“Bringing construction logistics into the 21st, and arguably even the 20th, Century is essential if the construction industry is to meet the requirements of its clients and customers for cheaper, faster and safer delivery of construction projects. In this book Greger provides a well-presented and argued analysis of the key logistics issues that the industry must get to grips with if it is to meet these requirements. His handling of the issue of construction materials consolidation is particularly good and relevant given the focus on congestion and safety in and around urban construction projects.”

Gary Sullivan, Construction Logistics specialist, Co-founder and Chairman of Wilson James Ltd and former Chairman of Essex Olympic Strategic Board for Legacy and the Thames Gateway South Essex Partnership

Supply Chain Management and Logistics in Construction is an accessible and practical text focusing on the importance of managing the supply chain outside of the immediate construction site. It provides essential guidance and expert advice for construction managers and logistics managers as well as researchers and students in the field.

This important title explores a broad range of strategic and operational responses to the challenges facing the construction industry today. In addition to offering topical case studies and research findings from internationally recognized companies, it examines a range of key issues relevant to the management of supply chains within the industry, including:

- arrangements with suppliers and the role of logistics specialists
- the use of construction materials consolidation
- the management of logistics for construction projects in congested urban areas
- the use of off-site manufacture and assembly, returnable packaging and other logistics strategies
- IT systems used to manage the supply chain, logistics operations and delivery management
- the contractual relationship between client, developer, main contractor and lower-tier contractors

Featuring contributions from leading experts in the field, Supply Chain Management and Logistics in Construction offers valuable insight into different perspectives of the various actors in the supply chain, and why the role of the construction logistics manager is more important than ever.

Greger Lundesjö has spent over 30 years in logistics-related businesses and has extensive international experience both in operative business roles and as a consultant. He has supported clients by applying logistics principles to construction projects, improving resource efficiency and reducing cost and environmental impact.
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Introduction

GREGER LUNDEJSJÖ

The expanding role of logistics in construction

If you ask professionals from a range of industries to define the term logistics you might be told that it refers to the methods and systems whereby specified products and materials are delivered to the right location at the right time, in the right quantity and quality and at the lowest cost. Others would say that it relates to the transport, storage and handling of products through the supply chain from raw material through value-added processes to the end user.

The construction industry is different. In construction, at least traditionally, the answer would typically be that the logistics function has responsibility for site security, vertical lifts, cleaning, walkways, hoardings, signage, staff welfare, the canteen and possibly also accommodation for construction workers, health and safety, traffic management, gates etc. That is, the logistics function is responsible for all the various site services essential for a functioning construction project except for the actual construction work. Put another way, the logistics function is a supporting role to the primary activity of construction. When asked about the supply of materials to the point of use, the logistics manager on a construction project might state that this is the responsibility of the various trade subcontractors engaged in the project, who are contracted on a fixed-price basis including all materials, and not part of the logistics operation. When logistics has included materials handling it has related to site logistics with little concern about what happens in the supply chain. As Andy Brown of Mace remarked during discussions about this book: ‘We are responsible for everything that does not get left behind when we leave the completed project.’ (The responsibilities of the logistics manager are covered in depth in Chapter 9 by Andy Brown.)

During recent years however there has been a growing involvement by logistics in issues concerning the management and handling of materials both on construction sites and in the supply chain. Comparisons are frequently made with other sectors – mainly retailing and manufacturing – and attempts are made to apply the advanced logistics and supply chain management practices from those sectors in the construction industry. But progress in this area is difficult for many reasons: construction lacks the continuity of other industries – projects start, run for a limited period of time during which conditions change continually and then finish; projects consist of many
different, often uncoordinated, supply chains operated by a range of sub-
contractors; construction projects are often large and the main contractor’s
first priority is to offload the risk by splitting the project into a number of
fixed-price separate work packages; and cash flow management might
lead to subcontracts being let as late as possible within the programme.
All this makes collaboration in the supply chain extremely challenging and
illustrates why logistics and supply chain management do not play (or at
least have not played) the central and strategic role that they do in some other
sectors. Another contributing factor to logistics being undervalued is that
the necessary logistics tasks within work packages are often not explicitly
identified; no cost is assigned and they are assumed to be included ‘free’.

One of the objectives of this book is to develop the logistics concept within
construction to encompass the complete, often global, supply chain. It should
be emphasized at this point that the site services traditionally provided by
the logistics function are essential and without them no project can be safely
and efficiently completed. Indeed with a majority of projects being con-
structed in busy, high-density cities and urban areas those tasks are becoming
ever more challenging. Nor should we imagine that logistics in construction
will be just the same as in, say, retailing. The following chapters will demon-
strate some of the ways in which a modern approach to logistics and supply
chain management can enhance the performance of the industry.

Construction is logistics

Logistics plays a much greater role in construction than many people
realize; it is simply taken for granted. This is why there is so much scope
for efficiency improvements (cost reductions and programme certainty)
through the application of a professional logistics approach. The extent to
which construction is made up mainly of logistics activities is illustrated in
Figure 0.1 by Stephen Robbins (the author of Chapter 4).

The diagram in Figure 0.1 is of course an extremely simplified example.
In real projects there are many such supply chains, but that does not
weaken the argument; in fact the opposite is true. The various supply
chains often compete for scarce resources such as gate access, site
storage space, forklifts and manual handling capacity. The supply chains
are interrelated in time with often complex build programmes; the just-in-
time (JIT) delivery of appropriate quantities of materials, the norm in
manufacturing industries, is often not achieved on building sites. The result
is all too often poor utilization of construction labour, and time and/or cost
overruns. It follows from this that a stronger focus on all aspects of
logistics and supply chain management does not just improve logistics
efficiency – it can greatly improve overall construction project
performance in terms of efficiency, cost and programme certainty.
FIGURE 0.1 Building a block wall

More than 80% of activity is logistics
Perspectives and opinions

It is in the very nature of supply chains that they are made up of different actors fulfilling different but interrelated roles. In this book, rather than only taking a bird’s-eye view of the supply chain, we also let the different actors speak. Chapters are provided by: academics specializing in logistics, supply chain management and the application of IT and building information modelling (BIM) in the construction industry; main contractors, including both supply chain management specialists and logistics specialists; the supply side of the industry with chapters from the heavy products sector (cement, asphalt etc) and from the builders’ merchants; the third-party logistics industry; sustainability experts; and from consultants and system suppliers.

Not only does this wide variety of voices provide different perspectives on the topic, but the various contributors also share with the reader their opinions as to the state of the industry and the direction it should take with regard to logistics and supply chain management.

Outline of the book

The book has four parts:

- Part One: Strategic perspectives on supply chain management and logistics in the construction industry.
- Part Two: The impact of BIM and new data management capabilities on supply chain management in construction.
- Part Three: Construction logistics and sustainability.
- Part Four: Logistics operations in the construction industry.

It should be said that these are very broad areas and that many of the writers cut across all areas from strategy to operations; but the structure might help to steer the reader to his or her particular area of interest.

Part One looks at logistics and supply chain strategy from three different viewpoints. Michael Browne sets the scene in Chapter 1 by defining logistics and analysing the key factors that impact on logistics in construction. Under the chapter title ‘The challenge of construction logistics’, he shows how construction logistics must respond to the global trend of increased urbanization while at the same time conforming to ever higher demands for sustainability.

In Chapters 2 and 3 Mark Franklin and Matthew Woodcock apply the suppliers’ perspective. Franklin in Chapter 2 looks at the builders’ merchants sourcing a wide product range globally for delivery to construction sites on a JIT basis. The chapter discusses how to achieve a lean supply chain and also who is best placed to serve this market, including not only the traditional players but also new web-based retailers. By contrast Woodcock, in Chapter 3, analyses in depth the significant market of bulk materials. After analysing
four key product areas (cement, aggregates, asphalt and ready-mixed concrete) the chapter assesses supply chain maturity in each area, how it can be improved and the benefits that will follow.

In Chapters 4 and 5 Stephen Robbins and Brian Moone respectively address supply chain management in construction from the main contractor’s perspective. In Chapter 4, Robbins analyses the effective management of a construction project’s supply chain. The chapter reviews existing theory and writing on the subject and then provides a structured overview of a number of strategic options for managing the logistics of the supply chain. In Chapter 5, also from a main contractor’s point of view, Moone takes a corporate perspective and introduces the concept of supply chain management with a focus on the assessment of risk, how to select partners and how to develop partners through learning.

In Part Two, Chapter 6, Wes Beaumont and Jason Underwood take on the subject of information and data management in the construction industry. They look at how the structure of the industry has changed and how that has influenced the ways in which information is held and distributed among the supply chain participants. The introduction of BIM is analysed, as is the concept of big data and how it applies to the construction industry. The chapter envisions how an often fragmented industry, where information flows can be chaotic, can move towards effective, lean and integrated processes; and the old concept of master builder gets a revival.

Part Three deals with sustainability and construction logistics. In the current debate about climate change and how to create a sustainable society there are those who argue that sustainability carries a high cost and requires sacrifices, while others maintain that with the right approach a focus on resource efficiency in fact lowers costs. Whatever your view on the wider debate, logistics is one of the areas where resource efficiency, and reduced environmental impact, go hand-in-hand with cost efficiency. In Chapter 7, Lars-Göran Sporre, Camilla Einarsson and Monika Bubholz look at the role of logistics in achieving sustainable construction from a Swedish perspective. They present an eight-dimensional model of sustainability and a logistics strategy for construction. Two case studies illustrate the approach. From a UK perspective, in Chapter 8 Malcolm Waddell analyses the resource efficiency benefits of effective construction logistics. The chapter shows some of the environmental impacts of the construction industry, such as waste volumes and CO₂ emissions, and then expands on a set of logistics strategies with demonstrated positive impacts on resource efficiency and cost.

Part Four starts with Chapter 9 and the role of the logistics manager. While it is focused on site logistics rather than supply chain management aspects, this chapter sets out in great detail the far-reaching responsibilities of the logistics manager in a modern context. Whether you need to draw up a logistics manager’s job description or want some input for developing a construction logistics plan (CLP), you will find the information here. Finally, Andy Brown also takes a critical look at how the role has been viewed traditionally and how it needs to develop.
In Chapter 10 Pete Flinders analyses the role of third-party logistics operators (3PLs) in the construction industry. 3PLs play a significant and often sophisticated role in other sectors and while they are active in construction their capabilities are not utilized to the extent they could be. Flinders analyses why that is the case and how they could provide much more value to the industry. A telling quote from the chapter is worth highlighting: ‘It is fairly inconceivable to imagine a town centre convenience retail store being supplied along similar lines to that of a common construction supply chain. Instead of consolidated deliveries with “shelf ready” packs on flexible-wheeled handling units coordinated outside of peak trading periods, the common building site approach to the supply chain could involve store aisles being full of materials that were delivered three weeks early, but missing some key lines, multiple vehicles waiting to unload outside the store with goods being moved by hand and a lot of packaging waste.’ Flinders then details how 3PLs can add value to the industry and illustrates the opportunities for improvement through case studies.

One of the fundamental trends identified in Chapter 1 is that of globally increased urbanization. This means managing construction logistics in high-density, inner-city areas with all that entails in terms of space restrictions, traffic conditions, rules laid down by local authorities etc. This is the topic of Chapter 11, ‘Managing construction logistics for confined sites in urban areas’. Ruvinde Kooragamage provides an in-depth analysis of the topic with all its ramifications and suggests management strategies.

Several chapters mention construction consolidation centres (CCCs) as a useful logistics solution for construction logistics. In Chapter 12 Greger Lundesjö analyses consolidation and its role in construction. The chapter sets out the resources required and describes the functionality, operation and benefits of a CCC. Many of the examples and benefits are drawn from studies carried out focusing on the environmental benefits of better construction logistics, mirroring some of the conclusions of Part Three of this book.

Finally in Chapter 13 Rick Ballard and Nick Hoare focus on one critical aspect of construction logistics: delivery management. This again is an aspect of construction becoming ever more critical as a result of the pressures of construction in inner-city areas. When the logistics strategy depends on JIT deliveries, the logistics manager needs the tools to plan, control and monitor those deliveries. The principles are further demonstrated in case studies from the UK and Australia.
Introduction

Construction logistics is a very challenging area in which to manage the range of logistics activities, including inventory control, transport, recovery of waste, recycling and so on. Some of the features of construction are unique to that industry. However, there are often useful lessons that can be found in other sectors such as manufacturing and retail. The aim of this chapter is to provide a broad introduction to logistics management as a discipline and to explain some of the main features of logistics management that have emerged since the mid-1990s. The chapter starts by defining logistics and explaining something about the interactions with other areas such as purchasing and supply chain management. The second part of the chapter focuses in more depth on transport and storage activities within logistics. Third, the chapter reviews some of the issues that have emerged in the consideration of construction logistics. Many of these themes are discussed in detail in subsequent chapters. A great deal of construction activity is associated with urban areas and this spatial context is discussed in the fourth section of the chapter. Finally, a short conclusion draws out some of the key features of the challenge of managing logistics within the construction sector.

Definitions and the importance of logistics

Logistics is now a widely used and understood term throughout the business world, and refers essentially to the management of supply chains in commerce and industry. The box below contains several definitions of logistics and shows the scope of the discipline and some of the changes over time.
Strategic Perspectives

Definitions of logistics

*The management of all activities which facilitate movement and the coordination of supply and demand in the creation of time and place utility.*
(Hesket, Glaskowsky and Ivie, 1973)

*The technology of control of the physical flow of materials and goods and related information that a firm sends, transfers and receives.*
(Colin and Fabbe-Costes, 1994)

*Logistics is an application-oriented scientific discipline. It analyses and models division-of-labour economic systems as time-based and location-based flows of objects (above all goods and people) in networks, supplying recommendations for action on the design and implementation of these networks.*
(BVL, 2010)

*Logistics management is that part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customers’ requirements.*
(CSCMP, 2013)

The Chartered Institute of Logistics and Transport defines logistics as ‘the time-related positioning of resource’. This definition is interesting because it draws attention to the importance of time as a feature that has been significant in changing the way that managers think about planning and organizing their supply chain operations and logistics activities.

Logistics is also described as the ‘five rights’. Essentially, it is the process of ensuring that a product or a service is:

- in the right place;
- at the right time;
- in the right quantity;
- at the right quality;
- at the right price.

Precise definitions can therefore be seen to vary, but the common thread is a concern for the movement and storage of goods, together with the associated information flows, from the beginning to the end of the supply chain (the supply chain being the entire system of supply from point of growth/production through to the point of use/consumption then beyond that to the point when
products are recycled or enter the waste stream). So, for a manufacturing company, logistics management could include:

- the procurement and sourcing of raw materials or components;
- inwards transport;
- materials handling and storage and the link to production processes;
- the final distribution of finished products to customers;
- after-sales services, including return and ultimate disposal.

Therefore logistics costs include storage costs, together with the financial cost of holding stock or inventory, handling costs, transport costs, packaging and administration. Increasingly, with the growth in environmental pressures and legislation and the need therefore to reuse or recycle materials, the transport and handling costs incurred in these activities can also be considered in the total logistics costs for a product.

The costs of these activities (transport, storage, handling and so on) can be considerable. It is not unusual for them to amount to some 10 per cent of the total sales value of products produced by a manufacturing company. Of course their importance as a proportion of the final price of goods varies according to the product in question. For products with a low value to mass ratio the significance of logistics costs in their final price is likely to be considerable.

However, measuring logistics costs can be difficult. Definitions vary and the significant role of outsourcing can make it hard for companies to keep track of the true costs of their logistics operations. Managers often adopt a number of key performance indicators (KPIs) in order to track and monitor costs (Braithwaite, 2014). Understanding and controlling costs and anticipating trends is argued to be an essential part of remaining competitive.

Logistics management has been referred to as ‘joined-up thinking’ and indeed it is this aspect of considering the trade-offs and interrelationships between different activities taking place in a supply chain (transport and storage, for example) that lies at the heart of logistics planning.

**Logistics and the supply chain**

Logistics management is a discipline that spans boundaries within an organization – therefore it helps to ensure the coordination of activities including purchasing, production, inventory management, finance and marketing. Logistics management is also required when flows between companies are considered. Supply chain management can be seen as a broader management approach that includes a strong focus on the interaction of organizations that are working together in the supply chain. Much of this interaction will involve the management of logistics.

Logistics management is an integrating function, which coordinates and optimizes all logistics activities. Logistics management also integrates logistics
activities with other functions including marketing, sales, manufacturing, finance and information technology. Mangan et al (2011) define supply chain management as ‘the management across a network of upstream and downstream organisations of material, information and resource flows that lead to the creation of value in the form of products and/or services’.

Management decisions concerned with the construction supply chain need to encompass many factors including:

- Spatial aspects of the supply chain (issues such as where to source products and materials and where to locate distribution centres to best serve the downstream construction activity).
- Transport operations within the chain (for instance the mode of transport used, whether transport is operated in-house or contracted out, consideration of different stages of transport in the supply chain etc).
- Stockholding systems used in the chain (for instance the size and degree of automation of warehouses, the amount of stock that should be held).
- Materials handling systems used in the supply chain (ie the systems used to load and unload transport vehicles and convey products within a warehouse and at a construction site. This can involve examination of the equipment used and the appropriateness of the operation itself).
- Interaction between different logistics activities in the chain (for instance consideration of trade-offs between different logistics activities such as transport and stockholding – by reducing the total number of warehouses it is possible to reduce total stockholding costs but transport costs are likely to increase; supply chain analysis can help to examine the most appropriate solution within a given set of constraints).
- The role of, and interaction between, different supply chain parties (ie consideration of how those involved in the chain could perform their tasks in a more efficient manner and how different parties could work better together through planning and information exchange).

By considering the entire supply chain associated with moving a product to the end user in an integrated manner it is possible to gain a better understanding of logistics costs arising in the supply of a product, and to consider ways in which the supply chain can be efficiently organized and managed in order to reduce these costs.

**Diversity of the construction industry**

A challenge for construction logistics is that while the processes described above can be argued to be generic, the application of these processes in construction is extremely varied. Construction sites vary from the small-scale building of private houses to major areas of urban regeneration with
The Challenge of Construction Logistics

multiple activities taking place in a city location at the same time. The nature of the construction industry means that organizations of many different sizes and levels of sophistication will often be involved in a project. This means that the coordination aspect of logistics management is complicated and can be hard to achieve.

Factors that influence logistics activities

When considering the logistics costs associated with a product a number of key factors about the characteristics need to be considered. The particular characteristics of any given product will have an impact upon the distribution system for that product. Product characteristics that will influence the distribution system can be classified in three categories: volume to weight ratio, value to weight ratio and special characteristics. Given the range of materials and products used in construction it is clear that there is tremendous variety in terms of these ratios and the special characteristics and storage, handling and transport requirements. It is also important to recognize that global issues also impact on construction logistics. For example the many political, regulatory and cultural differences that need to be taken into account when shipping materials internationally.

Volume to weight ratio

Both the volume and weight characteristics of a product are likely to have a significant impact upon transport costs. Distribution systems tend to deal with products with low volume to weight ratios more efficiently than products with high ratios (examples of products with low ratios include dense products such as steel and hard woods, whilst high-ratio products include many items such as insulation materials). This is because products with a low volume to weight ratio tend to fully utilize the carrying capacity of a road freight vehicle, handling equipment and storage space. Meanwhile high-ratio products occupy more space and result in the underutilization of vehicle/handling equipment weight constraints, and therefore raise transport and storage costs.

Value to weight ratio

The higher the value of the product, the greater the potential for absorbing the logistics costs (ie the smaller the proportion of the final cost of the product accounted for by logistics). By using the value to weight ratio it is possible to consider the distribution costs associated with a product in terms of the value per unit weight of that product.

Products with low value to weight ratios (such as sand, ore, coal and gravel) tend to be associated with higher transport costs (as a proportion of total
delivered cost) than products with high ratios (for example, electronic equipment and computers). However, conversely, the storage costs for products with high value to weight ratios are greater than those for products with low ratios; this is explained by the level of capital tied up in the stock and the need for expensive, secure warehousing.

**Special characteristics**

There are a number of other characteristics of a product that affect the selection of an appropriate transport, storage and handling system. The fragility of a product will determine the packaging requirements to safeguard the product during transportation and handling. The perishability of a product will affect the conditions under which it must be moved and stored and the speed at which it must travel through the supply chain. Certain products possess hazardous characteristics and must therefore be moved, handled and stored in isolation from other products and within stringent regulations. The nature of construction logistics means that there are many products that exhibit special characteristics, leading to complicated and challenging logistics management requirements.

**Time issues**

Construction logistics has many varied time issues that influence the scope for efficiency. For a large project, planning will take place over a long time period and the time before construction (or initial demolition if the site is already built on) may easily be a period of several years. The construction phase itself will run into years for a large project and during that time the flows to and from the site will vary considerably in terms of the volume of materials, the number of vehicle movements and the nature of the items being moved on to and away from the site. In addition, during the construction phase managing the flow of materials becomes critical to efficient use of the resources of labour and equipment at the site itself. All this planning and then execution takes place against a background of uncertainty over weather and, in the case of construction in urban areas, the need to consider complex traffic patterns and congestion, which can all influence the timely arrival of materials to a site. Much attention in logistics has been focused on just-in-time (JIT) systems and construction projects are often argued to need to adopt the principles of JIT. But the complexity and challenges of doing this must be acknowledged. Later chapters in the book give many examples of how logistics management can be improved to deal with the time challenge for construction.
Key transport and storage considerations for products

Transport

Transport is an extremely important element in the supply of most products. It is the key link in the supply chain – for example, in the case of food supply it joins all the activities that have to take place between the point of production on-farm through to the point of sale (eg at a supermarket) and finally point of use (eg consumption by the customer at home). Transport links together all these activities in the supply chain, which can include growing the food, harvesting, manufacturing and processing, handling and storage and the locations in which they occur.

The same is true within the construction industry where transport is essential in the process of transforming raw materials into finished products and ensuring that these materials and products are delivered efficiently and safely to many different destinations.

As well as transport being significant in any consideration of product supply systems – because of the role it plays in making the product flow smoothly between the point of production and consumption – transport is also important as a result of the costs associated with it. Transport expressed as a proportion of total delivered cost will vary depending upon the product in question, but is likely to be relatively high in the case of low-value products that are transported over long distances (which will be true for some construction materials). It is therefore very important that the necessary attention is given to consideration of transportation issues when planning the supply of materials and products.

Storage

Storage costs are made up of three key elements:

- the physical costs of stockholding (i.e., the cost of building, equipping and operating warehouses) including labour costs;
- the opportunity cost of holding stock (i.e., the cost of having money tied up in stock) or the cost of borrowing money;
- the costs of ‘goods loss’ during storage: this can result from damage to the stock, theft and changes in taste that make the goods unusable (or means they cannot be sold).

Products can be stored at several points in the supply chain: the point of extraction/harvest, the manufacturing/processing point, the distribution centre and at the retail outlet. Each point of stockholding requires handling of the product – and the more times the product is handled the greater the total logistics costs (as handling requires both equipment and labour).

As well as raising issues about who will be responsible for storage, this also has implications for the point in the supply chain at which storage costs will arise and who will bear these costs (and the impact that money tied up in stock will have upon cash flow). The size of the storage facilities
in the supply chain will also affect the transport arrangements. For example, a retail outlet with a relatively small on-site stock level (e.g., just what is displayed on the shelf – a few days’ supply) will require more frequent, evenly spread deliveries than an outlet with a large storage capacity (e.g., with an attached warehouse).

**Control of the supply chain**

The issue of supply chain control has received considerable attention over the years. Within a supply chain there are often many different organizations and the relative power of these organizations within the chain can play an important part in affecting the scope for efficiency and coordination. Within the grocery retail supply chain in the UK a strong trend has been for the major retailers to control more of their upstream supply chains. Until the 1970s the pattern of control in the grocery supply chain was one of manufacture control until the point of delivery to store (shop). However, retailers realized that by adopting a system of regional distribution centres (RDCs) they could gain valuable efficiency benefits in terms of receiving products from suppliers and also when delivering in fewer and more consolidated vehicle loads to their stores. Having achieved a high degree of centralization in the period from 1980 to the mid-1990s retailers then went a stage further and in some cases sought to control the whole of the physical chain between the supplier and the store, instigating what became known as ‘factory gate pricing’. This control enabled retailers to derive further efficiency gains and to improve service levels and reduce waste such as empty trips. A question that arises is whether this degree of control can be copied by other industries. It seems that in construction the scope for very tight upstream control may be more limited because the complexity of sourcing, the specialized nature of materials and handling requirements, the lack of a fixed infrastructure such as the RDCs all make it a more complicated logistics puzzle. Nevertheless the principle of control and visibility is an important one and it is evident that good construction logistics seeks high levels of transparency and visibility of the materials in the upstream chain.

**The role of logistics management within construction**

Clearly logistics is at the heart of construction activities and since the late 1990s it has received much more attention. The increased focus on logistics has been driven by a number of studies and working groups that identified the way in which logistics management in construction lagged behind other sectors such as retail and some manufacturing industries (for example the automotive sector).
The Challenge of Construction Logistics

The report ‘Accelerating Change’, published by the Strategic Forum for Construction in September 2002, highlighted that ‘a considerable amount of waste is incurred in the industry as a result of poor logistics’. Evidence of poor logistics management affects transport, storage and coordination. The Strategic Forum for Construction Logistics Group (2005) noted the following:

- poorly loaded vehicles that often had to wait for access because scheduling was not well organized;
- materials being unavailable on site, leading to poor time utilization;
- excessive stockpiling of products with extra costs and the greater risk of deterioration and damage;
- lack of coordination between activities;
- high proportion of damaged and returned items.

More information about these problems is detailed in the following box.

### The consequences of failing to manage construction logistics

#### Additional costs

All the evidence points to there being additional cost in the system that could be saved if the process operated more efficiently as a result of improved logistics. Research by BSRIA has shown that on average 10 per cent of the working day of site operatives in all trades is lost due to waiting for materials, or collecting materials, tools and equipment. Given that site operations account for about 30 per cent of construction costs, this would suggest that this inefficiency alone is adding about £3 billion to the annual cost of construction.

#### Poor image of the construction industry

Lorries parked in an inconsiderate way outside construction sites whilst waiting to unload do not give the image of an efficient industry. Disorganized sites with skilled craftspeople being used for unskilled jobs do not encourage quality people to join the industry. Vehicles driving around empty or with part-loads do not convey the image of an industry that has environmental concerns at the top of its agenda, nor do large amounts of waste being removed from site, 85 per cent of which go to landfill. None of this seems consistent with the growing attention that companies are expected to pay to corporate social responsibility.
Poor quality construction

Working in a disorganized environment will inevitably make the production of quality construction more difficult. Work interrupted whilst materials are sought from elsewhere on site, or delayed whilst products are delivered, will have an adverse effect on quality. Secondary working of products on site is also less likely to provide the same quality of product that could be manufactured in a factory environment.

Increased project time

Most of those features of construction projects that point to poor logistics will add to the time of construction projects. Delays whilst product is unloaded, subsequent movement of products around site and secondary working of product all add unnecessary time that would be eliminated in a well-organized project.

Added risks to health and safety

Unnecessary products stored on site inevitably bring with them additional potential hazards. Additional manual handling (either because product is in the wrong part of the site, or because the right equipment is not available) adds to the health risks to those on site. Secondary working of material also brings risks and research has shown that a number of accidents on site occur as a result of workers tripping over discarded material arising from secondary working.

**SOURCE:** Construction Logistics Group (2005)

Managing the logistics activities within construction has to take account of the way that many projects are developed and organized and the resulting implications for the supply chain structure. A recent report (BIS, 2013) identified very high levels of fragmentation in relatively simple packages of work – particularly at the Tier 2 and 3 levels of final transactions with suppliers. Construction projects involve very high volumes of purchasing activity and supplier coordination. This has a major impact on the way in which logistics management needs to work.

There are many reasons for this structure and the BIS (2013) report referred to above stressed that developments in technology could encourage even higher levels of fragmentation in view of the increasing complexity of the technology used in construction products and services. The building services supply chain was noted to be an example of this.
The Challenge of Construction Logistics

Construction is heavily reliant on road freight transport with a typical construction site requiring many vehicle trips each day. The types of vehicles arriving and leaving sites will of course vary according to the type of project and the stage of development. In a number of recent large projects non-road modes have been used to a greater extent than was common in the past. Two UK examples are the construction of Terminal 5 at Heathrow Airport and the work on construction in connection with the 2012 Olympic Games in London ( Lafarge, 2011; ODA, 2011 ). In both cases extensive use was made of rail transport and this was part of the commitment of the projects to achieving high levels of sustainability. Other examples have also been noted relating to the removal of waste materials from the Cologne metro and the Alter Mainzer Tunnel projects (DB Schenker, 2013). The pressure to increase levels of sustainability within construction supply chains places more requirements on logistics management, and the application of non-road alternatives will continue to receive attention.

One country that is often noted for its technological innovation is Japan; the scope for prefabrication in construction has been noted as one of the areas where innovation can be achieved. There are some activities that can be changed in terms of where the activity takes place. The scope to transform products off site through prefabrication has been noted ( Linner and Bock, 2012 ):

Japanese prefabrication industry acts rather like a ‘production industry’ than a ‘construction industry’. Similar to many other high-tech industries, Japan’s prefabrication industry incorporates the latest product and process technologies and combines automation, products and services into complex value-capturing systems.

There are many ways that the flow of materials to and from construction sites can be planned and organized in order to minimize environmental and other impacts. The boxes below contain summaries of two examples of UK initiatives that have received considerable attention: construction logistics plans (CLP) and construction consolidation centres (CCC).

**Construction logistics plans**

Freight vehicles play a key role in all construction projects by transporting equipment, delivering materials and removing waste. A construction logistics plan (CLP) provides a framework to better manage all types of freight vehicle movement to and from construction sites. Having a management plan will improve the safety and reliability of deliveries to
a site, reduce congestion and minimize the environmental impact. There are a number of benefits and advantages:

- reduced delivery costs and improved security;
- more reliable deliveries, meaning less disruption to the business day;
- time saved as you identify unnecessary deliveries;
- less noise and intrusion.

In addition, the plan provides an opportunity to feed into a corporate social responsibility (CSR) programme and ensure operations comply with health and safety legislation. Freight operators also benefit:

- legal loading areas mean less risk of freight operators receiving penalty charge notices;
- fuel savings through reduced, re-timed or consolidated deliveries;
- more efficient use of vehicles as greater delivery reliability will help with planning;
- improved reputation.

A CLP should be developed as part of a transport assessment. Each CLP needs to be tailored to a site’s requirements, but things to consider include:

- looking at where legal loading can take place;
- using freight operators who can demonstrate their commitment to best practice – for example, accreditation to the Fleet Operator Recognition Scheme (FORS);
- consolidating deliveries so that fewer journeys are needed;
- using more sustainable delivery methods;
- working with other construction sites in the area.

Construction consolidation centres

A construction consolidation centre (CCC) is a distribution facility through which material deliveries are channelled to construction sites. Specialist material handling, storage and consolidated delivery combine to improve the overall resource efficiency of a construction project.

WRAP (2011) notes that while data varies from project to project, use of a CCC can:

- reduce freight traffic to site by up to 70 per cent;
- increase productivity of site labour by 30 minutes per day leading to a 6 per cent productivity gain;
- cut waste reduction by 7–15 per cent through less material damage and shrinkage.

Other examples of innovation in construction management and logistics can also be identified and further chapters in the book feature these.

The challenges of the urban environment

A high proportion of construction activity takes place in cities. Given the scale of construction activity during periods of economic growth, and when there are many regeneration projects, it is not surprising that construction logistics faces some very demanding requirements in terms of operations in urban areas. Urbanization is already very pronounced in richer countries where over 70 per cent of the population is typically urban. However, globally the pattern is complicated and is changing rapidly. In 2013 the United Nations noted that overall the proportion of the population living in urban areas reached 50 per cent. Globally, urbanization is expected to rise to 70 per cent in 2050 and by then there will be 27 ‘megacities’ with at least 10 million people. It is not just the large cities that face change – at least half the urban growth in the coming decades is predicted to be in the many smaller cities. This growth in cities will have implications for supply chains. Construction activities in many cities will grow in response to this. Yet at the same time the pressure for a sustainable way of dealing with urban logistics, and particularly freight transport activity, will put more pressure on everyone concerned with managing commercial supply chains. This will be very much the case for the construction industry.

Due to the high populations and extensive commercial activities of urban areas they require the delivery and collection of large quantities of goods
and the provision of services for commercial and domestic use, resulting in considerable freight activity. Making better use of the capacity available for urban freight, and finding smarter solutions to sharing space in cities, is becoming ever more essential. Again this general trend will be very much applicable to construction. A consequence will be the rise in the requirement for even greater efficiency in the operation of construction logistics activities and tighter management of all aspects concerned with sustainability within logistics. This development includes aspects related to safety. For example, Construction Logistics and Cyclist Safety (CLOCS) is an initiative to increase the consideration of vulnerable road users. CLOCS has developed the CLOCS Standard for construction logistics: managing work-related road risk, a common standard for use by the construction logistics industry (CLOCS, 2014).

It has to be recognized that although the activities associated with construction logistics are essential to the well-being of cities they also contribute to social and environmental impacts, particularly to local air quality and noise. The problems experienced by those providing logistics services in urban areas are far less well understood. In many cases, urban freight activities result in conflicts between economic and social/environmental issues. Addressing such conflicts and trade-offs in urban freight transport requires change and innovation in the public and private sectors.

Interestingly the management consultancy firm PwC (2014) noted in their survey of chief executive officers (CEOs) that the CEOs of transport and logistics organizations considered urbanization to be one of the most important trends facing their industry. Awareness therefore appears to be high, which is a positive factor.

**Conclusion**

There are many challenges in construction logistics and among them are: 1) the challenge of place; 2) the challenge of complexity; 3) the challenge of achieving higher levels of sustainability. There are many others but these three challenges profoundly influence the need for excellent construction logistics management.

Construction activity most frequently takes place in urban areas. The locations change over time (unlike a factory location for production, or a retail store). In combination this makes each project to an extent unique, with specific local problems in logistics that need to be solved. The processes of coordinating the logistics activities of transport and storage – and ensuring the supply chain interaction such as purchasing and the provision of materials and finished products – are very hard to achieve. However, construction logistics management is improving all the time and the construction industry has devoted considerable efforts to devising solutions to these problems. The next few years are very promising in terms of the scope to apply new tools such as BIM to this field. Nevertheless the challenge of managing complex projects in major cities will become even more demanding as the
need to pay ever higher levels of attention to aspects such as noise and safety will become even more prominent in future.

Multiple stakeholders and decision makers are typical of construction projects. In many cases there is a complex interaction between the public and private sectors as well. This leads to complexity within the supply chain and makes good logistics management more difficult. It is also typical for greater complexity to lead to higher logistics costs. Of course organization within construction logistics seeks to manage this complexity and prevent extra cost burdens. Construction logistics also covers a wide range in relation to the scale of activities from major sites to very small developments. Techniques that work for one will not necessarily work at a different scale, even if the principles are the same.

Balancing the economic, social and environmental requirements is always a challenge, and for construction logistics there are many dimensions to this. As discussed in this chapter, most movements to and from construction sites take place by road. The use of fossil fuels for transport continues to receive considerable attention. Within the EU the goal of achieving virtually CO₂-free city logistics by 2030 has received considerable attention. This will be very difficult for construction logistics because of the current reliance on large vehicles for many of the transport activities associated with this industry. While it is possible to see how smaller vehicles will be able to use alternative fuels and possibly to achieve zero emissions at the point of use, by means of electric vans for example, the picture is more complicated for the larger vehicles. As noted earlier in the chapter there are examples of using non-road modes (especially rail) for some large construction projects both in the UK and elsewhere. However, it will be a challenge to translate the lessons learned on these large projects to a wide range of construction projects that take place across a city.

Note

1 Tier 1 refers to designers and constructors that have a direct contract with the ultimate client. Tier 2 are those designers, constructors and suppliers with a subcontract with the Tier 1 contractor. Tier 3 are those with a subcontract with Tier 2. This pattern of contracts and subcontracts is common in construction. Examples from Tier 2 include: manufacturers and material distributors, suppliers of major plant and equipment such as tower cranes. From Tier 3: specialist subcontractors, manufacturers and material distributors, and plant and equipment supply and hire firms.

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PwC (2014) 17th Annual Global CEO Survey: Key findings in the transportation & logistics industry (February)


"Bringing construction logistics into the 21st, and arguably even the 20th, Century is essential if the construction industry is to meet the requirements of its clients and customers for cheaper, faster and safer delivery of construction projects. In this book Greger provides a well-presented and argued analysis of the key logistics issues that the industry must get to grips with if it is to meet these requirements. His handling of the issue of construction materials consolidation is particularly good and relevant given the focus on congestion and safety in and around urban construction projects.”

Gary Sullivan, Construction Logistics specialist, Co-founder and Chairman of Wilson James Ltd and former Chairman of Essex Olympic Strategic Board for Legacy and the Thames Gateway South Essex Partnership

Supply Chain Management and Logistics in Construction is an accessible and practical text focusing on the importance of managing the supply chain outside of the immediate construction site. It provides essential guidance and expert advice for construction managers and logistics managers as well as researchers and students in the field.

This important title explores a broad range of strategic and operational responses to the challenges facing the construction industry today. In addition to offering topical case studies and research findings from internationally recognized companies, it examines a range of key issues relevant to the management of supply chains within the industry, including:

• arrangements with suppliers and the role of logistics specialists
• the use of construction materials consolidation
• the management of logistics for construction projects in congested urban areas
• the use of off-site manufacture and assembly, returnable packaging and other logistics strategies
• IT systems used to manage the supply chain, logistics operations and delivery management
• the contractual relationship between client, developer, main contractor and lower-tier contractors

Featuring contributions from leading experts in the field, Supply Chain Management and Logistics in Construction offers valuable insight into different perspectives of the various actors in the supply chain, and why the role of the construction logistics manager is more important than ever.

Greger Lundesjö has spent over 30 years in logistics-related businesses and has extensive international experience both in operative business roles and as a consultant. He has supported clients by applying logistics principles to construction projects, improving resource efficiency and reducing cost and environmental impact.