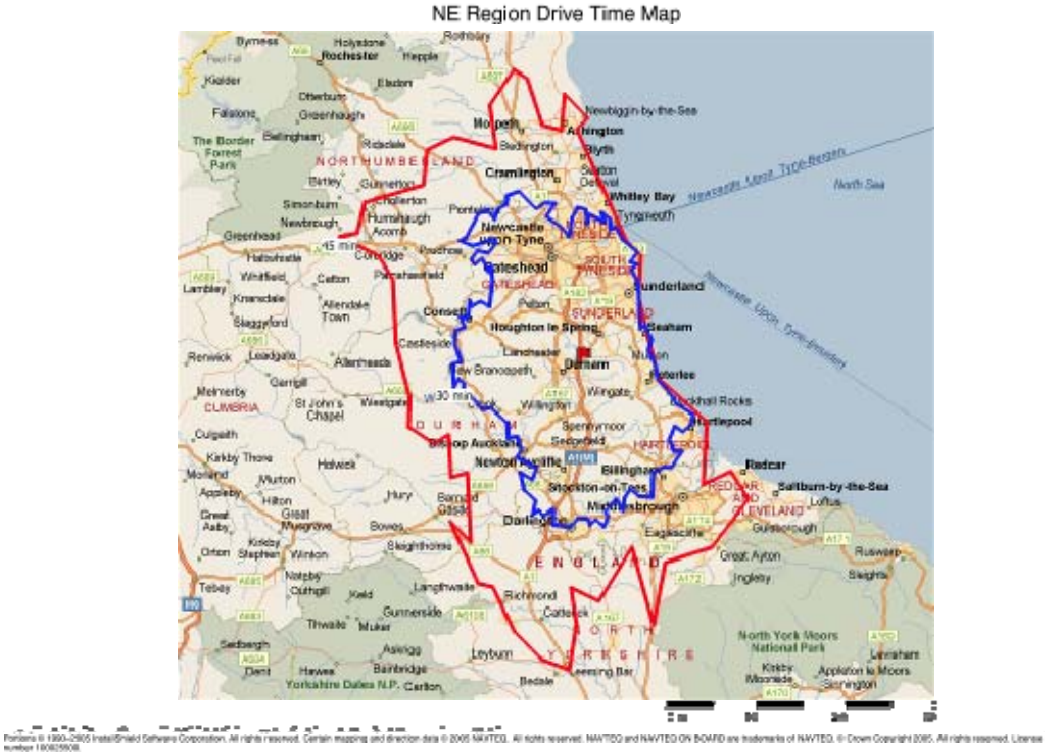
Leeds Region Drive Time Map



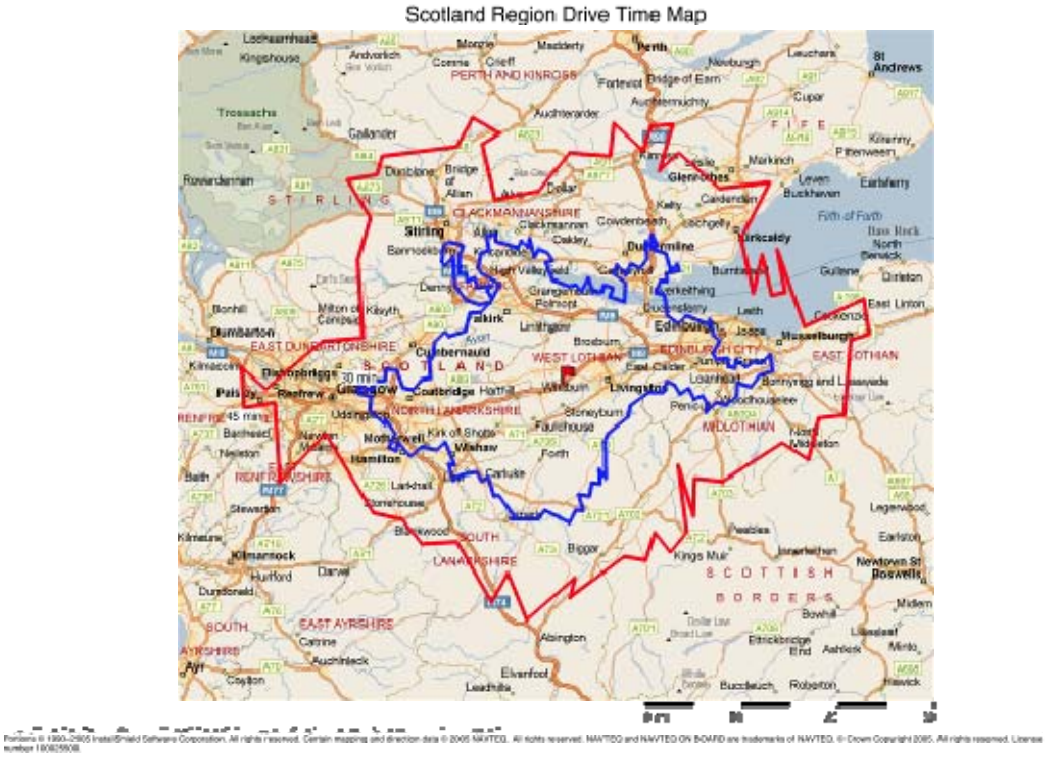
6.3.4 North West region

NW Region Drive Time Map

6.3.5 North east region



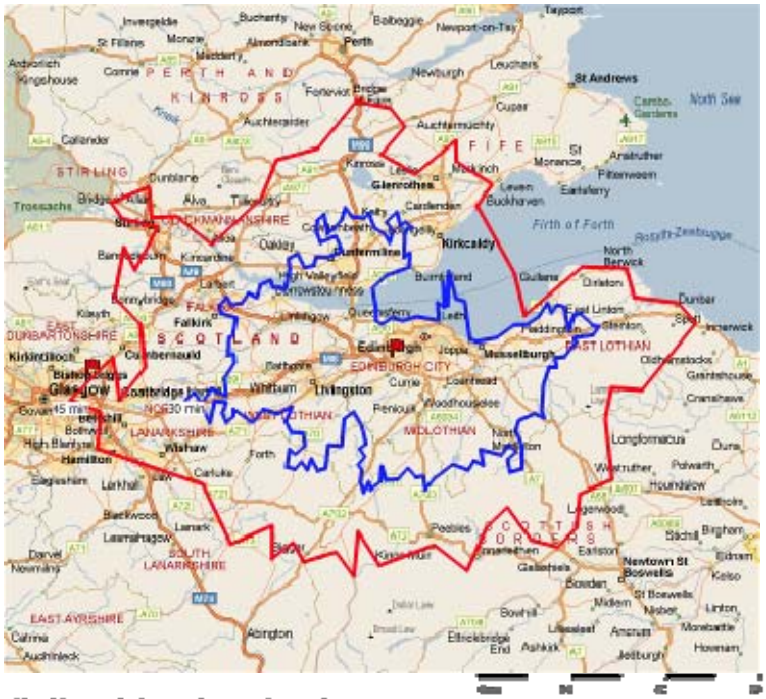
6.3.6 Scotland



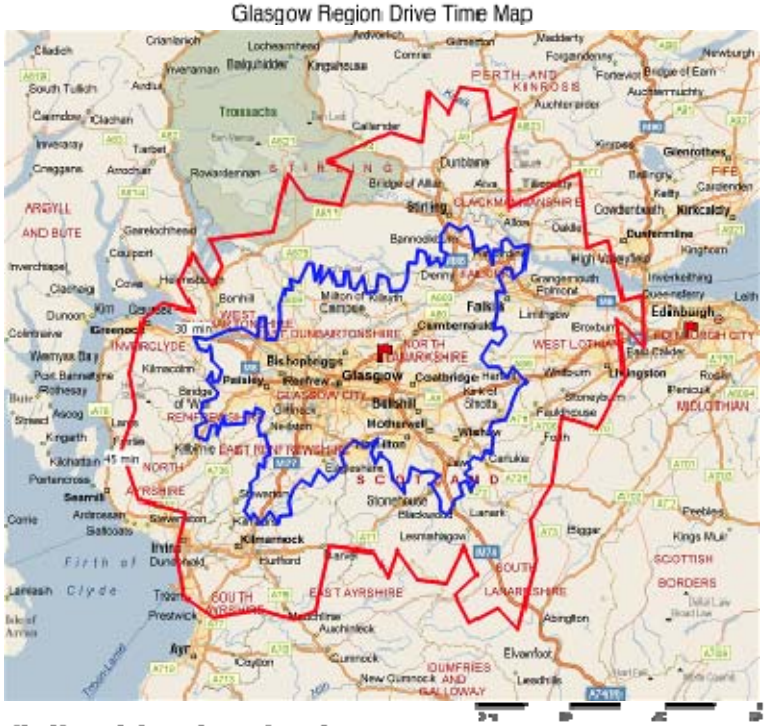
It is interesting to compare the single Scotland region map above with the two separate Edinburgh and Glasgow maps. Unless the locations of projects were to be mainly on the east side of Glasgow and to the west of Edinburgh the drive time will normally be in the 30-45 minute range.

A detailed transport study based on real project locations would very likely show that two smaller CCCs would be the preferred option from both an environmental and a financial point of view.

Edinburgh Region Drive Time Map



Glasgow Region Drive Time Map



7.0 How should a CCC be integrated into the construction process?

The purely transport related benefits of consolidation can be achieved whether an on site logistics service is provided or not. Reduction in local area traffic, better vehicle utilisation and fewer arrivals at the site on a Just-in-time basis are useful whatever the on site arrangements. There are however many strong arguments in favour of integrating the CCC operation, the transport between site and CCC and the on site material management and handling. There are many successful examples from other industries of such integration of logistics processes with forward business operations:

- Just-in-time delivery to the point of use of material kits and subassemblies in the car industry in a process that seeks to eliminate waste (including wasted time) and maximise efficiency – as pioneered by Toyota.
- The different parts that make up a complete computer system (servers, screens, keyboards, printers etc) sourced from different parts of the world and matched up as a complete system at the clients' premises by the logistics operator – as in the case of Dell.
- At the supermarkets' distribution centres roll cages are packed with mixed products in a sequence to match shelf locations in the supermarket for most efficient shelf stacking which minimises costs and disruption to the customers.

These strategies reduce cost and increase productivity in these very different sectors; there is nothing to suggest they aren't equally relevant in the construction industry.

7.1 Controlled supply chain to the point of use

As has been shown at many sites there are significant additional benefits of using a CCC, namely improved productivity, better housekeeping with less material held on site, reduced material wastage and fewer safety hazards. In fact these are benefits that can make using a CCC a very profitable option; and without integrating the CCC with the on site handling you cannot be sure that you gain those benefits. If on site handling is performed in the traditional way by the trade contractors they will spend a significant time handling materials; studies show that a time saving per trade operative of 30 minutes per day can be expected if on site handling is provided.

Gates and goods receiving points are often bottlenecks. If the on site handling is not integrated with the delivery process, coordination between contractors can cause problems, resulting in waiting time.

7.2 Extended use of the CCC

Once a CCC is in use, creative contractors learn to use it to its full advantage. At the Central St Giles project (a central London project by Bovis Lend Lease) the air conditioning contractor organised a work area at the LCCC and did the lagging of the ducts there. This had many advantages: a good working environment meant the job was completed faster, the operative was not in the way of other trades on a busy site, less waste was generated and any material that was wasted was never carried to site but could go straight to the waste handling at the LCCC. Pallets were made up of completed duct-work for each area, speeding up installation on site.

Figure 7 A workstation at the LCCC used for lagging air-conditioning units prior to delivery to site

At the Quadrant III project in London's West End Sir Robert McAlpine has adopted a similar approach. Plaster-board is cut at the LCCC instead of on site, and the off cuts are also boxed up and delivered, to be used for boxing in. Lighting units are fitted into ceiling panels; this speeds up installation on site while movement of large volumes of packaging waste from the site is avoided.

Creative use of CCCs, undertaking some normally site-based activities at the CCC, can give many advantages:

- speedier process by organising a better working environment than the often crammed site conditions;
- faster installation processes on site;
- waste reduction through improved control at CCC;
- reduced waste handling on site; and
- reduced waste removal from site.

8.0 Sharing the costs and benefits of a CCC

It is normally up to the main contractor to take the decision to use a CCC and to carry the costs. As has been shown above the savings from using a CCC often clearly outweigh the costs – yet contractors often fail to be convinced of the business case. Why is that? Being able to analyse the cost savings doesn't necessarily make it easy for the main contractor to realise those savings.

Most projects are broken down into a number of major subcontracts where each contractor in turn supplies both labour and materials, often on a fixed price basis. This makes it difficult to identify all the savings that are achieved through waste reduction and reduced over-ordering, productivity improvements, reduced waiting time, reduced haulage costs, programme certainty etc. To establish these costs subcontractors must evaluate their material suppliers in more detail – for instance separating out transport costs so that faster vehicle turnaround times can be reflected in appropriate cost reductions.

In summary – all the participants in a construction project can benefit from using a CCC:

Hauliers

- Faster vehicle turnaround time at a CCC compared to when delivering construction sites. Apart from driving into a city centre and/or to a congested site the actual time spent off-loading is also significantly shorter at a purpose-built distribution facility. For instance a study has shown that it takes more than 50 minutes longer to deliver in central London than to the Heathrow CCC.
- Better vehicle fill as the CCC can receive and store materials in a good environment and then deliver smaller lot sizes to site.
- Increased opportunities for reverse logistics, for instance collecting unused materials and reusable packaging at the CCC.

Material suppliers

- Can deliver in economic load sizes, as suitable site batches are made up at the CCC.
- It is easy to implement a reverse logistics solution with a CCC; suppliers can easily take back pallets and reusable packaging.

Trade contractors

- Improved productivity as no or minimal time is wasted in looking for and handling materials. Studies show that on average 30 minutes per day are saved.
- Improved safety – a significant proportion of on-site incidents and injuries relate to the handling of materials.
- Reduction in material waste by 10-15% according to several studies.

Waste management contractors

- Waste removal integrated with CCC return journeys reduce waste handling costs.

Main contractor

- Improved programme certainty.
- Reduced over-ordering of materials. Over-ordering at a 15% level is not unusual; providing a CCC should allow contractors to target a 10% reduction in waste. As key waste streams are measured in the SWMP the savings can be verified.
- Improved site conditions.
- Lower costs and improved competitiveness.
- Reduced waste and carbon emissions enabling the attainment of environmental objectives. Site traffic related to material deliveries often reduced by up to 70%.

Clients

- Faster project programmes.
- Improved project certainty.
- Lower overall costs.
- Reduced impact on the environment through reduced traffic, a better organised site and minimisation of waste.

Clients and main contractors need to develop models that break down the overall contract into the major subcontracts and apportion the benefits of using the CCC in line with the expected savings of each subcontractor. This then can form the basis of a CCC cost recovery formula.

9.0 Acknowledgements

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