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More than materials:

managing what's needed to create value in construction

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Abstract

Construction is primarily an assembly process. This will remain the case as the industry moves to offsite manufacturing of sub-assemblies. Unlike automotive assembly, it is an example of *one-off project-based production* more akin to film-making or ship-building. Every project—road, school, hospital, even home—is a prototype. Each is unique. Yes, there are repetitions within the construction process, but the totality is unique.

In construction, value is created when elements are correctly assembled. In order for that to happen a number of resource flows need to converge simultaneously at the workface – operatives, information, plant, tools as well as materials. If we are to deliver our projects faster and with fewer defects, these critical flows along with space management (for safe operations) and the completion of prior assembly work need more systematic management than they generally receive.

This essay challenges the narrow (movement of materials) focus of most current construction logistics and suggests that there are significant benefits for clients and constructors from a broader definition. Realising the full range of benefits requires significant changes at design stage.

1 Introduction

This is a plea for designers, constructors and construction researchers to pay more attention to logistics, to consider a wider definition, and to consider logistics at the earliest stages of design.

The title of an earlier essay was "Construction Logistics: improving productivity, cutting carbon & creating client value by systematically bringing people, information, plant & materials together at the workface". Both that title and the current one describe different views of the same issue.

The industry already attaches greater importance to logistics considerations when faced with physically constrained sites say in city centres, but can be heard complaining about the failure to learn from that experience on the next project where space is no longer at a premium.

Where logistics receives due attention there are cost savings from opportunities to prefabricate, more easily constructed designs and a shorter programme as well as other benefits for many involved in construction – for example, increased productivity (and increased earnings for those on piece rates), improved safety, delivery and reduced carbon footprint of the construction process.

2 What is value?

I am using value here in the *lean* sense — value is what the customer wants to receive and is willing to pay for. "Value is an assessment made relative to a set of concerns that someone [the customer or client] wants addressed. There is nothing *of value* independent of a person saying … it is *valued*. Client concerns—interests, not worries—… inevitably change over the life of [a] project." (Macomber *et al* 2007)

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Anything else is waste. Clients and owners expect to pay for design, the materials required to create the building or structure and for the assembly of those materials. If they knew, would they want to pay for the waiting, delays, multiple handling, rework, etc that characterises much construction work? None of it creates any value *per se* though some movement of information, materials, plant and people is necessary to create value. Thus we have three categories of work – value creating work, work that is necessary to support the creation of value and waste. There are a number of studies of the relationship between these three types of work as illustrated in Figure 1[2].

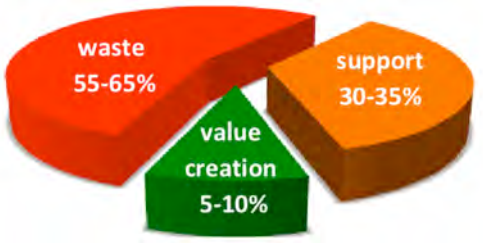

Figure 1: proportion of construction effort creating value (5-10%), supporting value creation (30-35%) and wasted (55-65%) – much of the activity that supports value creation is logistics.

3 What is logistics?

Chambers Dictionary (1972) defines logistics as the "art of movement and supply of troops", SOED (1970) as the "art of movement and quartering troops" & Merriam-Webster Online as the "procurement, maintenance, and transportation of military matériel, facilities, and personnel". This is a much broader definition than the one generally used in construction — getting materials to site *before* they are required.

What if we define construction logistics as *the movement, supply & welfare of builders*? And what if we were to require our logistics team to deliver *just-in-time* rather than *before*. With fewer materials awaiting assembly on-site, constructors would spend less on moving materials, less on replacing damaged items, have more space and fewer opportunities for materials to obstruct work or cause accidents. We might see fewer delays as people more often arrived at the workface *with* the information, tools and materials that they need to create value in *safety and comfort*[3]. Although it adds no customer value itself, logistics enables value-creating work to *flow.*

3.1 Measures of the effectiveness of logistics processes

- Percentage of tasks able to be done when planned
- Time spent waiting by people (caused by logistics failures)
- Itemised cost of delivery
- End-to-end cost of materials
- Time spent waiting by materials, on-site and off-site (less time = lower cash-flow)
- On-site area used for storage – planned vs. actual
- Walking distances (measured by pedometer) of skilled tradesmen
- No of times materials moved once they arrive on site

3.2 Examples of unnecessary logistical waste

- Long distances for staff to reach the toilets and other facilities
- Multiple-handling of materials required later so that current operations can proceed
- Damage to and pilfering of materials stored on site
- Operational delays caused by late delivery of materials, information, plant or equipment
- Skilled trades-people moving materials, information plant or equipment so that they can use their skills

[2] Sources: Construction Industry Institute; Cameron Orr, AWD personal communication with author; Constructing Excellence (forthcoming) review of the decade since Egan

[3] Based on Baudin's definition of lean logistics as "*all the operations needed to deliver goods or services, except making the goods or performing the services*" (2004)

- Skilled trades-people waiting for materials, information plant or equipment
- Accidents caused by "making do", hurry and rush or inadequate planning caused by delays both on site and in surrounding streets
- Sub-optimal construction processes after inadequate consideration of logistics in design
- Traffic congestion caused by inadequate logistics planning & traffic management
- Over-ordering of materials *just-in-case*

4 What is the potential scope of logistics

Table 1 sets out the key responsibilities subsumed under logistics using the Baudin (2004) definition — materials of course, but welfare, safety, waste, environment, information and much more besides. Some elements may be covered under other headings and any construction logistics plan is likely to develop iteratively alongside the design. This checklist, developed by the author, is the basis for the development of logistics plans developed by German construction company Kőster.

Table 1: key elements checklist for a lean logistics plan

Element	details
Health and Safety Management	how the site manages the health of the workforce and addresses any particular issues that could affect individual or site safety and health.
Procurement	how project procurement is managed, who has authority & who is responsible
Site Security	how security of the site, of operatives & of other and future users is managed.
Traffic Management	arrangements for movements of vehicles both on and in the vicinity of the site
Administration Offices	providing for administrative and technical staff who need to be based on or very close to the project site during construction
Site Housekeeping	how equipment and materials on site will be stored safely and securely; how the site will be kept clean and tidy and how that will be paid for.
Environment Management	how sensitive aspects of the environment will be cared for whether they are flora, fauna or parts of our archaeological or architectural heritage
Site Waste Management	how surplus resources and waste will be managed both on and off site.
Insurance	How the project is insured and how the insurer(s) interests will be protected
Information Management	how information will flow to the workface; to suppliers and from the project to neighbours, the community and to other stakeholders
Personnel Management	Welfare and other facilities provided for the workforce and the management of those facilities.
Materials Management	how materials move from source to workface and how surpluses and waste are moved back from the workface; takes account of the different characteristics of materials and of the constraints that affect their movement.
Site infrastructure	temporary & permanent drainage, water, electrical & compressed air supplies
Plant, tools & equipment management & maintenance	the demand and how it will be satisfied.
Payment Systems	procedures for keeping money flowing – to suppliers, subcontractors and staff.

4.1 So what's the construction manager's role?

I want to make some distinctions between *construction management* (the value-creating building assembly process), project logistics, project team management and supply chain management:

Construction management (building assembly or construction)	Management of the transformational work that **creates value** for the end user/client/owner by joining together the elements of the building or structure in a particular sequence —this is principally an assembly or a layering process whether it is in the creation of a building or in civils type projects such as roads, railways, etc.

project logistics	creating no value *per se*, this is a process of aligning and delivering the operations needed to create a structure or building, except for the assembly work above
project team management	A socio/technical alignment process (within commercial realities) to build and maintain the team and the relationships that enable the execution of the project. The project team management process aligns the project logistics and building assembly processes. It may also involve aspects of supply chain management.
supply chain management	A social & commercial alignment process managed by a constructor to create a network (i.e. a *supplier association* or *keiretsu* (Hines & Rich 1998)) of well managed, viable specialists who understand the Supply Chain Manager's *modus operandi* and are available to work on present and future projects. In this definition supply chain management is essentially a development process—development that can occur both within and between projects; supply chain members tell each other about new technologies, working practices, opportunities and collaborate on tenders and on negotiating future projects.

In this view *project logistics* and *project team management* are servants of *construction management*. The purpose of supply chain management is to prepare a network of suppliers to work in a variety of combinations on a range of often-unknown future projects, thus it is something that takes place outside the requirements of a particular project.

As we move towards integrated supply teams there will be an increasing overlap between *supplier association* and *project team* management processes but it will rarely be a 1:1 mapping—the skills required for different projects will almost inevitably vary and the individuals involved in delivering particular skills will change too.

While some assert that logistics is part of supply chain management, Jones *et al* offer *lean logistics* as a *new way of thinking about the supply chain* (1997, 170).

There are seven flows critical to construction success: Materials, People, Info, Equipment, Prior work, External conditions & Space (see Table 2). Construction logistics can help the first four and, in that way, contribute to the fifth. External conditions are beyond the control of anyone on site but construction managers and logistics planners can plan around them and help ensure that space inter-dependencies are minimised by contributing to the predictability of task completions.

Table 2: the seven flows (after Koskela 2000)

Flow	example in Design	in Site construction
Materials	Do I have the cheque to go with the building warrant application?	Do I have the bricks, mortar, ties, etc. to build this wall?
People	Do I have the staff to do the work?	Do I have the operatives to do the work?
Information	Do I have the information I need to do this task to the required standard? – brief; planning guidance; site investigations; etc.	Are all the drawings, contracts, method statements complete & RFIs answered so that I understand the *conditions of satisfaction*?
Equipment	Do I have the CAD systems, work-stations, meeting rooms; etc to complete the task?	Will I have access to the tools, scaffolding, scissor lifts, hook time etc. that I need?
External conditions	Planning authority; building warrant approval; land acquisition – are these all lined up?	Weather; building inspector; NHBC inspector; utility provider – are these all lined up?
Space	will I have control of this aspect of design or will other people work on it simultaneously?	Will I have safe access to the workspace to do the work?
Prior work	Is the design for the superstructure complete so foundation design can be completed?	Is the wall built so that plastering can begin?

5 Logistics and skills

In UK, as in many other countries, there is a shortage of skilled construction personnel. The Construction Skills Network *Blueprint for UK Construction Skills 2007-2011* (2007) gives an indication of the UK shortages.

It is generally accepted that skilled operatives are prevented from deploying their skills for significant periods every week. There is debate about how much time is wasted. The UK Strategic Forum for Construction's 2005 report *Improving Construction Logistics* stated (my emphasis):

> *"In construction, skilled craftsmen are often using their skills for less than 50% of their time on site[4]. Amongst the non-skilled tasks they are involved in* ***are unloading lorries and moving products around site****." (my emphasis) &*
> *"Research by BSRIA [a UK building services research organisation] in the 10 years since 2004 [sic] has shown that on average 10% of the working day of site operatives in all trades is lost due to* ***waiting for materials****, or* ***collecting materials, tools, and equipment****." (my emphasis)*

A note on the BSRIA website states "BSRIA research between 1994 and 2002 showed that on a construction project approximately 40% of all site labour is lost due to delays and a further 10% due to variability in installation performance."[5]

A Swedish study, Hammarlund (1989, quoted by Bertelsen & Neilsen 1997) showed that about "a third of the time used by the worker on the building site is spent **procuring his materials in the widest sense**, equalling about 10 percent of the total building cost." (my emphasis)

Whether the percentage is 10%, 30%, 50% or more there is room for improvement. There are shortages of construction *management* skills too—people who understand how a building goes together, how to manage and improve a project. In the absence of a dedicated logistics team part of their attention is diverted to logistics issues and to sorting logistics failures.

"…unloading lorries and moving products around site", "… procuring … materials in the widest sense", "… collecting materials, tools, and equipment"—these are all examples of material logistics. "Waiting for materials" is generally the result of a failure of materials logistics.

This suggests that improving logistics by systematically bringing people, information, plant & materials together at the workface will have an impact on the current skills shortages and probably a significant one. If the UK major contractors are right and skilled operatives currently only use their skills 50% of the time an improvement to 55% represents a 10% increase in productivity.

6 Logistics, safety and health

Good logistics will have the minimum of materials on site awaiting assembly. As well as being good for cash flow, this makes it easier to keep the site clean and tidy and reduces opportunities for slips, trips and falls. An effective logistics team will also pay attention to the maintenance of plant and equipment. Good logistics planning allows scaffolders and others to do their design and planning in good time, further reducing the risks to those who erect the scaffolding or other temporary works and to those who use it.

Fire is a risk on site even in steel and concrete framed buildings. Everyone is responsible for fire safety, but who takes the lead on fire prevention and mitigating the effects of fire should it occur? Using my definition this is a logistics responsibility.

Earlier I wrote "good logistics is concerned with how people, information, equipment and materials arrive at the workface able to create value in safety and comfort." For me this includes the attention to the ergonomics of the workface and provision of appropriate workbenches, tools and equipment to do the job without incurring musculoskeletal injuries (see e.g. Court et al 2005).

7 Logistics in master-planning

I have heard many complaints from constructors about inadequate consideration of logistics during design. This has implications for buildability and ultimately for cost. But particularly in larger (re)development and regeneration areas even earlier consideration can create green benefits too.

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[4] 50% was "*derived from comments from major contractors and some of the better ones at that, so for the less efficient the figure could be higher. [It] refers to non-productive time for whatever reason and … the non-skilled tasks referred to are only part of the explanation"* according to one of the authors, Michael Ankers of the Construction Products Association. Ankers believes that "*the anecdotal comments from the major contractors were … based on their own in-house surveys."* Personal email 07 may 07

[5] http://www.bsria.co.uk/process/?content=process+and+productivity&service=construction+facts 22mar08

For many larger developments consultants prepare a *master-plan*. The plan will be realised by different constructors on different sites. Designers for each building or structure will work independently. Establishing parameters for construction logistics for the total development/ regeneration process from the outset creates the possibility to reduce traffic movements, congestion in, and around, the development area and construction time, particularly if provision is made for a consolidation centre and even site offices that can later be used for other employment uses. To help realise these benefits planning authorities can ask for construction logistics proposals at master-plan stage. Planning conditions for individual sites/projects can be used to reinforce these logistics decisions later.

8 Logistics in Design

Architects & designers make logistics decisions, often unconsciously. Generally the impact of these decisions is to restrict constructors' choices later in the development process. In one instance the design involved a significant roof overhang close to the edge of the site. The design of the roof and overhang structure meant that they had to be installed before the vertical cladding panels. This prevented 3-story high cladding panels being craned into place. The panels therefore had to be made in sections and lifted into place from the ground at a significantly higher cost—and with more opportunity for a leaky envelope.

The Strategic Forum for Construction report (2005) stated: "Design Professionals need to be more aware of the part they play in ensuring good logistics, particularly at the scheme design stage." More training for architects may not be the answer—we might wish that they be more aware of logistics, but there are many more issues demanding their attention as buildings and codes become more complex.

Transport for London's *London Freight Plan* (TfL 2007) notes: *"… it is important at all stages of the development process – from design and planning through to construction - that full consideration is given to the freight and servicing implications of the development and its potential users. It is essential that freight activity is considered alongside the movement of people, throughout the planning system, to avoid generating conflict with other road users, particularly pedestrians and cyclists."* To which the *London Plan* (Mayor of London 2008) adds "*The planning system can assist the efficiency of road freight operation and reduce its impact by, for example, encouraging the provision of waiting areas for freight vehicles, or consolidation centres to avoid unnecessary trips or mileage and the resulting pollution and emissions*"

TfL is already responding to planning applications for larger projects in Greater London with a suggestion that a Construction Logistics Plan be requested and that it should be secured through a planning condition. TfL suggests that by 2011 *"… planning applications for all major developments, along with smaller developments over an agreed threshold, will require the submission and implementation of CLPs*." The *London Freight Plan* sets out criteria and expectations for a Construction Logistics Plan (CLP):

- reduce congestion and emissions during the construction phase by reducing contract duration and minimising trips (particularly in peak times), lane closures and illegal waiting/loading activities, justified by a transport assessment that considers the benefits of using consolidation:
  - consolidate loads, using larger vehicles making fewer deliveries when possible
  - a site delivery booking system to reduce/avoid the possibility of vehicles queuing on the highway
  - out-of-hours/off-peak working where possible
  - use of more sustainable modes, i.e. water and rail freight, where facilities exist
- details of contractual changes that require suppliers and servicing companies to reduce the number of trips and to use legal loading facilities
- a plan showing when and where deliveries and servicing can take place legally and in safety
  - demonstrate how lane closures and illegal waiting/loading will be minimised for deliveries.
- include design features to minimise the number of delivery trips during the operation phase of the building (when a *Delivery and Servicing Plan* will be enacted)

It is interesting to note that these relate only to materials and waste and that there is at least an implicit recognition that attention to logistics can help reduce contract duration. There is nothing about the workforce getting to site or about the impact of early consideration of logistics on numbers employed on site.

Before then, TfL wants government bodies in Greater London to set an example to private sector clients. This may require changes in public construction procurement methods to enable constructors to work with designers and clients/end-users to make decisions at appropriate points in the design process. This is discussed in more detail in section 12 and may also require changes in EU procurement rules.

8.1 Early constructor involvement

Involving constructors at the design stage is one way to enable the logistics plan to emerge *with* the design. This requires clients to understand how attention to logistics can affect the cost of their projects and to accept more collaborative procurement methods than Design-bid-build. In the current economic climate for construction where it seems constructors are procured either very early in the process to ensure that there is someone and preferably an A-team to build the project this is not difficult. But:

- Are designers using the opportunity to work with constructors to ensure buildability and that implicit logistics decisions are made explicit? *and*
- What will happen when it is once more a client's market rather than a constructor's?

Early constructor involvement has other benefits too. It can enable the use of set-based design, a process that allows the design space to be kept open for as long as possible while a range of design options are evaluated against both design and constructability criteria (Parrish et al 2007), and allows time for constructors to develop off-site fabrication solutions that allow one or more of:

- Reduced cost
- Safer construction
- Reduced waste
- Faster construction

8.2 Building Information Modelling & n-Dimensional design

Building Information Modelling (BIM) will support this process when time becomes one of the dimensions. nD CAD packages can enable the design & construction team to look at the organization and management of both the construction sequence and the site well before construction starts. A single BIM model on a project extranet enables all team members to work with the same up-to-date information.

BIM produces a *virtual* prototype. Just as physical prototypes enable manufacturers to identify and eliminate bugs from production items so do virtual ones – yes they are second best but they are much better than no prototype at all. A recent LCI Annual Congress heard how disaster was averted in this way on the Channel Tunnel Rail Link in Central London—the contactors had a 51-hour window to carry out a complex operation to divert a river and a sewer without affecting weekday commuter trains. A virtual rehearsal revealed that, as designed, the precast elements would not fit. A simple re-design enabled the project to be delivered in 36 hours. (Koerckel 2005).

Other logistics benefits accrue from moving to BIM. Most people – including some architects - find it difficult to visualise what a 2-dimensional drawing will be like in the reality of three dimensions. When confronted with 3-D reality clients and others sometimes want changes. Some of those changes could be made at design stage at far less cost and far less waste if the client and construction team had been able to look at the design in 3-D.

Construction operatives are more likely to build it right first time if they have good three-dimensional representations of the details and have access to a computer model that *they* can fly through at the detail level to see how to assemble the elements.

More accurate counts for the *Bills of Materials* are possible with object-oriented software, reducing logistics as well as materials costs. At Westbury, a UK house-builder acquired by Persimmon, estimators used to take-off cavity brickwork in their own way–there was no standard process. After they installed BIM they discovered they had been paying brick-layers for 10m^2 more brickwork than was needed to build one of their more popular house types.

9 Logistics in Construction

For some time now construction operations on confined sites have paid great attention to logistics. With nowhere to store materials and space for site accommodation limited, they've had no choice. Many involved in such projects have commented on how much better such projects have gone, yet seem to revert to business as usual when they no longer need to plan to the same degree because there is more space on site. One of the benefits of the planning is that materials are more likely to arrive just-in-time, can then be moved direct to the

workface. This in turn reduces the opportunities for materials to be damaged, stolen or to obstruct operations and require moving once, twice or more before reaching the workface.

This section looks in turn at some aspects of people, information, equipment and materials logistics in practice. In *lean* terms, none of these elements create *value* for the end-user/client/owner but the value creation process cannot be completed without them. All logistics, planned or not, are a cost to the constructor. Logistics costs eliminated and reduced through effective planning drop straight to the bottom line. This is one reason why it is really important to plan.

9.1 People logistics

London Heathrow's new Terminal 5 (T5) had a number of logistics teams. In addition to materials handling, these teams were responsible for office accommodation, welfare, occupational health, security and a range of other facilities to support those working on the site. They took care of traffic management, reduced traffic movements and contributed to safety.

At T5 getting people to site was a major constraint on material logistics. With up to 7000 people on the project and access restricted to a single bridge with one lane in each direction, early in the process someone realised that logistics was *the* major constraint. On-time completion required two vehicles a minute in each direction to cross the bridge every hour the site was open. Constructor operated buses collected and security checked operatives from up to 40 miles away and dropped them off at their workface. Buses also operated from tube stations and off-site car parking.

That size of workforce requires significant welfare and office facilities. WCs provided close to every workface maintained value creation time (and help operatives on piece rates make good money).

9.2 Information logistics

Late or defective information is a frequent reason for delayed delivery of assembly operations—operatives and managers need it to know the *conditions of satisfaction* for successful delivery of work. According to two American studies *missing information and information delivered late constitutes 50-80% of the problems in construction* (Thomas *et al* 2002; Thomas *et al* 1997).

Sometimes operatives and managers complain about too much information in one area and not enough for another or about the format in which information is provided. Usually the information needed comes from more than one source. Who is responsible for finding out what is needed, in what form, by whom and when?

9.3 Equipment logistics

The issues relating to materials and equipment are similar and, in so far as equipment is used to move materials, inter-dependent. They will be considered together. There are many factors that contribute to material and equipment delivery problems including manufacturing & maintenance problems, design delays, long supply chains, road (and rail) delays, weather.

9.4 Materials logistics

In the groundwork and civil engineering phases of a project materials tend to be high volume and low variety—cement, aggregates, rebar, shuttering, steel — often requiring specialist vehicles. At fit-out time materials are high-variety low-volume items that need sensitive handling to preserve the finishes the customer will see and feel. Material logistics operations need to handle both of these extremes and everything in between. All are required just-in-time. All three stages can happen simultaneously on all but the smallest projects.

9.5 Logistics and/or Consolidation centres

In UK construction there is growing interest in the use of consolidation centres to buffer projects from the vagaries of delivery. A consolidation centre receives materials for one or more sites and then delivers them as required to the sites. The London Construction Consolidation Centre (LCCC) in SE London served 4 sites in central London. Apart from steel, cement, concrete, sand and aggregates, the main contractor expected all

materials to be delivered to LCCC for just-in-time delivery to each site. While this did not happen to the extent initially envisaged, in addition to 95+% on-time delivery, there were significant benefits to the sites—materials inspected on receipt at the centre [damaged materials returned] and stored in a warehouse until required so arriving at the workface in good condition; as much packaging as possible is removed before materials go to site so that there is less to dispose of; because materials are not subject to external storage they were delivered to LCCC with less packaging.

The decision to use a consolidation centre may have implications for design as well as be influenced by it—another reason for involving the constructor at an early stage.

9.6 Off-site fabrication

The T5 consolidation centre provided somewhere warm and dry for operatives to produce rebar cages for just-in-time delivery and installation on site. As well as providing ideal conditions for making the cages, this reduced clutter on site, improved the quality of cages and meant that large volumes of air were only transported a few hundreds of metres.

10 Logistics for sustainable construction – lean & green

In addition to enabling skilled construction workers to create more value for clients, owners and end-users, a logistics team or function can create value for society through environmental benefits. The UK Strategic Forum Report (2005) describes environmental as well as productivity benefits:

> *"On [the Mid–City Place development in Central London] a strategy was developed to reduce multi-handling and repeated moving of materials. This improved logistics led to some 35% less material waste than benchmark sites, distribution of material with one less pair of hoists, and almost 100% performance in materials being distributed in the right time and place. This all contributed to the project being completed 11 weeks ahead of the planned programme, with a build rate 60% ahead of the industry benchmark, building cost 80% of industry benchmark, and 675,000 hours worked without a single reported accident."*

Evidence from the LCCC suggests that, in a dense urban environment, logistics planning is good for the environment. In the first six months of operation, the LCCC resulted in (TfL 2006):

- *"CO2 emission lowered by 73 per cent, from 11,985kg to 3,175kg*
- *The need for deliveries reduced by three-quarters from around 1,500 to 395*
- *Journey times for lorries cut by up to two hours*
- *Less deliveries turned away from building sites, with the right materials arriving on time 95% of the time, up from 50 per cent*
- *Traffic flow maintained around major construction sites, reducing congestion."*

In Europe & Japan, attention is now given to the identification of waste streams as resources for others. The coordinated removal (reverse-logistics) of waste can reduce vehicle movements and help to ensure reuse when possible and otherwise safe recycling or disposal. This is another role for the logistics team and a potential source of income for a project.

Over-packaging is a major source of waste for the supplier who buys the packaging material, for the installer who has to remove it, for the trades it obstructs and for removing it. Some companies are already working with suppliers and manufacturers to eliminate some or all packaging and to create re-useable packaging.

11 Raising the profile of construction logistics

Construction culture is dominated by stories of hard men (and generally they are men) who deliver projects despite enormous obstacles. The emphasis is on being good at handling adversity and *fire-fighting*[6]. Many of those in leadership positions in construction got there because they are good in that way. They have a natural tendency to promote others who are good fire-fighters and good in adversity because they believe *that's how projects get delivered in construction*.

[6] *Fire-fighting* is here used as a metaphor for a highly action oriented approach to dealing with crises.

Many in construction are fed up with this way of doing things. Yet those who don't have a fire-fighting reputation precisely because they are able to deploy excellent collaborative fire-prevention methods such as Last Planner, good construction logistics & logistics planning and who work collaboratively with the client and the whole of the project team do not feature in construction folk tales to the same degree as the fire-fighters. **Culture eats change for lunch**. We need to be subtle about how we make change.

11.1 Telling different stories – celebrating new heroes

To raise the profile of these and other fire-prevention methods we need to find ways to celebrate a new set of heroes – men *and women* who deliver quality projects on time and to budget without the drama of endless fires. Yes, shit happens in construction and there will be fires to fight. But fires aren't necessary to success.

- Who will document the stories of the *A-teams* that big developers want to secure for their prestige projects? Who will help members of these A-teams tell their stories to construction audiences?
- Who will seek out the project managers who work in a different way – quietly and without fuss and drama - on smaller projects in your town, in your city, in your country? Who will make space for their stories in institution, institute, professional and trade meetings?
- Which CEOs & Managing Directors will celebrate individuals and project teams that have good fire prevention measures in place throughout their areas of responsibility and downplay the prowess of those that fight endless fires?

New stories can attract different people into the industry, more women even. Deep down there are not many who enjoy working in a cut-throat high pressure adversarial setting for long periods.

There has been some change over the last decade and more. Mace was founded to go this better way after a good experience on a Bovis project in the City of London. Others are doing it too. But good news is not news – that's why leadership has to work harder to change the stories.

Leadership is going to have to work hard to ensure that stories of the new heroes and heroines are heard over the obvious buzz and excitement of stories about yesterday's gung-ho macho heroes. The former will need to be told and retold in board meetings, school speech days, company newspapers, management briefings, industry conferences, press releases … wherever and whenever the opportunity arises. Repetition will help the message go home.

11.2 Developing skills and knowledge

Construction logistics teams require people with new combinations of competences. Depending on the size of the project different levels of competence will be required. So far as I am aware there are not yet any courses that cover the required range of topics at any level. Research is required to establish the range of skills required at different levels in logistics management from logistics operatives through to senior logistics managers on major projects.

12 A way forward: Integrated Project Delivery

Integrated Project Delivery (IPD) collaboratively aligns people, systems, business processes & practices so as to harness the talents & insights of all participants so that they can optimise value for the client (while creating an appropriate return for all stakeholders), reduce waste & maximise effectiveness through all phases of design, fabrication & construction. Integrated projects are led by a highly effective collaboration between client, lead designer & lead constructor from early in design through to project handover and use lean thinking throughout the process. IPD is different from both Design & Build and from historic Design-Bid-Build.

As Figure 2 indicates, a major change in IPD is to concentrate design much earlier in the overall process. For this to work well the first, and preferably second, tier constructors need to be fully engaged in the design process with the client. At least initially it seems likely that clients will need to take the lead on implementing IPD as members of the Construction Users Round Table, health and prison authorities are doing in the US. Some smaller developers in the UK are moving in this direction too.

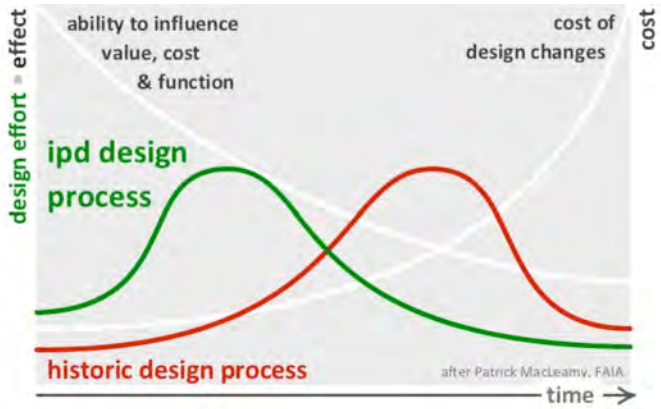

Figure 2: comparison of integrated and historic design processes

The upper diagram in Figure 3 shows some of the current problems with the historic design-bid-build way of doing things when construction planning *by constructors* is left to the start of the construction phase.

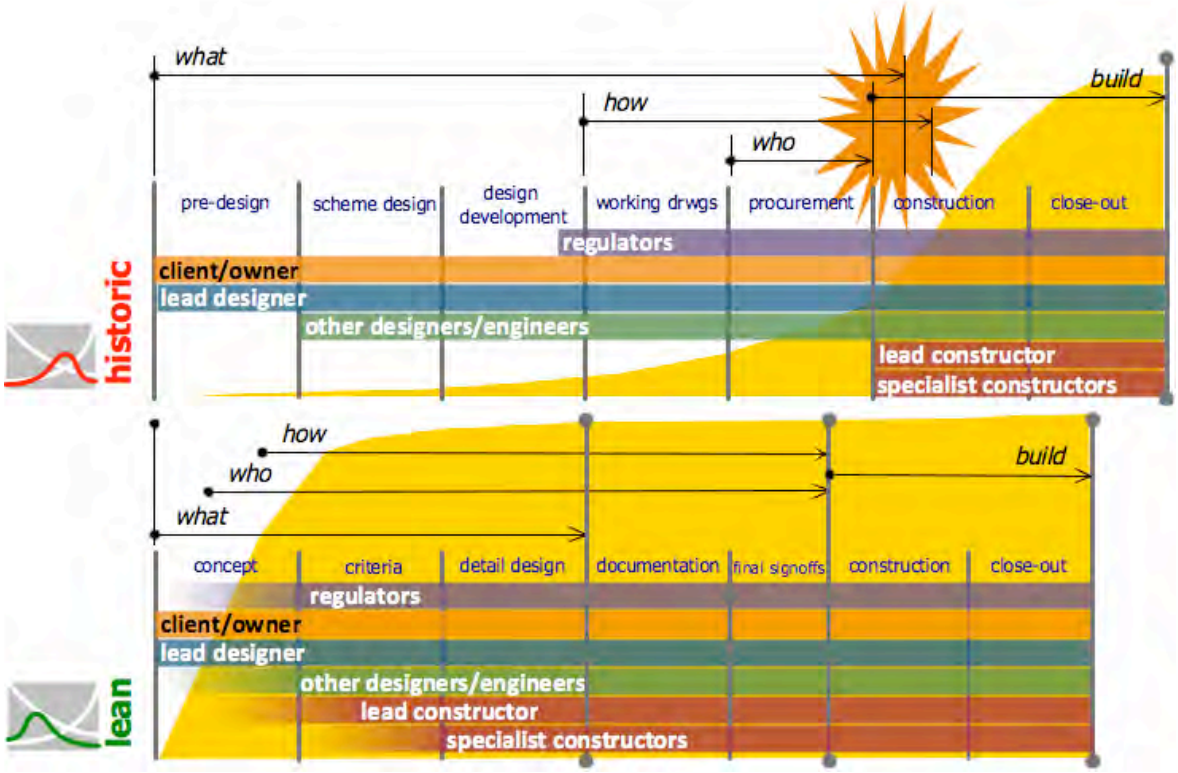

Figure 3: comparison of integrated lean and historic project delivery timelines[7] & their impact on the development of a shared understanding of the project by the whole team (yellow)[8].

The lower diagram shows how, by giving the lead designer a more strategic role, moving design to the left and involving constructors and specialist suppliers in the design process, there is much more time for constructors to plan the construction phase effectively and to use off-site fabrication and manufacturing where it supports the overall process and suggests how it is possible to compress the overall project programme. The overlay of Will Lichtig's observations about project understanding (yellow) suggest why this works. Recent unpublished evidence from Japan and from the US seems to confirm that this is a viable way forward.

12.1 Logistics Planning Systems

Construction is a human activity and the unpredicted happens – even with the best-laid plans. While useful for testing the feasibility of a project and for compiling the risk register, CPM systems are of limited use for managing a project (Koskela & Howell 2002) as it only considers one of the seven flows listed in Table 2 – prior

7 after Eckblad *et al* 2007 The Possibilities of an Integrated approach

8 Will Lichtig 2007 Creating a Relational Contract to Support Lean Project Delivery – note Lichtig suggests that in the historic approach *shared* understanding may never reach 100%

work. Last Planner, or one of its derivatives such as *ProjectFlow*, offers a far more realistic way to collaboratively manage project-based production. Research in Denmark shows that it is associated with reductions in accidents (down 45+%) and absenteeism (down between 10 and 70% depending on the trade), both of which have implications for productivity. This is not the place to describe Last Planner[9] (LPS) in detail. I want to focus on one aspect: The **MakeReady checklist**. This is built around the seven flows listed in Table 2.

The MakeReady checklist is used to ensure that work can be done when it should be done according to the schedule. It may not be for the logistics team to chase late delivery of *prior work,* but the logistics team need detailed knowledge of when work is, or is likely to be, completed, when delays are likely or have occurred so they can ensure that the right materials are ready for each crew *when* they *are* ready to work.

As Bertelsen has noted (2005) "*The complex nature of construction causes often great variability in the flows, not least the flow of work but also other flows such as information, crew, materials and space. One approach is to better manage this variability, where* ***situation based management methods such as last planner have proven efficient.*****"** (my emphasis)

LPS is the vital link between the logistics team and building assembly teams. MakeReady and Production Planning support both key processes and PPC is at least as much a measure of *logistics* team effectiveness as it is of *building assembly*. (It is for these and other reasons that I believe that LPS stands for *Logistics Planning System.* Trade foremen propose when they will do which task next week so that the logistics team know what they have to do to enable that to happen.)

13 Conclusions

Building design, assembly and *logistics* are inter-dependent processes vital to the successful delivery of any construction project. Moving *Materials, People, Information* and *Equipment* to the workface creates no value. Value can only be created when they all come *together at* the workface. Getting them there—and ensuring that they can remain there until the work is done—is *the* logistic function. *External conditions* are outside the control of the project team—but they can be anticipated. *Space* is primarily about safety and reducing uncertainty.

There is a growing interest in construction logistics in UK and the US. More is being done and evaluated by practitioners in the field. Improving Construction Logistics is fully within the remit of the industry itself. It requires no additional powers to do what they do already on very constricted sites. The industry can choose to test the hypothesis that systematic attention to construction logistics both in design and in construction:

- Improves quality, cost and delivery
- Reduces carbon emissions in the construction process
- Reduces the shortage of skills that the industry faces
- Improves safety and health for all on site

What academic thinking there has been about logistics *per se* in construction has tended to focus only on materials. Even the dictionary definition is wider than this.

Accepting Baudin's even wider definition—and resourcing for it—has the potential to free skilled workers and managers to focus their time and effort on delivering quality and value for the client while others—the logistics team—ensure that everything else is in place to support this value creation process.

If it is true that skilled operatives spend a sizeable proportion of their work time doing logistics tasks—or just waiting because of logistics failures—improved logistics has the potential to make a significant contribution to the construction industry.

It is not clear from the research to date that improving logistics improves productivity in the industry. We need more, and more focussed, research to establish that and to detail the contribution that the discipline can make to reducing waste, carbon emissions and so forth.

14 References

Baudin, Michael (2005) Lean Logistics: The Nuts and Bolts of Delivering Materials and Goods Productivity Press

[9] For a general description of Last Planner see Mossman (2005)

Bertelsen, Sven & Jorgen Nielsen (1997) Just-In-Time Logistics in the Supply of Building Materials. paper to *1st International Conference on Construction Industry Development: Building the future Together*, Singapore, 9-11 December

Construction Skills Network (2007) *Blueprint for UK Construction Skills 2007-2011* ConstructionSkills

Court, Peter F, Christine Pasquire, Alistair Gibb & David Bower (2005) "Lean" as an antidote to labour cost escalation on complex mechanical and electrical projects In: *Proceedings of the 13th IGLC Conference* pp 153-160 www.iglc.net/conferences/2005/papers/

Hammarlund, Y & Rydén, R (1989), *Effektivitetet i VVS-branschen, Arbetstidens utnytjande*, Svenska Byggbranschens utvecklingsfond, Sweden. (quoted in Bertelsen and Nielsen 1997) http://www.aia.org/nwsltr_pm.cfm?pagename=pm_a_112007_targetvaluedesign

Koskela, L (2000) *An exploration towards a production theory and its application to construction* VTT Building Technology, Espoo. 296 p. VTT Publications; 408. ISBN 951-38-5565-1; 951-38-5566-X

Koskela, L & Howell, G (2002) The underlying theory of project management is obsolete, in Slevin, D, Cleland, D and Pinto, J (eds): *Proceedings of PMI Research Conference* 2002, pp. 293–302.

Macomber, Hal, Gregory Howell, and John Barberio (2007) Target-Value Design: Nine Foundational Practices for Delivering Surprising Client Value in *AIA Practice Management Digest* Fall 2007 http://www.aia.org/nwsltr_pm.cfm?pagename=pm_a_112007_targetvaluedesign 14 Feb 07

Mayor of London (2008) *The London Plan: Spatial Development Strategy for Greater London (Consolidated with Alterations since 2004)* http://www.london.gov.uk/thelondonplan/thelondonplan.jsp 1 may08

Mossman, Alan (2005) *Last Planner - an overview* www.obom.org/DOWNLOADS2/LPSoverview.pdf 19 Oct 07

Parrish, Kristen, John-Michael Wong, Iris D Tommelein & Bozidar Stojadinovic (2007) Exploration Of Set-Based Design For Reinforced Concrete Structures Proceedings IGLC-15, July, Michigan USA

Pearson, Andy (2004) The Longest Day in Building 16 Jan 2004 http://www.building.co.uk/story.asp?storyType=7&sectioncode=32&storyCode=3031359 15 apr 07

SOED (1970) The Shorter Oxford English Dictionary OUP

Strategic Forum for Construction (2005) *Improving Construction Logistics*. www.strategicforum.org.uk/pdf/LogisticsReportAugust2005.pdf 7 may 07

TfL (2006) *New freight centre cuts emissions and lorry trips by 70 per cent* http://www.tfl.gov.uk/corporate/media/newscentre/3525.aspx 8 may 07.

TfL (2007) *London Freight Plan: sustainable freight distribution: a plan for London.* http://www.tfl.gov.uk/assets/downloads/businessandpartners/London-Freight-Plan.pdf 29 apr 08

Thomas, HR, M Horman, U Lemes de Souza, & I Zavrski (2002) "Reducing Variability to Improve Performance as Lean Construction Principle" ASCE, *J of Constr Eng & Mgmt*., 128(2), 144-154

Thomas, HR, M Horman, E Minchin, & D Chen, D (2003) "Improving Labor Flow Reliability for Better Productivity as Lean Construction Principle." ASCE, *J of Constr Eng & Mgmt*, 129(3), 251-261

Thomas, S, Tucker, R, and Kelly, R (1997). "An Assessment Tool for Improving Team Communications." *Construction Industry Institute (CII)*, Technical Report No. RR105-11, Austin, Texas.

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