

# Implementing Lean in construction

*a Lean guide for client organisations*

**Gerry Chick, Building Research Establishment Ltd and  
Collaborative Improvement Ltd Alliance**

## Feedback

CIRIA and the project steering group welcome your feedback on the documents in the Lean series.

However, before reading this guide, and without reference to the contents list, please write down five areas or specific questions that you are hoping the guide will help you with.

We invite you to list these points, and the extent to which they have been covered, in the Lean questionnaire, which can be found at: [www.ciria.org/service/lean](http://www.ciria.org/service/lean)



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**Implementing Lean in construction: a Lean guide for client organisations**

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# Why read this guide?

Within the built environment, building and infrastructure clients like you are the key link between the end users and those that formulate the design and carry out the construction on site. Most involved in our industry now seem to accept that waste in construction processes and communications remains annoyingly persistent despite the best efforts of many over the last two decades.

Regrettably, our public buildings and infrastructure still costs more than they should. As clients it is surely our responsibility to demand better, and then to contribute to improving matters.

‘Lean’ is a simple, intuitive way to remove waste of all kinds from everything we do. When we work collaboratively for improvement we can together change our industry. However, this will only happen if you, the client, demand that it should. Reading this guide is a first step on that road to better, more cost effective, quicker, safer, more sustainable and more enjoyable ways of constructing our built environment.

This guide has been authored and reviewed by individuals who have worked with some of the UK’s leading client organisations in terms of delivering Lean solutions within their supply chains. Accordingly, this guide uniquely explains the principles behind ‘Lean’ and describes how to put them into practice from a client’s perspective.

**Chapter 1** of this guide provides you with a description of the principles of Lean, with **Chapter 2** giving an overview of Lean practices. Both chapters are couched in terms specific to you, the building and infrastructure client and/or developer. **Chapter 3** guides you through a six step practical guide to Lean implementation and is intended for use by both large organisations funding a succession of projects every year or developers that might be commissioning a single project.

## Background to topic

In 1995 Lord Latham identified the high level of waste within the UK’s building and construction industry. Shortly after Sir John Egan identified a way forward (Egan, 1998). Despite all the activity that has occurred since, many of us still find it hard to sustain improvements and carry forward the progress we make. Others are still to commence their Lean journey. The UK Government is now asking for a 20 per cent saving on the building and infrastructure work that they commission and the current economic climate demands that we get more for less if we are to survive. These factors seem to be providing a stimulus for many of us to revisit the potential that Lean has for improving our industry. This guide is aimed at helping commissioning clients gain a better understanding of the principles of Lean and then guiding them through the practices from a client’s perspective.

### CIRIA Lean guides

This guide is one of a series of publications and, together with an overview document, can be found at: [www.ciria.org/service/lean](http://www.ciria.org/service/lean)

- C725 Lean and BIM (Dave, B, Koskela, L, Kiviniemi, A, Owen, R, Tzortzopoulos, P)
- C726 Lean and sustainability (Corfe, C)
- C727 Lean benefits realisation management (Smith, S)
- C728 Lean client’s guide (Chick, G)
- C729 Selecting a Lean consultant (Fraser, N)
- C730 Lean tools – an introduction (O’Connor, R and Swain, B)

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Gerry is a civil engineer by profession and spent much of his career working for BAA plc in various capacities. BAA plc were then the world's largest airport group that developed and operated airports in the UK and abroad. As such they were one of the UK's major building and infrastructure clients.

For the past 20 years Gerry's passion for eliminating waste has focused upon working collaboratively with consultants, contractors and suppliers within BAA's multiple supply chains to improve the manner in which they worked together through adopting a Lean philosophy. This approach generated multi-million pound savings for BAA plc while at the same time improving the quality, delivery time, health and safety, sustainability and reliability of their construction projects and improved profitability for their supply chain.

Gerry left BAA plc in 2010 and is now a director with Collaborative Improvement Limited, a private company with the purpose of helping the building and construction industry increase the value they bring to their customers and end users.

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# Contents

|   |            |
|---|------------|
| <b>Why read this guide?</b>   | <b>iii</b> |
| <b>Background to topic</b>  | <b>iii</b> |
| <b>Acknowledgements</b>   | <b>iv</b>  |
| <b>Boxes</b>  | <b>v</b>   |
| <b>Case studies</b>   | <b>vi</b>  |
| <b>Figures</b>  | <b>vi</b>  |
| <b>Tables</b>   | <b>vi</b>  |
| <b>1 Lean principles for the building and infrastructure client</b>   | <b>1</b>   |
| 1.1 Why does Lean matter to me, the client?   | 1          |
| 1.2 Great expectations – Lean consultants   | 4          |
| 1.3 Waste is so much more than wasted materials   | 8          |
| 1.4 Understanding Lean basics: why value doesn't equate to cost and why it is not the same as cost or price | 9          |
| 1.5 Lean assessment   | 10         |
| 1.6 Final thoughts  | 10         |
| <b>2 Lean practice for the building and infrastructure client – a roadmap</b>                               | <b>11</b>  |
| 2.1 Introduction  | 11         |
| 2.2 Lean is possible for all client organisations   | 11         |
| 2.3 Lean client leadership – seven top tips   | 12         |
| 2.4 Four critical success factors   | 14         |
| 2.4.1 Success factor 1: behaviour and culture   | 14         |
| 2.4.2 Success factor 2: commercial considerations   | 15         |
| 2.4.3 Success factor 3: contracts matter  | 17         |
| 2.4.4 Success factor 4: simple and appropriate tools and techniques. Learn to be present                    | 18         |
| 2.5 Six-steps to implementation – a framework   | 19         |
| <b>3 Six-steps to implementation – the detail</b>   | <b>20</b>  |
| 3.1 Introduction  | 21         |
| 3.2 Step one: establishing the basics   | 22         |
| 3.3 Step two: acquisition for improved performance  | 27         |
| 3.4 Step three: creating a collaborative team   | 30         |
| 3.5 Step four: Lean implementation on-site  | 34         |
| 3.7 Step five: multiple projects  | 39         |
| 3.8 Step six: supplier performance and relationship management for sustained success                        | 42         |
| <b>References and further reading</b>   | <b>46</b>  |
| <b>Boxes</b>  |            |
| Box 1.1 Why you should read this guide: a sector perspective  | 2          |
| Box 1.2 The seven wastes  | 8          |
| Box 1.3 Seven Deadly Diseases and True North Values   | 10         |
| Box 3.1 The Velodrome, London   | 22         |

|         |   |    |
|---------|---|----|
| Box 3.2 | Lean Maturity Assessment Toolkit, Highways Agency . . . . . | 24 |
| Box 3.3 | Anglian Water . . . . .                                     | 35 |
| Box 3.4 | Knowledge sharing . . . . .                                 | 27 |
| Box 3.5 | Pareto analysis . . . . .                                   | 39 |

### **Case studies**

|                |  |    |
|----------------|--|----|
| Case study 2.1 | Reducing waste using Lean tools, Wolverhampton University and NG Bailey. . . . . | 15 |
| Case study 3.1 | Collaborative working . . . . .  | 36 |

### **Figures**

|            |   |    |
|------------|---|----|
| Figure 1.1 | Progressive application through the project life cycle. . . . . | 3  |
| Figure 2.1 | BAA plc Performance Improvement Toolkit 1995–2010. . . . .      | 13 |
| Figure 2.2 | Employing Lean tools such as observation . . . . .              | 15 |
| Figure 3.1 | Use of off-site manufacturing – standard product. . . . .       | 35 |
| Figure 3.2 | Teamwork – adopting a collaborative approach . . . . .          | 36 |
| Figure 3.3 | Root cause analysis . . . . .                                   | 39 |
| Figure 3.4 | Supplier positioning matrix . . . . .                           | 43 |

### **Tables**

|           |   |    |
|-----------|---|----|
| Table 1.1 | 11 things that make the building and infrastructure industry unique . . . . . | 6  |
| Table 1.2 | Why organisations have different characteristics . . . . .                    | 7  |
| Table 1.3 | Five components of Lean . . . . .   | 9  |
| Table 2.1 | Where to find maximum returns . . . . .                                       | 12 |
| Table 3.1 | Benefits from supplier relationships . . . . .                                | 43 |
| Table 3.2 | Skills, competencies and behaviours for managing suppliers . . . . .          | 44 |

# Lean principles for the building and infrastructure client

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## 1.1 WHY DOES LEAN MATTER TO ME, THE CLIENT?

Building and infrastructure clients have an important responsibility to society to ensure that the work that they commission is designed and constructed in a manner that minimises cost, delivery time and accidents, while at the same time ensuring maximum build quality and sustainability.

Whether or not your client organisation chooses to be 'Lean', it has an important role in spearheading a Lean approach, with the accompanying cultural change, to ensure that the supply chains it funds work collaboratively and in a way that ensures improved performance.

Lean working breaks the stereotypical view that reductions in cost will compromise quality and programme delivery. Collaborative Lean improvement methodologies correctly adapted and applied will lead to improvements in:

- ▶ cost
- ▶ programme delivery
- ▶ health and safety
- ▶ quality
- ▶ environmental impact
- ▶ social responsibility
- ▶ employee work satisfaction.

If your client organisation doesn't initiate these changes, who else do you think will?

In his report, Sir John Egan (1998) quoted research that suggested that up to 30 per cent of construction is rework, labour is used at only 40 to 60 per cent of potential efficiency, accidents can account for three to six per cent of total project costs, and at least 10 per cent of materials are wasted. Guidance by Woolstenhorne (2009) reports some progress, including safety, productivity and predictability, but acknowledges that there is still much to be done. However, many of us will know of projects where performance is much poorer. There is no room for complacency.

Client organisations are rarely the end users of the buildings and infrastructure that they commission and it is ultimately these end users or taxpayers who normally foot the bill. The case for considering Lean is compelling, whether your perspective is financial, social or simply if you are in the position of having to do more for less.

|   |   |
|---|---|
| <p>Why you should read this guide: a sector perspective</p> | <p><b>Public sector clients:</b> budget cutbacks are now forcing you to seek cost savings in all your activities, including construction. While the current economic climate is providing an acute driver, arguably, the potential has been there all along.</p> <p><b>Private sector clients:</b> consumers can no longer endure frequent price rises. There is more pressure than ever to reduce your operating overheads. Construction spend is an obvious area of potential saving. Using Lean can help you achieve this and achieve greater value for your business from every pound spent.</p> <p><b>Tier 1 contractors:</b> most companies prefer to work for Lean clients that appreciate the difference between value and costs. Being Lean means that you can better serve your client and, in turn, build a stronger supply chain.</p> |
| <p>Box 1.1</p>  |   |

Any Lean intervention or transformation, whether it is for your organisation, a project that your organisation has commissioned or your organisation's building and infrastructure supply chain across many projects, requires appropriate leadership. Leadership styles differ from one organisation to another, however in terms of helping to facilitate Lean practices your client organisation can help in two ways.

What your organisation does when it commissions and manages building and infrastructure projects will have a major influence on this. Different organisations show different forms of 'Lean leadership'.

Firstly, some clients feel that it sufficient to choose providers that present the lowest compliant cost at tender, arguing that the market will then ensure that their providers are the Leanest or they would not be the lowest cost option. While this argument might have a simplistic appeal it is often found wanting within the building and infrastructure industry for many reasons.

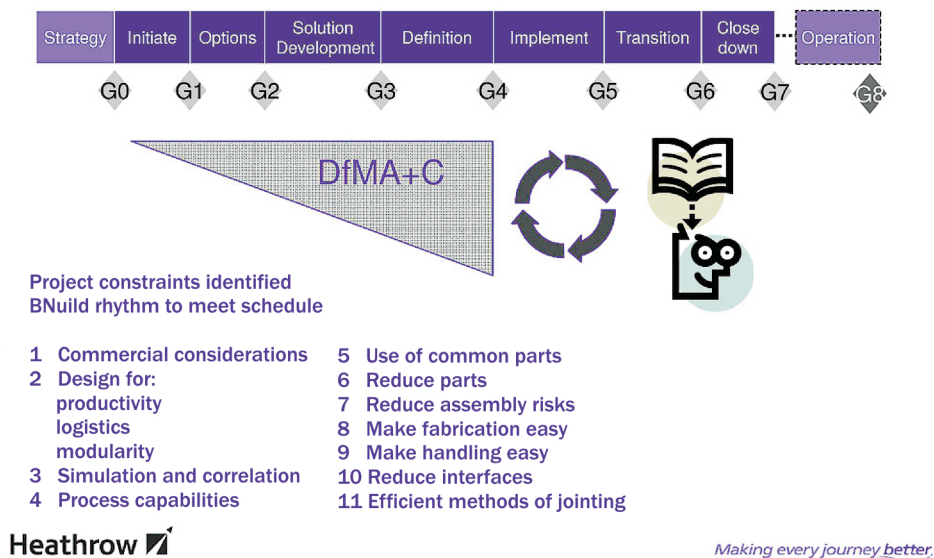
Clients that rely on this mechanism need to be very certain of their requirements when going to tender. Many are not and make changes after design and/or construction has started, which often leads to unmanageable and unplanned claims for increases in cost and time. If clients rely on this mechanism they are unlikely to have a true understanding of the cost of their projects in terms of the individual components of their specifications and they will certainly have no understanding of the magnitude or cost of waste of their projects. Lastly, cheapest definitely does not equate to waste free and fixed price contracts have no incentive for the contractor to identify waste that has been 'designed in'.

Secondly, clients adopting a more proactive methodology range in approach. Some like to ensure that their designers, contractors and suppliers are fully trained in Lean practices either by providing training themselves or requiring it is undertaken by external suppliers. Some agree project and/or ongoing improvement targets that may or may not be contractual. Some require visibility of Lean performance on a self-reporting basis.

For example on appropriate projects, Heathrow Airport Limited issue a Design for Manufacturing, Assembly and Commissioning (DfMA+C) brief, which is a contractual requirement. The principal contractor is then required to provide a DfMA+C strategy. An intervention regime is then managed by the client throughout the project life cycle and is checked against technical and design performance standards with the principal contractor being 'pushed' to clearly identify and realise all respective benefits.

This approach is illustrated in Figure 1.1.





**Figure 1.1** Progressive application through the project life cycle (courtesy Richard Kelly, Heathrow Airport)

As well as what is done by your client organisation its culture and the resultant behaviours displayed by your colleagues can also provide Lean leadership. These are covered later in Sections 1.6 and 2.4 of this guide and in the assessment matrix illustrated in Terry and Smith (2011).

The manner in which your organisation commissions its design is also important. Your client organisation will have commissioned the design for each facility it builds or constructs. By demanding that the design is carried out to enable waste to be minimised during construction you, the client, demonstrate Lean leadership which can make a considerable difference.

In addition to the DfMA+C process, the 13 things that all clients should do to enable Lean construction on site are:

|    |   | Section    |
|----|---|------------|
| 1  | Concurrent engineering  | 3.2        |
| 2  | Standardisation   | 3.6        |
| 3  | Simplicity  | 2.4.3, 3.5 |
| 4  | Building Information Modelling (BIM)  | 3.5        |
| 5  | Performance specifications  | 3.5        |
| 6  | Off-site manufacture  | 3.5        |
| 7  | Knowledge of what is available off the shelf                                  |            |
| 8  | Shared active learning  | 3.8        |
| 10 | Knowledge of what manufacturers would be able to change at no additional cost |            |
| 11 | Encourage or require designers to apply Lean to their design processes        | 3.2, 3.4   |
| 12 | Ease of build   | 3.5        |
| 13 | Whole life costs  |            |

We will revisit these points in Chapter 2 of the guide.

Similarly, project programming needs to be viewed differently.

Traditionally your client organisation might have established a target completion date with only limited information. When budget costs are also fixed on the same basis difficulties can occur.

To incorporating Lean principles the customer's/end user's view of value must be fully understood and not simply assumed. It is then possible to understand how value will be delivered in design and in manufacturing, material supply and on-site assembly. Programming needs to allow for flow so that information, deliveries to site and on-site assembly are carried out when, and only when they are needed to meet the desired end date. Obviously as the programme progresses systems should be established to facilitate continuous improvement.

Traditionally each part of the project process is usually run sequentially with one stage finishing before the next starts. For Lean to work programming should break elements down into smaller chunks and allow some sections of processes to run in parallel. For example, it might well be necessary to carry out some of the detailed design before the completion of the conceptual phase or some of the off-site manufacture and fabrication may need to be carried out before completion of the detailed engineering design.

To allow this to happen, your client organisation may need to approach procurement in a less traditional way than usual to allow for concurrent engineering of the project as this requires input from contractors and subcontractors before the detailed design is completed. This will also allow a realistic programme to be established through a series of collaborative planning workshops, which will also ensure that delivery can be achieved in a shorter time than might have otherwise been possible.

Clients should be wary when offered proprietary Lean planning solutions but rather work to apply fundamental Lean principles to their own circumstances remembering always that waste elimination is the priority for Lean success.

Attacking waste does not only mean saving on capital costs. It will also:

- ▶ improve quality
- ▶ reduce time spent on site
- ▶ reduce accidents
- ▶ enhance sustainability
- ▶ increase the work satisfaction of all involved.

As we've said, after all, you are the client, so if you don't insist on collaborative improved performance from your supply chain leading to less wasteful, Leaner projects, who else is going to bother?

## **1.2 GREAT EXPECTATIONS – LEAN CONSULTANTS**

Lean transformations are always a big ask for any client organisation as they use valuable resources in terms of time, commitment and cost and require a degree of faith upfront before results have been obtained. So it is only fair that many clients challenge the appropriateness of using tools and techniques developed for use in manufacturing within building and infrastructure environments. It is important that this is clarified before progressing further to describe the principles of Lean and waste elimination.

Whatever assurances you receive from a Lean consultant, Lean tools and techniques seldom work as well in construction as they do in manufacturing unless they are suitably modified. It is certainly true that waste is waste, in whichever industry it is found, and that the underlying principles still hold good. The difference comes in how these principles are applied, and how the resultant tools and techniques have accordingly been adapted, not only within a particular industry, but within a particular organisation within that industry.

Every industry has different characteristics. This first needs to be experienced by anyone wishing to provide Lean advice at any level. Once this has been done it needs to be taken into account

when designing Lean interventions or transformations. The contents of Table 1.1 need to be thoroughly understood through practice rather than scholarship.

Every organisation has different characteristics. This is often called its culture. Culture represents the beliefs, ideologies, policies and practices of an organisation. It gives the employees a sense of direction and also controls the way they behave with each other. Some of the more important characteristics that will make your organisation's culture (or 'that's the way we do things around here') different to others, and that are most relevant to client organisations wishing to embrace Lean, are listed as follows and summarised in Table 1.2.

It is hoped that these tables confirm your view of the uniqueness of our industry and your organisation.

The remainder of this guide is written with this in mind and you are urged to read it with the same perspective.

Also, when seeking Lean advice, find somebody (the person that you are going to be working with is more important than the organisation they work for) who:

- ▶ has extensive experience of working within building and infrastructure organisations in traditional roles
- ▶ can show you a portfolio of Lean interventions and transformations that they have personally facilitated
- ▶ has a proven track record of coaching and mentoring all levels of people from board members to operatives within a building and infrastructure organisation
- ▶ has received Lean training from a manufacturer (rather than a training organisation) with a recognised Lean track record and further training specific to our industry
- ▶ is prepared to spend time getting to know your organisation
- ▶ does not try to convince you that you require a standard solution such as Six Sigma or Lean Six Sigma.

Toyota drew on the work of Deming (2000) in developing the Toyota Production System (Liker, 2004).

Toyota is perhaps the only organisation whose trainers and coaches will implore you not to copy them. Rather they will advise you to take away what you have learnt and then adapt it wisely to suit your own working environment because you are the experts in how your organisation and industry works.

The whole concept of 'Lean' resulted from observing Toyota and other companies that had copied them. Toyota don't seem to use the term. We will make frequent references to Toyota not in the belief that we in construction should copy them. Why ever would we? They mass produce cars using a manufacturing process. In fact, Toyota also has a construction arm.

We, for the most, construct one-off, bespoke building and infrastructure projects. There are many key differences although we should endeavour to understand the underlying principles of what Toyota do and then adapt them to the construction environment and, to a lesser extent, how our own companies work.

See Fraser, 2013.

**Table 1.1**      **11 things that make the building and infrastructure industry unique**

|  |
|--|
| An on-site construction or assembly process requires those adding value to work by moving over what they are making whereas during a manufacturing process the product being made usually moves through various work stations where value is added.  |
| Part, and in some cases all, of the work is affected by weather, causing discomfort, stoppages and making consistency more difficult than within a controlled environment.   |
| <b>Organisations of projects and project teams</b>   |
| Building and infrastructure work has traditionally been managed and accounted for on a project-by-project basis making learning and evaluating improvement from one project to the next more difficult than in manufacturing.  |
| Project organisation makes retaining the same workforce challenging. So learning is more difficult to capture and pass on. Most manufacturing organisations have a much more stable workforce and consequently don't have to accommodate these limiting conditions.  |
| Contractors and sub-contractors typically hire and reward project managers, site managers and foremen for their ability to fire-fight when things don't go according to plan rather than to make the plan correct in the first place. This is the opposite of what is required in a Lean culture and creates much of the waste we pay for on our projects.   |
| Contractors and sub-contractors still employ a 'craft' approach to work with operatives carrying out tasks in the manner they feel most appropriate. A Lean approach requires standard work to be employed by both operatives and management where jobs (rather than individuals) have a standard way of being done that is followed.  |
| Clients, contractors and sub-contractors within the building and infrastructure industry are frequently looking for quick fixes rather than longer term sustaining Lean transformations. Whereas Lean tools and techniques can help with the former, the true benefits and rewards can only be obtained with a longer term outlook. This must emanate from each client.  |
| Clients are increasingly outsourcing expertise that were traditionally in-house. This includes design, architecture, cost management and quantity surveying, project management, site supervision and inspection and health and safety and sustainability expertise. Without continuity of work, individuals from these suppliers will inevitably need to be trained in Lean principles for each project and will not have the same knowledge of your organisation's culture as would be if your own staff were doing the same work. |
| <b>Culture</b>   |
| The industry has always been, and continues to be, largely adversarial in nature.  |
| In general the workforce in construction is less familiar with being asked to contribute intellectually to the planning or detailing of tasks than production line employees.  |
| A that's the way we've always done it (TTWWADI) culture is endemic within construction. While there are signs that this is changing, many in the sector seem far less ready, willing or able to change than their counterparts in successful manufacturing organisations.  |

**Table 1.2**      **Why organisations have different characteristics**

|  |
|--|
| <b>The business</b>  |
| The nature of the business.  |
| The business's goals and objectives: the strategies and objectives designed to achieve results are a contributor.  |
| Values and reporting structures  |
| Reporting structure: whether the structure is tiered or flat.  |
| How the organisation handles its employees: how free individuals are to make decisions and participate in strategy planning leads to employee loyalty, for example.        |
| The physical environment: the space the organisation occupies, with common areas being particularly important.   |
| Work place: also relates to home life balance.   |
| Values: the beliefs at the centre of the culture.  |
| Heroes: the people that embody the values.   |
| Rites and rituals: interactions and routines that mean something symbolically.   |
| Stability: when staff and workers feel stable in what they are doing, there is a much greater tendency for individuals to be enthusiastic with regard to Lean involvement. |
| <b>Internal and external communications</b>  |
| The cultural network: the informal communication network that brings informal power.   |
| Language and communication: both in terms of internal and external communications.   |
| Clients and external parties: these make demands on the company and often dictate how responses are made.  |
| <b>Resulting behaviours and approaches</b>   |
| Innovation and risk-taking: organisations that are very prudent will often find change and improvement challenging as some degree of risk-taking is essential to move on.  |
| Attention to detail: where too much importance is placed on this there is a tendency to struggle with the big picture, creativity and idea generation.                     |
| Outcome orientation: an emphasis on what is to be achieved rather than on micro management is a key to Lean success.   |
| People orientation: it's people that collaborate, not organisations, and so again this is key to collaborative improvement.  |
| Team orientation: working in a team is another key element to improving collaboratively, so this is also extremely important.  |
| Individuals working within the organisation and their attitudes, mentalities, perceptions and interests.   |
| Aggressiveness: this type of culture was endemic in our industry of old and is still widespread. Failure to change will severely limit Lean success.                       |
| The industry remains male dominated (in some organisations more than others) that can result in a macho approach   |

## 1.3 WASTE IS SO MUCH MORE THAN WASTED MATERIALS

Waste can take many forms, including: unnecessary cost, reduced quality, increased project delivery time, more accidents, doing more damage to the environment and a reduction in satisfaction at work. Lean practices can address these, although before it is possible to do anything about waste, it is necessary to understand its origins.

Consider other departments within your own client organisation that provide you with information or a service, for example, finance, procurement or human resources. If you now think of yourself as their customer for everything that you receive from them, you should find little difficulty in identifying your own examples of each of the wastes listed in Table 1.3. Also, building and infrastructure related examples are provided for each. Taiichi Ohno, Toyota's chief engineer, was probably the first to formalise various categories of waste. These categories have become known as the 'seven wastes' (or MUDAs, to quote the Japanese terminology). An eighth is often added, as shown in the box:

**Table 1.3**      *The seven wastes (from Terry and Smith 2011)*

|                                    |   |
|------------------------------------|---|
| <b>T</b><br><i>Transportation</i>  | <ul style="list-style-type: none"> <li>◆ moving work-in-process from place to place etc</li> <li>◆ delivering equipment, incomplete orders</li> <li>◆ moving to and from storage.</li> </ul>  |
| <b>I</b><br><i>Inventory</i>       | <ul style="list-style-type: none"> <li>◆ excess raw material, WIP or finished goods causing longer lead times, obsolescence, damaged goods, transportation/ storage costs and delays etc</li> <li>◆ large site stores of materials</li> <li>◆ poor stock management</li> <li>◆ too much material compromising workspace.</li> </ul>   |
| <b>M</b><br><i>Motion</i>          | <ul style="list-style-type: none"> <li>◆ unnecessary movement of people and equipment that does not add value, including walking between different work places etc</li> <li>◆ walking between workplace and welfare facilities, manual paperwork processing</li> <li>◆ movement of materials and drawing information.</li> </ul>  |
| <b>O</b><br><i>Waiting</i>         | <ul style="list-style-type: none"> <li>◆ workers unable to do value-creating work, and capacity bottlenecks</li> <li>◆ waiting time between processes or for capacity to take the next step</li> <li>◆ documents awaiting updating or processing</li> <li>◆ equipment downtime.</li> </ul>  |
| <b>O</b><br><i>Over-production</i> | <ul style="list-style-type: none"> <li>◆ producing items earlier than needed or beyond specification</li> <li>◆ producing more than is needed</li> <li>◆ larger than necessary excavations, orders placed for same materials with different suppliers</li> <li>◆ generating waste through overstaffing, storage and transportation costs</li> <li>◆ can be physical or information that is produced.</li> </ul>   |
| <b>O</b><br><i>Over-processing</i> | <ul style="list-style-type: none"> <li>◆ taking unnecessary steps</li> <li>◆ multiple plant movements</li> <li>◆ inefficient processing, especially due to poor design or work planning causing something unnecessary</li> <li>◆ providing higher quality products than necessary, and produced to standards beyond specifications (BS)</li> <li>◆ work done to 'fill the gaps' rather than appear to be waiting, eg 'waiting for instructions'.</li> </ul> |
| <b>D</b><br><i>Defects</i>         | <ul style="list-style-type: none"> <li>◆ production of defective work or corrections, snags, not meeting specifications first time etc</li> <li>◆ inspections to reduce/remove defects</li> <li>◆ wrong information on drawings</li> <li>◆ production of replacements – rework.</li> </ul>  |
| <b>S</b><br><i>Skills misuse</i>   | <ul style="list-style-type: none"> <li>◆ losing time and ideas, skills improvements and learning opportunities etc</li> <li>◆ learning from one site not being used well on another</li> <li>◆ people working one or two levels down from their true capability</li> <li>◆ mismanaged health and safety.</li> </ul>   |

When your client organisation encourages, and engages with your architects, designers, contractors and suppliers to focus on eliminating these wastes the benefits enable our building and infrastructure industry to become more profitable. When the Lean tools necessary for the removal of this waste are applied with appropriate commercial models, contractual forms and collaborative, project centric behaviours 'profitable construction' can be truly achieved.

Your supply chain will become more profitable without the need for you to pay any more and your client organisation will benefit from lower costs, quicker delivery times, fewer on-site accidents and near misses, fewer snags on each and every project, much greater cost and time predictability, reduced material waste and fewer environmental impacts.

Your customers and end users will benefit from right first time delivery, at the time they require handover and at an improved price.

This is because the philosophy and practices contained within this guide focus on the elimination of waste, which we all pay for but benefits none of us.

## 1.4 UNDERSTANDING LEAN BASICS: WHY VALUE DOESN'T EQUATE TO COST AND WHY IT IS NOT THE SAME AS COST OR PRICE

As stated previously, Womack and Jones were the first to suggest the term 'Lean' for the way in which Toyota, and others that have managed to copy them, work. They suggest that Lean has five components that need to be achieved (see Table 1.4). It is important to note that value will rarely coincide with the price paid for something, which is different to its cost.

Price = cost + overheads + profit. In seeking to eliminate waste it's the cost of everything that is useful to understand, rather than the actual price paid.

Value is not the same as price as the customer may value other things too. When did you go out and buy the cheapest car you could find, irrespective of make or specification? Do you value functionality or style? The end users of the projects that we build also value things about it that they are prepared to pay more for.

When seeking contractors, consultants and suppliers for a project it is equally inconceivable why any buyer would always choose the cheapest option that seems to meet the technical specification. What does your organisation's procurement team do? In seeking a Lean provider the culture of the organisation and the experience of the individuals being offered are just two of the non-price factors that are crucial to success on a collaborative Lean project (see also Fraser, 2013).

**Table 1.4**      *Five components of Lean*

|   |
|---|
| <p><b>Value:</b> this must be defined by the customer. In construction, value-adding activities can be broadly defined as those that transform materials and information into something that the customer would be prepared to pay for. Non-value activities are those that do not. Everything described above as waste are non-value adding activities. A further category includes activities that don't add value and that cannot be avoided at the present. Checks carried out for legal compliance are an example of the latter.</p> |
| <p><b>Value stream:</b> the flow from raw materials to completed project. The value stream can be mapped between activities that add value to expose waste. Value streams exist both on site and across company boundaries from all raw materials being used on the project whether they arrive on site as a raw material (aggregate) or as a finished product (a lift).</p>  |
| <p><b>Flow:</b> in manufacturing the product flows through work stations or companies, each of which adds value. In construction projects it can still represent the flow in or between companies until materials and products arrive on site for assembly. Construction's uniqueness is partly that it is then the workforce who tends to flow over the project rather than the other way round. The construction programme can then flow in this sense.</p>   |
| <p><b>Pull:</b> all components and information are made and supplied at the necessary time to deliver the product or service to the customer at exactly the time the customer wants it. Perhaps this has always been the goal in construction rather than in manufacturing where mass production was pushed onto the customer. In construction one of pull's biggest enemies is excessive unexposed risk contingency.</p>   |
| <p><b>Perfection:</b> for both manufacturing and construction this represents an 'ideal state' that will never be achieved in the field. Striving for it by continuously improving through collaboratively identifying and removing waste provides the desired results.</p>   |

# 1.5 LEAN ASSESSMENT

Various methodologies exist to help you understand where you as an organisation or your project or supply chain are in terms of the Lean journey. Guidance by Smith and Terry (2011) features one such model to help in the assessment of Lean leadership or Lean readiness. Another can be found on the Highways Agency website.

# 1.6 FINAL THOUGHTS

Lean is as much about how you approach your role as a client, the management behaviours you demonstrate and the behaviours you encourage within your supply chain as it is about management systems and tools. There is no template for applying Lean and your approach will depend on a variety of cultural, commercial and other considerations. We will consider these further in Chapter 2.

In so doing, we have drawn on Demings *Seven Deadly Diseases* (Deming, 1998), which describe the most serious barriers that management faces in its current management actions, and Toyota's *True North Values* (Liker, 2004) meaning that they are at the core of everything that they do. Further details are provided in Box 1.2.

These provide a good place to start when developing you own approach for leading Lean building and infrastructure supply chains.

|  |                                       |  |
|--|---------------------------------------|--|
| Box 1.2<br>Seven Deadly Diseases and True North Values | <b>Deming's Seven Deadly Diseases</b> |  |
|  | 1                                     | Lack of constancy of purpose.  |
|  | 2                                     | Emphasis on short-term profits.  |
|  | 3                                     | Evaluation by performance, merit rating, or annual review of performance.                                    |
|  | 4                                     | Mobility of management.  |
|  | 5                                     | Running a company on visible figures alone.  |
|  | 6                                     | Excessive medical costs.   |
|  | 7                                     | Excessive costs of warranty, fueled by lawyers who work for contingency fees.                                |
|  | <b>Toyota's True North Values</b>     |  |
|  | 1                                     | Challenge.   |
|  | 2                                     | Kaizen mind (everybody naturally sees continuously improving as being part of their role and a way of life). |
|  | 3                                     | Go and see (at the workplace).   |
|  | 4                                     | Teamwork.  |
|  | 5                                     | Respect for humanity.  |



# Lean practice for the building and infrastructure client – a roadmap

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## 2.1 INTRODUCTION

In Chapter 2, we consider more closely how you can start planning and applying a Lean approach. We do this by introducing:

- 1 **Seven top tips:** Section 2.3 introduces seven key factors that need to exist for your Lean implementation to be successful.
- 2 **Four critical success factors:** Section 2.4 describes how behaviour and culture, commercial considerations, contractual approaches and appropriate tools and techniques are important to the success of your approach.
- 3 **Six steps to implementation:** Section 2.5 introduces a roadmap that you can adapt and apply to your own circumstances.

Chapter 3 considers each of the steps of this framework in more detail.

## 2.2 LEAN IS POSSIBLE FOR ALL CLIENT ORGANISATIONS

Benefits can be gained from adopting a Lean approach whether your client organisation is embarking upon its first building and infrastructure project or is a long established developer or government department with a rolling programme of work.

However, the method for adopting a Lean approach to gain the maximum payback for the effort employed may differ.

Lean initiatives can take the form of transformations or interventions. Transformations require a holistic change in working whereas interventions tend to apply Lean methodology at a specific point, typically where something is not going as well as planned. Accordingly transformations tend to be more proactive whereas interventions are typically reactive.

Both transformations and interventions can be applied to a project, company or supply chain. However, the commitment in time, cost and effort is much greater in the case of a supply chain transformation than for a project intervention and the payback period may be longer in the former case. As such clients with only one or few developments might rightly question the value of this level of commitment preferring to work on a single project transformation or intervention. Table 2.1 shows broadly where maximum returns might be found.

**Table 2.1** Where to find maximum returns

|                |                          | Project | Organisation | Supply chain |
|----------------|--------------------------|---------|--------------|--------------|
| Intervention   | Single development       | ✓ ✓ ✓   | ✓ ✓          | ✓            |
|                | Intermittent development | ✓ ✓ ✓   | ✓ ✓          | ✓            |
|                | Frequent development     | ✓ ✓     | ✓ ✓ ✓        | ✓ ✓ ✓        |
|                | Continuous development   | ✓       | ✓ ✓          | ✓ ✓ ✓        |
| Transformation | Single development       | ✓ ✓     | ✓            | ✓            |
|                | Intermittent development | ✓ ✓ ✓   | ✓ ✓          | ✓            |
|                | Frequent development     | ✓ ✓     | ✓ ✓ ✓        | ✓ ✓          |
|                | Continuous development   | ✓       | ✓ ✓          | ✓ ✓ ✓        |

Obviously there are all manner of shades of grey between these categories and generally the larger the project is and the longer it runs for the greater will be the payback at a transformational level.

Whatever type or size of client your organisation is, the project level is always a good place to start, and to learn, perhaps first with an intervention, when something has gone wrong, followed by a whole or part project transformation.

## 2.3 LEAN CLIENT LEADERSHIP – SEVEN TOP TIPS

Based on our earlier references to Deming (2000), we have adapted these to form seven top supply chain tips for building and infrastructure clients and these are provided as follows.

### 1 The requirement for Lean must emanate from the client and must be underpinned by actions.

The client should clearly describe their philosophy and create a vision with aligned goals. These must:

- ▶ be shared with the supply chain for every project
- ▶ be accompanied by clearly defined improvement expectations for the supply chain as a whole
- ▶ translated into agreed and realistic targets with strategically important first tier contractors, consultants and suppliers.

Progress should then be jointly monitored.

### 2 Long-term consistency of purpose is vital for clients that wish to reap the full potential of Lean.

This can be significantly undermined if there is an over-emphasis on short-term profits or figures that can be manipulated in the short-term to the detriment of the more sustainable long-term.

### 3 Organisational and personal performance should not be judged solely on financial performance.

Worker and supplier potential will not be maximised if they are judged only on financial criteria. Accordingly it is important to consider how things are done as well as what has been achieved financially. Also, when constructing a balanced scorecard or other supplier or project performance measuring and monitoring mechanism the quality of the relationship, sustainability and health and safety need to be considered alongside cost, project programme and quality. Also project programme and cost need to be considered in the

context of the level of waste within the project and performance of previous projects (if your client organisation carries out multiple projects and comparative data exists) as well as being viewed simply as a factor of predicted finish time and budgeted cost.

**4 Improvements should be continuous in nature.**

Using the plan-do-check-act cycle, or a derivative of it, all employees should be made responsible for the quality of their own work. Supporting daily improvement as being part of everybody's job is a key contribution that every client can make and support with appropriate questioning and encouragement on every site visit.

**5 Alliances are important enablers particularly if developed on a range of criteria.**

Mutually beneficial alliances with important contractors and consultants should be selected not only on price but with quality, delivery time, health and safety, sustainability and culture also being considered. Once these supply chain partners have been chosen a collaborative working partnership should be developed to maximise the effectiveness of any Lean initiative.

**6 Clients should encourage appropriate management behaviours within their supply chains.**

Clients should promote a supportive and facilitative approach to management and supervision using techniques such as coaching. Controlling and purely directive approaches should be discouraged. Similarly, such organisations should be encouraged to reward their staff for their ability to plan projects on a 'right first time' basis rather than rewarding them for fire-fighting when the plans they created in the first place go wrong. Clients need to establish this by example in terms of how they behave towards such organisations.

**7 Training, coaching, education and sharing knowledge is extremely important for Lean initiatives.**

Training needs to be at least in part carried out by doing by example at the work face. Knowledge is always best shared at the point of application, and is best achieved by encouragement and coaching. Accordingly clients should do all they can to progress this within their supply chains by, for example, encouraging cross-organisational knowledge sharing at the work face and senior management walking the project at least daily with a view to actively encouraging the disclosure of what has gone wrong (and also how it was corrected) rather than limiting their interest to what went right. Self-development is also an important commitment for Lean clients to make, as is being seen to 'walk the talk'.

Figure 2.1 illustrates how these principles were applied by BAA.

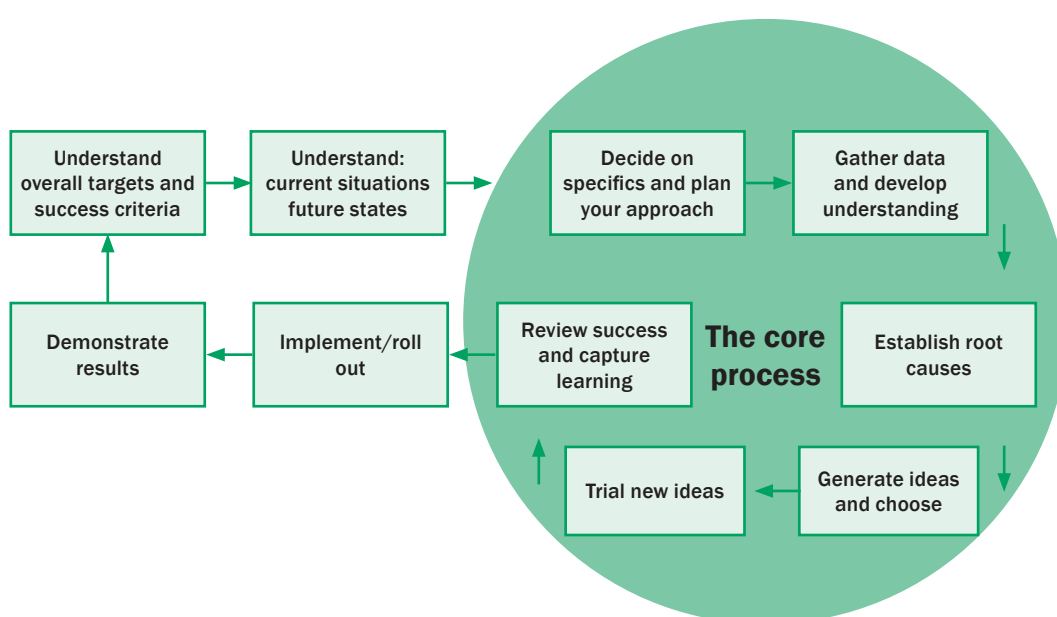


Figure 2.1 BAA plc Performance Improvement Toolkit 1995-2010

## 2.4 FOUR CRITICAL SUCCESS FACTORS

Although important, Lean tools and techniques alone are unlikely to deliver Lean to its full potential and must be supported by four other key factors. The importance of these together with deploying Lean tools and techniques to their full potential are explained here:

- ▶ Success factor 1: behaviour and culture
- ▶ Success factor 2: commercial considerations
- ▶ Success factor 3: contracts
- ▶ Success factor 4: appropriate tools and techniques.

### 2.4.1 Success factor 1: behaviour and culture

This is the most important delineator of Lean success.

**Top management buy-in, if only superficially, is a prerequisite:** the more top management demonstrate genuine commitment and support, the more likely it is that long-term improvements are achieved in a self-sustaining manner. This is further helped when the same corporate and framework leadership remain in place for the duration of a framework.

**Spending time understanding what each party wants is important:** better results are delivered, whether at a project or a framework level, when a client organisation spends time with their supply chain to fully understand what each wishes to achieve from the agreement.

**Treating each framework agreement as a single 'organisation':** bringing the management teams together to develop an organisational model, mission, vision, values, agreed level of improvements etc will produce better and more sustained results. Better results will be achieved if the next tier of management from all parties is invited to develop the lower level strategy including the plan for the first 12 months.

**Inducting everybody is vital:** Lean results will best be achieved where all members of both the client and supplier teams are provided with an induction that addresses both the culture and the techniques and tools that they might come across or be asked to use. Where this is the only Lean-related training that will be received it should perhaps have a duration of one or two days for supervisory and managerial staff (foremen and above) if it is to be fully effective. Cost and time challenges might be encountered but any investment made here will be repaid many times over by the later improvements of the results obtained.

**Choosing and training Lean champions from framework partner organisations works best:**

Lean champions are those who are given a more comprehensive training than most in terms of both soft and hard skills and then are empowered to facilitate Lean working within their own organisations. Better results are obtained where the:

- ▶ champions are chosen jointly by the framework supplier and the client from the framework supplier's team
- ▶ champions are provided with training by either the client or by the client together with an advisor
- ▶ champions are provided with training that has been very specifically tailored to the client organisation's project environment
- ▶ client continued to support the champion community.

These Lean champions are then more likely to deliver better results than where specialist consultants are brought in to carry out all the training or where the clients or the framework supplier's 'head office' or 'group' performance improvement or Lean specialists are used.

**Continuing the induction programme for new members of both client and supplier teams is critical:** failure to do this will soon result in cultural and technical ‘creep’. For example, if new members are not inducted culturally, so they don’t adapt new behaviours more in-line with the non-adversarial approach necessary for Lean to work, then cultural drift will occur over time. As new members of the team begin to outnumber the old, there will quickly be a return to more traditional confrontational behaviours and results will begin to decline.

**Clients and client teams must take the lead in demonstrating the right behaviours:** the client has to be the first to demonstrate the behaviours necessary for collaborative improvement. If the client, and just as importantly their consultants and managing contractors, fail to display the necessary trust, blamelessness, facultative non-directorial leadership style, and are not willing to share responsibility for both successes and failures, results will be limited and not be sustainable over time. Clients and their representatives must also demonstrate informed risk-taking, project-centric thinking (putting the success of the project before that of each individual organisation), creativity, and a strong sense of fun and enjoyment for what they are doing if this is to be reproduced throughout a project or framework agreement.

**Case study 2.1 Reducing waste using Lean tools, Wolverhampton University and NG Bailey**



**Figure 2.2**  
**Employing Lean tools**  
**such as observation**

Building client Wolverhampton University worked with mechanical and electrical contractor NG Bailey to reduce waste through employing simple Lean tools such as observations and root cause analysis. Once some basic training had been provided, workforce participation in the improvement project was encouraged with the supervisors and workforce being invited to run the project. It was felt that they were best placed to understand the processes that they used and were the real ‘experts’. All the analysis was carried out by the workforce and ideas for improvement came from them too. The improvement work resulted in a 40 per cent improvement in pipe fitting productivity with productivity for the job as a whole improving by 13.8 per cent.

## 2.4.2 Success factor 2: commercial considerations

**Let’s be friends:** alliance or partnering agreements or framework agreements should not be mistaken for an easy ride necessitating little more than being friendly or having lots of joint team building days out that have no direct relationship to the work in hand.

When this approach alone is used, any improvements made are likely to be very short-lived. If nothing more is done, even where open book accounting is in place, prices are likely to rise annually, quality might be reduced and accidents are likely to increase. This is simply because the traditional methods of checks and balances had been removed without anything being put back to replace them.

For example, ongoing checks on quality would stop without operatives being provided with the infrastructure, training or management support necessary to ensure that quality was truly perceived and treated as being each person’s responsibility.

**Open book irrespective of risk allocation:** if a client doesn’t understand the cost of the elements of the work that they are commissioning, how can they decide whether or not they are obtaining

good value or where the most important areas to start any Lean transformation work are? Open book doesn't only represent being open about how much everything actually costs (without profit, overheads, mark-ups, contributions to the centre, cross company charges and risk allocations) as important as this is. It also represents complete openness with regards to defects, time spent, environmental and social impact and the health and safety statistics (including near misses and reported hazards) for each element of each and every project.

The purpose is not to expose the contractor, consultant or supplier so that their prices and profits can be squeezed on the next job but rather to have clear sight of all the costs so that the cost of waste can be identified and eliminated.

Understanding cost at an elemental level is vital for a client who commissions work of a similar nature on an ongoing basis if they are to properly understand where savings have been made over time. This is best done at the activity level. For example, while knowing the average cost of constructing a road per metre is important in terms of high level budgeting, more needs to be considered for a client to fully understand and monitor performance. Firstly, understanding the overall costs of plant, labour and materials and then breaking that down further as necessary is important to direct improvement activity in the right areas for best results. Then it is necessary for the contractor to disclose how those costs are broken down with time by activity, and then by sub-activity, each time by cost and time, noting any particular health and safety and quality issues or significant environmental impacts. It is possible to build a picture over several projects to determine whether or not genuine improvements have been achieved. In terms of providing cost information at the tender stage, activity scheduling will provide a solid base.

Your client organisation should demand this level of detail irrespective of how the risk is structured within the contract. This might seem a little contrary in the case of a lump sum arrangement, for example. When a client enters into a framework agreement with one or more contractors for a particular type of work, that client presumably wishes to see improvements in costs over the life of the framework agreement, which could be as much as five or even 10 years. At the point of tendering, although the client will know the relative costs for each tenderer, there will be nothing to indicate how much waste is built into each submission. This can be ascertained by measurement as time progresses and improvements can be made. It is then necessary to track a direct relationship between these improvements and the effect this has on cost. While it is true to say that in the case of a lump sum contract no benefit will accrue to the client on this project, they will have a firm basis for achieving a lower fixed price on the next.

When several contractors or consultants have been appointed to carry out similar projects, understanding costs to this level of detail also allows comparisons to be made in a far more useful manner than simply understanding costs at project level. This is also a useful way of identifying areas of best practice and sharing knowledge.

**Targets are vital:** when contractors are procured to carry out multiple projects over a long period, improvements must be demanded by the client and these must be established as contractual obligations through the use of output targets relating to outturn costs, quality, delivery time, health and safety and environmental and social impact. Also, a client will almost certainly want to agree enabling improvement targets such as:

- ▶ an increase in the time spent on value added activities
- ▶ the number of improvement initiatives undertaken in a set period.

These targets should be jointly agreed and be realistic. If improvement information is shared this soon becomes a relatively simple and pain-free process. See also Smith (2013).

### 2.4.3 Success factor 3: contracts matter

Having a contract form that is supportive of collaborative improvement is important if the results of any Lean initiative are to be maximised. The following contract attributes should be considered when considering the specific form to use.

**Collaborative:** as has been stated throughout this guide, collaboration is a vital constituent of improvement and of successful Lean implementation of any kind. Historically, building and infrastructure contracts have tended to be just the opposite and inadvertently encourage adversarial behaviour. The NEC broke the mould and is truly collaborative in all its forms. With 20 years of use and written by those in the industry the suite provides a tried and tested collaborative contract form that can be used for consultants, contractors and suppliers. Other collaborative contract forms have also recently become available such as PPC2000.

**One size fits all:** during a building or infrastructure project it is possible that a client will wish to directly engage with contractors, consultants and suppliers. In collaborative arrangements intended to promote improvement it can be highly advantageous to have a common contract form for all. This promotes the feeling of equity, which is important as all parties must feel that they are being treated fairly by the client. Also, it allows the client to manage all contracts on the same basis, promoting simplicity and visibility, both of which are Lean attributes.

**Commercial models that promote improvement:** it is clearly important that any contract used best supports commercial models that promote Lean and so are most likely to deliver improved performance. Three of the most important of these attributes are:

- ▶ target costs
- ▶ shared rewards
- ▶ activity schedules.

So, the contract form chosen should allow these options.

**Overarching agreements:** it is often desirable for a client to have an overarching agreement with contractors, consultants and suppliers that are going to be working on a particular type of project. Framework agreements such as that used for Terminal 5 at Heathrow, are frequently used to accommodate this. This might initially be done directly to promote collaborative agreements or may simply be used by a client to comply with EU procurement legislation where such applies. In the latter case, clients may well later take the view that it is worth pursuing improvements as long-term relationships might have been created. It is important that the chosen form of contract can sit comfortably as part of such an agreement.

**Proactive change management:** traditional forms of contract seek to attribute fault rather than promote early resolution of difficulties that frequently occur when changes are encountered or asked for. It is important that the contract should lead the parties through a clear process that promotes the appropriate actions at the work face to ensure that the work needed to accommodate these changes is done quickly and cost-effectively.

**Risk management:** inappropriate management of risk is frequently an important source of waste in building and infrastructure projects. This can be because risk is inappropriately placed with parties that are not in a position to properly manage it or because elements are hidden in the form of undeclared contingencies. A contract should be chosen that promotes the concept of risk sitting with the party most able to manage it and risk being openly declared and visible to all parties.



## 2.4.4 Success factor 4: simple and appropriate tools and techniques. Learn to be present

In trying to replicate Toyota in the west, far too much emphasis has been placed on the importance of tools and techniques and far too little on how they are applied and the culture and behaviours necessary to support them. This tendency is predictable as tools and techniques are easy to introduce and, when they work correctly, produce the quickest and most tangible results. When these tools are then deployed without the appropriate changes being made to an organisation's culture to promote behaviours supportive of the use of Lean tools and techniques, inevitably improvements will be less pronounced than they otherwise would have been.

In terms of building and infrastructure projects there is a very strong tendency to seek solutions long before the root cause of the problem has been identified and properly understood. This is a significant challenge as contractors tend to employ those best suited to fire-fighting rather than those who are skilled at planning to allow Lean working or those who seek longer term solutions to problems avoiding the wasteful replication of errors that we see daily on our sites.

However, as a general rule the best Lean tools are usually the ones that make waste visible. Activity sampling (see O'Connor and Swain, 2013) is very strong with respect to this, particularly if observers are chosen from a variety of positions and roles from within the organisation being observed and your own. Check to see if your organisation has a philosophy for continuous improvement that could be used or adapted for Lean work.

Using the simplest tool to do the task that required the least amount of adaption will provide the best results. Introducing these through a fully coached methodology is the most effective for both short- and long-term results. As has been said previously, short-term success can be maximised, and that intended for the longer term will be most enduring, when such introduction forms part of a carefully introduced Lean change management programme including addressing cultural and behavioural issues.

A very important technique frequently ignored in the west is the power of 'mindful observation'. This is very different to simply

going and having a look round – which we can all do! Observing mindfully requires intent, patience and practice. Toyota use the term 'go see'. When a trainee comes back from looking they will ask them to do it repeatedly. The purpose of this is to help to develop the skill of seeing what is really happening and not just what is assumed to be happening. Worse still, we in the west seem desperate to report a solution and often jump to this as part of the observation without properly investigating or understanding what the root cause might be. To observe mindfully it is important to have as little else in your mind as possible to distract you (a technique used by many in eastern cultures is meditation. Kornfield (2005) offers a useful guide to start practising with).

Activity sampling is particularly useful for identifying waste and for helping others learn how to see it. Although there are more sophisticated tools available, Toyota's five whys is the simplest and most effective tool for identifying waste. Best Lean solutions are to be found when working with a group of those who have direct experience of the process that is being considered. Facilitation skills are essential and tools for idea generation and reaching agreement are important to master. These are every bit as important as many of the more complicated methodologies that are frequently peddled currently.

In terms of a process for improvement, the best starting place is a thorough understanding of Deming's PDCA cycle (Deming, 2000). See if some form of continuous improvement process has already been established within your own organisation that can be used. If not, try to write one for yourself that both uses Deming's principles but also suits the cultural climate of your own organisation.

This guide does not have the scope to explore the full range of tools available. Please see O'Connor and Swain (2013).

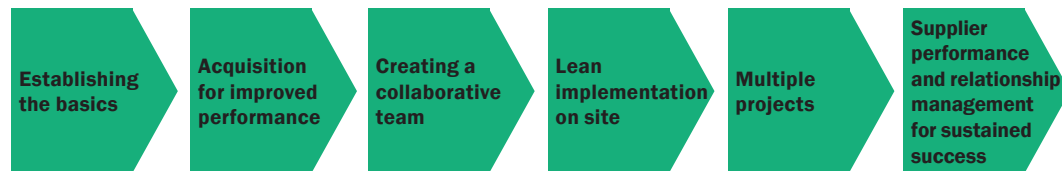


## 2.5 SIX-STEPS TO IMPLEMENTATION – A FRAMEWORK

The following six step framework provides an overview of how Lean can be introduced and implemented specifically from a client's perspective on building and infrastructure projects.

Having read Chapters 1 and 2, and using your knowledge of your own organisation, this should help you plan your approach at a macro level.

However, for those wishing to explore these steps further, Chapter 3 of this guide provides the detailed 'how to' walk through each step in the process.



*Six step framework*

# 3

## Six-steps to implementation – the detail

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### 3.1 INTRODUCTION

Having introduced the six step framework in Chapter 2, this part of the guide addresses the practice in detail on a ‘how to’ basis. It suggests how you might implement the principles when engaging with projects and/or organisations and/or supply chains that your organisation has tasked to construct building and infrastructure work on your behalf.

This chapter follows the six step framework introduced in Chapter 2.

- 1 Establishing the basics.
- 2 Acquisition for improved performance.
- 3 Creating a collaborative team.
- 4 Lean implementation on site.
- 5 Multiple projects.
- 6 Supplier performance and relationship management for sustained success.

Each step comprises a quick guide page followed by a more detailed explanation on collaborative Lean practice. Short case studies are also included to illustrate some of the points made.

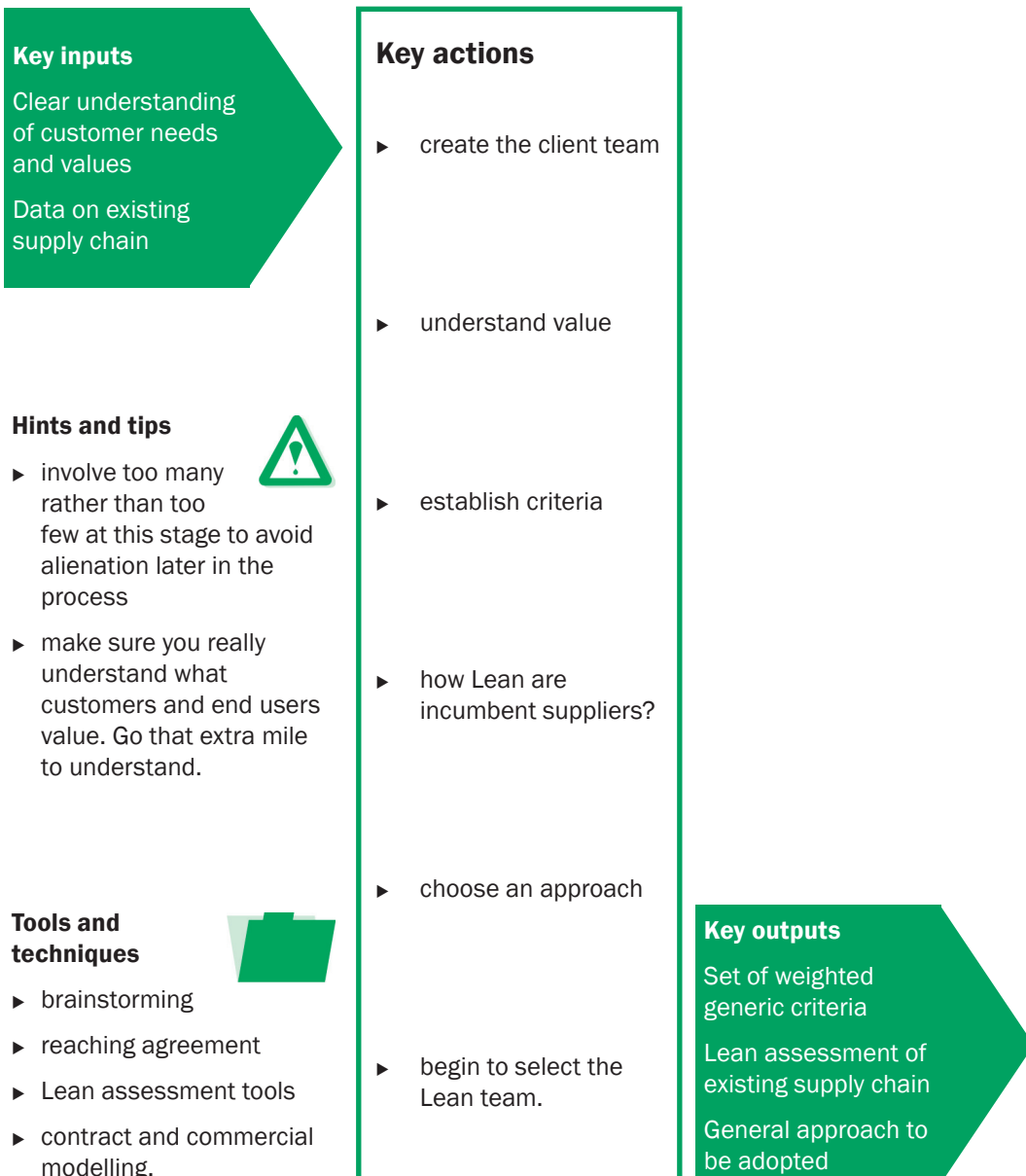
Although the practical advice provided is specifically for client organisations wishing to engage with, or create, Lean supply chains for their building and infrastructure work, others will also benefit due to the general applicability of Lean practices.

## Step 1: establishing the basics



### Who to involve

- ▶ the customer and/or end user
- ▶ procurement
- ▶ commercial management
- ▶ project construction
- ▶ maintenance
- ▶ operations
- ▶ Lean champion or other facilitator.



## 3.2 STEP 1: ESTABLISHING THE BASICS

- 1 **Create the client team:** most client organisations will have more than one individual responsible for defining a project's requirements. It is important to identify all those whose views and opinions need to be considered throughout the project at the earliest possible stage. The same is true if the intention is first to establish a Lean supply chain of contractors and suppliers who will be used for a commissioning client's building and infrastructure requirements over a period of time. In large client organisations this can involve several departments and individuals who will necessarily have different interests and concerns that will need to be accounted for when choosing the right team of consultants, contractors and suppliers. In many cases the number of individuals involved will be too great to include them all in all the decisions that have to be made and accordingly a core, representative team will need to be selected. While departments and individual roles will vary from one client organisation to another it is important that the team has an understanding of:
  - ▶ customer/end user requirements in terms of the customer's value preferences
  - ▶ the acquisition process including contract and commercial matters
  - ▶ project construction
  - ▶ building and/or infrastructure maintenance once the project(s) is complete
  - ▶ operating the facility
  - ▶ a facilitator, typically the Lean champion.

The advice of functional areas such as sustainability, quality and health and safety will also be needed, although it is not usually necessary to include these in the core team. It is not only important that the team truly represent the key areas of the client organisation as far as establishing a Lean supply chain is concerned, but that it is perceived to be. Adopting a Lean approach will inevitably mean change for the organisation and individual roles. For these changes to take place smoothly and quickly buy-in is essential, and if elements of the client organisation feel excluded this will not be forthcoming. Failing to recognise this at the earliest opportunity will inevitably lead to difficulties later on. Typically departments or individuals are omitted because they are perceived as being difficult or 'stuck in their ways'. Such issues need to be addressed initially by the Lean champion who may choose to provide or recommend coaching on a one-to-one basis. Once the team has been chosen the Lean champion may choose to hold a workshop to help the team understand their objectives and priorities. This will probably also be the first time that the team has worked together as a group and accordingly this session can be used to help the team begin to feel comfortable with each other. Inevitably every team will go through a process of 'forming, norming and storming' before they begin 'performing' (Tuckman, 1965) at their best. Although friction with the team needs to be managed to ensure that matters don't become personal, for example, generally it should be considered to be a healthy and natural part of team growth.

Box 3.1 The Velodrome, London



Courtesy Munkfishmonger

(go to: [http://upload.wikimedia.org/wikipedia/commons/b/ba/London\\_Velopark\\_Panoramic\\_-\\_Feb\\_2012.jpg](http://upload.wikimedia.org/wikipedia/commons/b/ba/London_Velopark_Panoramic_-_Feb_2012.jpg))

Before design started on the Velodrome for the London 2012 Olympics and Paralympics a team of top cyclists were assembled to provide advice on their requirements for racing. This understanding of what the users valued by the client, OCA and the designers, influenced the design of both the building and the track, even to the extent of the positioning of a toilet on the same level as the track for competitors' use immediately before racing.

- 2 **Understand value:** the first and arguably most important component of Lean is understanding value from the customer's or end user's perspective.

It is important that client organisations do not view themselves as the arbiter of value without reference to their customers or end users. Sometimes these are not one and the same thing as far as a building and infrastructure client is concerned. For example, the owner and operator of an airport will have airlines as immediate customers whereas the end users are the travelling public. While it might be tempting for a client organisation to solely rely on their immediate customer for advice regarding the end user's needs, independent checks are valuable as emphasis can be different. Where client organisations are in part monopolies, former government bodies, utilities or nationalised industries, they may be regulated by an agency established by the government. It is important that their priorities are also fully understood, and they may well require the improvement that the Lean initiative is being established to deliver. Shareholder expectations are also important to define and understand. Any organisation will have several stakeholders all of whom cannot be included. While it is important that their views are heard, this is best done through a member of the team or when the team consults a functional area of the organisation. For example, the department responsible for sustainability and corporate social responsibility will be able to advise on the stance of relevant pressure groups. Where information is not readily available it might be necessary to undertake some market research, perhaps in the form of voice of the customer (VOC) exercises. This will also help when establishing more detailed specification or quality function deployment (QFD). The latter was originally developed by Akao and Mizuno in Japan in 1965 for use in manufacturing and is now more widely used. It is an important element of design for Six Sigma and is included in ISO 9000:2000.

- 3 **Establish criteria:** the objective of this step is to establish the high level criteria that will be used for selecting consultants, contractors and suppliers, evaluating their performance on projects and on a project to project basis and to be able to determine performance of each project as a whole. Often these sets of criteria are not linked and this will inevitably lead to client dissatisfaction. Typically, price alone might be used at the acquisition stage and then a raft of other criteria used for monitoring performance with a separate and different evaluation being carried out for the project. While a QFD methodology can be used, serious consideration should be given to using a methodology that might be more familiar to those working on building and infrastructure projects. Such projects are frequently defined in terms of cost, quality and time. Health and safety and sustainability also should be added. Lastly, consideration should be given to including a factor to take into account a company's culture. There are many other factors that can be included too, but keeping things as simple as possible often pays dividends. The relative importance of each factor from the customer's perspective then needs to be established. As the members of the team have different areas of responsibility, it is these that they will often feel are the most important. Each criterion can be weighted if a balanced scorecard approach is used. It is by far and away preferable to reach consensus to determine these rather than just asking each team member to vote. Reaching consensus inevitably requires discussion and compromise, which best facilitates buy-in and involvement.
- 4 **How Lean are incumbent suppliers?** If you have an ongoing requirement to commission building and/or infrastructure work, you may have consultants, contractors and suppliers that you use on an ongoing basis and may wish to understand how Lean they already are and how suitable they might be to participate in your Lean journey. Various Lean assessment tools exist that will help you to determine this if you have no information to date (see O'Connor and Swain, 2013).

If you have been collecting information to monitor an individual supplier's performance or project performance, these measurements will also help you inform your decision. It should be noted that just because a particular supplier has no Lean experience they should not be ruled out automatically if they are otherwise performing well. In this case the use of a Lean readiness tool (see O'Connor and Swain, 2013) will help you assess how ready they are to embark on such a journey and how likely they will be to succeed in terms of attitude and culture. Although in this case it would be necessary to either train the supplier through an

in-house programme or ask that the supplier receive training elsewhere. Often, this can be preferable to re-sourcing as the latter will mean introducing a new, unknown supplier, which is an expensive process and comes with all the usual difficulties associated with introducing new suppliers to unfamiliar environments and working practices.

**Box 3.2** Lean Maturity Assessment Toolkit, Highways Agency

The Highways Agency use their Lean Maturity Assessment Toolkit (HALMAT) so that members of their supply chain can determine how Lean they are on a self-assessment basis. This covers:

- ▶ strategic use of Lean
- ▶ Lean leadership
- ▶ delivering customer/client value
- ▶ Lean structure and behaviour
- ▶ process flow
- ▶ standard work
- ▶ process control and quality
- ▶ planning, design and construction
- ▶ maintenance (of plant and equipment)
- ▶ supporting infrastructure.

For more information go to: <http://www.highways.gov.uk/>

- 5 **Choose an approach:** now is a good time to decide who will manage your organisation's or project's Lean transformation or Lean intervention. If you are already on a Lean journey as a company (rather than a supply chain) it might well be possible to use Lean champions that are already in place. This can either be done by using them directly or by obtaining their assistance in choosing and training a Lean champion specifically for the task from your building and infrastructure staff complement. Although initially potentially a little slower in start-up time it brings the distinct advantage of having a champion who is fully familiar with building and infrastructure projects. This is arguably harder to learn than the Lean elements of the role. If your organisation has not yet begun to become Lean, then the options available to you are to train an internal team member, only in this case Lean training and supervision will need to be carried out by an external organisation, or appoint a Lean consultant. If your organisation is doing anything other than a single project intervention then outsourcing this vital role completely would seem to be a false economy. Accordingly, if the latter route is chosen, it is imperative that the consultant chosen is prepared to transfer their knowledge to selected members of your team. More comprehensive guidance on how to select a Lean consultant can be found in Fraser (2013).
- 6 **Begin to select the Lean team:** this is the point at which a high level acquisition strategy should be developed. Discussion of everything relevant to such a strategy is beyond the scope of this guide. Accordingly, issues that need to be taken into account to procure suppliers for Lean projects and ongoing transformations are addressed, ie the guide describes what you should consider over and above matters that you would take into account traditionally. The main differences are described here:
  - 1 **The order of procurement:** architects, design engineers and cost consultants would normally be procured before the main contractor and any specialist contractor, which is generally logical because of the potential difficulties encountered in trying to select a contractor when there is no design or specification to tender against. However, the reason for wanting to depart from this in the case of design for Lean construction is that:
    - ▶ the contractor's expertise may well be necessary to produce the Leanest design to participate in concurrent engineering
    - ▶ to assist with the practicalities involved in designing to allow for Lean on site assembly
    - ▶ to consider the practicalities of off-site manufacture for some elements of the works
    - ▶ to provide advice on the cost implications of various elements of the design and decisions made by the client.

These can be achieved by employing the contractor as a consultant or by using an existing framework contractor etc.

- 2 **The contract type:** as described in Chapter 1 of this guide the contract type needs to encourage collaborative working, whether or not to use a framework approach and, if so, which suppliers to prioritise.
- 3 **The commercial model:** again this is described in Chapter 1 of this guide with some of the key considerations being the use of an ‘open book’ approach:
  - ▶ whether improvement targets should be a contractual obligation
  - ▶ whether or not to adopt a shared approach to improvements achieved and/or cost overruns
  - ▶ how to deal with defective work that occurs when a new approach or methodology is being applied
  - ▶ how the Lean work will be financed
  - ▶ whether particular suppliers should be considered (eg their strategic importance) and by who
  - ▶ how to track improvements across non-identical projects.

It is also necessary to decide how you will manage the selection process, the design and the project management. This will affect the order of acquisition. Do you intend to use in-house resources or are you going to hire in help? In the latter case, are you going to choose one organisation for the whole task or several specialist teams? These decisions are important as they will not only affect the order in which you acquire the consultants that you intend to use, it will inevitably affect how successful your Lean efforts are too.

- 4 **The selection process:** this may need to be modified from that normally employed to procure projects to permit the assessment of the Lean capabilities and potential of suppliers. This is described in Step 2 (Section 3.3).

## Step 2: acquisition for improved performance



### Who to involve

- ▶ the customer and/or end user
- ▶ procurement
- ▶ commercial management
- ▶ project construction
- ▶ maintenance
- ▶ operations
- ▶ external experts in relevant areas
- ▶ Lean champion or other facilitator.

### Key inputs

Weighted generic criteria  
Lean assessment  
Market intelligence  
Full set of needs and specifications

### Hints and tips

- ▶ don't make Lean experience a prerequisite, rather ensure the willingness to learn and collaborate
- ▶ don't be afraid to set hurdles such as open book
- ▶ ensure your contracts have improvement targets.



### Tools and techniques

- ▶ market assessment matrix
- ▶ attendance at trade fairs and professional seminars
- ▶ cultural assessment questionnaires
- ▶ assessment days.



### Key actions

- ▶ check your requirements
- ▶ look at the market
- ▶ further develop a Lean procurement strategy
- ▶ do the buying
- ▶ finalise the contractual targets
- ▶ complete the procurement.

### Key outputs

Lean procurement strategy  
A Lean supply chain as far as possible  
Agreed improvement targets



### 3.3 STEP 2: ACQUISITION FOR IMPROVED PERFORMANCE

- 1 **Check your requirements:** being as sure as you can be with regard to your requirements will reduce waste, cost and minimise delays later in the project or supply chain agreement. Extra time spent now, ensuring your project requirements and selecting your suppliers, will always pay dividends in the long run. It is often tempting to rush to market as soon as we believe we know what we want. How many changes did your organisation originate during the last project that they were involved in that didn't add to the cost or increase delivery time? Are you really sure that what you are proposing adds the maximum value to your customers and end users? Would they agree? Are you sure? Have you checked with them or do you simply think you know?
- 2 **Look at the market:** particularly if you feel that you are already behind time it is very easy to assume that you are fully familiar with the marketplace without carrying out the necessary research. It is worth bearing in mind too that this time round you are not only seeking an architect but a Lean architect, not just a project management firm but a Lean project management firm, and not just a contractor but one who can deliver improvements throughout each project and from one project to the next. Studying the market can be time-consuming, particularly if you intend to do more than a simple desk study, which is usually advisable. Again spending time here will pay dividends later, both in terms of saving time during the acquisition process as you will be able to more accurately define your requirements and being more likely to procure the supply that best suits your particular organisation and its needs. You might like to try:
  - ▶ attending trade fairs and asking questions of participants
  - ▶ attending, or at least seeing which organisations are speaking at, important Lean events
  - ▶ talking to existing suppliers
  - ▶ talking to other clients responsible for commissioning building and infrastructure projects. Particularly worthy of consideration might be those that might be a little further ahead in their Lean journey than your organisation is currently
  - ▶ attending seminars and conferences run by professional organisations such as ICE, RIBA, IPM and RCS.

|                |                          |  |
|----------------|--------------------------|--|
| <b>Box 3.3</b> | <b>Knowledge sharing</b> | Events in the US have tended to overshadow those run in the UK. Of particular note is the annual conference run by the Association for Manufacturing Excellence in the USA (not the UK division). Bearing in mind what it chooses to call itself, it is surprising that the Association covers every type of industry imaginable. For example presentations from the RAF and the health service regarding their Lean journeys have been available in recent years. It is one of few organisations remaining in the world that is run by the members for the members, in a truly altruistic manner, with the simple desire to share Lean knowledge. It is by far the most prestigious forum for Lean learning available anywhere and the best source of Lean information. |
|----------------|--------------------------|--|

- 3 **Further develop a Lean procurement strategy:** once you have completed the market research you will be able to complete and finalise the development of your Lean procurement strategy. You have already chosen your broad strategy headings and agreed the relative importance of each. It is now time to look at each individual procurement and consider how you are going to translate these into specific criteria for each supplier that you need to acquire and how the weighting will be applied over the various stages of the procurement process. Also remember that it is important to fully understand how you are going to assess each stage not just for core competence but for Lean knowledge and practice and culture too.
- 4 **Do the buying:** this guide is not intended to turn the reader into a procurement expert, so if this is necessary it should be sought elsewhere. The importance of having the knowledge and skill to understand and to select a culture that is right both for Lean and for your own organisation cannot be understated. If your organisation doesn't have the necessary pre-requisite skills in-house, it is worth either acquiring them or buying in some help with

this phase of the process. Such help would ideally be co-opted onto the core team for this process step so the team comprises both internal and external expertise. For example, you might want to run a Lean assessment day or need help with preparation of questionnaires. Two final points to mention:

- ▶ this process can be time consuming. Make sure you programme sufficient time. Rushing to a solution is ill-advised
- ▶ ensure that the key players who will be working with you attend all the selection phases and insist on reselecting individuals if circumstances change. Make it clear that members of the applicant company's sales and marketing team will be excluded at all stages should they be offered for attendance.

- 5 **Finalise the contractual targets:** now you have your Lean supply chain in place it is necessary to transform your selection criteria into performance criteria that can be measured year on year and throughout each project. These should be kept to a minimum and should not include key operating indicators. It is useful to ensure that all contracts have the ability to add targets annually to ensure they are 'real'. It should be noted that a key performance indicator (KPI) is what is measured, eg reportable accidents per million hours worked, whereas a target is a quantifiable amount of what is being measured, eg reducing reportable accidents to less than one for every million hours worked by the first anniversary of this contract. Targets should always be Specific, Measureable, Achievable, Realistic, Timebound (SMART). To do this it is necessary to convert the key performance indicators into hard targets that can be easily and visibly monitored on an ongoing basis. This should be agreed collaboratively with the supplier and should not be in the form of an instruction from the client if joint ownership is to be achieved. The benefits of achieving the targets should be clear and clearly communicated.
- 6 **Complete the procurement, announce the successful organisations and debrief those that didn't make it:** although this sounds obvious it can be overlooked or its significance underestimated. All the organisations tendering will have diverted a good deal of time and money into preparing the tenders and going through the various evaluation stages. It is important to make a decision as soon as possible and let the successful organisations know while at the same time arranging debriefing for those that were not selected. Please take particular care when debriefing existing organisations that have not been re-selected as the effects on their business can be profound. Avoid them getting to hear through the grapevine at all costs.

## Step 3: creating a collaborative team



### Who to involve

- ▶ top and middle management from supplier organisations
- ▶ top and middle management from your client organisation
- ▶ Lean champions
- ▶ everybody for cultural and Lean inductions.

### Key inputs

Lean procurement strategy.

A Lean supply chain as far as possible.

Agreed improvement targets

### Hints and tips



- ▶ hold separate workshops with each major supplier facilitated by somebody external to establish what they really want from working with you
- ▶ be gentle with site supervision in workshops, they may be more uncomfortable than you realise.

### Tools and techniques



- ▶ Lean and cultural workshops
- ▶ separate and joint facilitated workshops
- ▶ Lean and soft skills training for Lean champions
- ▶ Gantt charts.

### Key actions

- ▶ create the agreements
- ▶ agree Lean governance
- ▶ train Lean champions
- ▶ introduce the culture
- ▶ determine improvement methodologies
- ▶ create the plan

### Key outputs

Joint alliance agreements.

Agreed governance.

Trained champions.

An outline improvement plan

## 3.4 STEP 3: CREATING A COLLABORATIVE TEAM

- 1 **Create the agreements:** although these agreements are usually informal and have a certain symbolic nature they need to be treated as seriously as if they were formally recorded in the contract. If the contract permits incorporating the document, this should be given consideration as they are intended to provide the roadmap for future joint success. Agreements should not be filed and left on a shelf, but rather should form the core of the visual management system (O'Connor and Swain, 2013) used by all parties to the agreement. The agreement can be at company or project level. In either case the purpose is to describe what each party wishes to achieve and then to formally record how the parties to the agreement intend to work together. An inter-company agreement will typically have a statement of intent and desired outcomes from each party and then will focus on what the parties have agreed jointly in terms of the purpose, mission, vision, values, key objectives, governance (see point 2), strategy, systems, people, processes and organisation for working together. The final area to be covered should be the first stages of tactical deployment and areas for improvement. A project-centred agreement will be very similar although the focus will be on the actual project. It will seek to describe what the end user or client's customer wishes to achieve from the project and key high-level areas for improvement focus such as reducing the delivery time or accidents on site. The mission will also be in project terms.

At the start of a major runway resurfacing project at Heathrow, BAA plc held a project start-up workshop with key members of its supply chain extending over several days. Part of the workshop focused on understanding value from the customers' perspective and from this the team developed the mission of being 'the unseen workforce' as customers wanted uninterrupted use where permissible. This was even printed on all mugs used by site workers on the site to reinforce the message. The latter part focused on delivering improved value by reducing potential disruption by shortening the project programme. Designers and contractors worked together and established that considerable improvement in time and cost could be achieved if a second blacktop paver were deployed. However, this would only be possible if a longer night working window could be achieved than was currently permitted. Working with Heathrow's operations team uncovered that the root cause for the length of the window was contingency as contractors historically had not handed back the runway at agreed times. On a trust basis the window was extended for an hour, enabling the second paver to be deployed. On the first night the hand-back was five minutes late. On every subsequent night it was early. By understanding what was of most value to their customers and end users and focusing on that, the team completed the work at a reduced cost in two-thirds of the programmed time.

In either case the agreement is likely to be developed through a series of facilitated workshops. The first of these is likely to be run with senior members of each party to the agreement independently so that the facilitator can tease out all the underlying factors for each party wishing to participate and any fears they have. When done well, this can more than pay for the cost of all the workshops. The next step would normally be for these more senior members of each party to come together to have the results of the individual workshops fed back, to resolve any remaining issues and to develop the purpose, mission, vision, values and key objectives. These will set the tone of the agreement and describe, in behavioural terms, what it will feel like to work as part of the agreement. These outcomes will then be fed to the participants of the next workshop, comprising the middle managers from each party who will be fully deployed working on the agreement of project. Again, this workshop should be managed with its purpose being to

disseminate the outcomes from the first workshops and to then develop the more detailed and practical aspects of how those outcomes will be achieved. A final round of facilitated workshops should then be held, with the participants being those working at a more tactical level in the agreement or specific project. They will consider how everything has been developed so far can be applied to the area that they work in or the specific discipline that they are involved in. At the end of the process a full agreement will have been developed in which all parties involved to date should have participated. This will have the obvious benefits of not only capturing best knowledge, but also in creating the culture of involved joint participation that is necessary if full, sustainable success from any Lean initiative or transformation is to be achieved.

- 2 **Agree Lean governance:** this is mentioned specifically because it is a particularly important part of any agreement and can be easily overlooked. A person from each organisation party to the agreement needs to be nominated as a principal contact and their main responsibilities need to be clearly defined as far as the agreement is concerned. If an executive of some kind, either for the project, a bilateral agreement or several agreements is to be used, then its terms need to be clearly defined and its members stated. Any evaluation procedure needs to be clearly specified as do the timescales for meeting. Typically, these would be annually or six monthly for the executive and at least quarterly for the evaluation teams. Consideration should also be given to the possible advantages of adopting a Lean co-ordination team. It is important that it is stated in the governance document that discussion in the evaluation meetings should be open if the client is to derive maximum benefit from them. It is also important that evaluations should be two-way. Although this might initially seem counter-intuitive to clients new to working collaboratively for improvement, the gains to be made from promoting an open and honest dialogue cannot be understated. Lastly, a resolution procedure should be included. This is an informal device intended to reduce the risk of more formal contractual disputes arising and should contain a resolution ladder where members from each team are identified who can be contacted when agreement cannot be reached at a particular level of interchange.
- 3 **Train Lean champions:** once the Lean champions from the various supplier organisations have been chosen, they need to be trained. The advantages to training being provided by the client's own Lean champions are discussed in Chapter 1 of this guide. It is important that such training should address soft as well as the harder, more tangible skills needed for Lean skill deployment and that the culture and values needed for the agreement should be fully explored. The training should be participative in nature and might follow the form of a period of classroom work being followed by each champion carrying an improvement project within their own organisation that is supervised by the client's Lean coach. A day can then be allocated where prospective Lean champions come back to share their experiences and present the results to a senior member of the client team.
- 4 **Introduce the culture:** in an ideal world all organisations that the client intends to have collaborative improvement agreements with will be on board more or less at the same time. This is seldom the case and in a single project scenario, where there are no 'incumbent' suppliers, it is usual that the various types of suppliers will be brought on board at different stages even though this isn't ideal from the perspective of achieving the best Lean results. This means that training the Lean champions and providing cultural assimilation sessions will need to be carried out over a period of time. In the latter case the need is to help new members of the team learn and experience the culture necessary for improving collaboratively through the adoption of Lean techniques. The sessions are really intended to provide participants with a sense of 'this is what it feels like to work around here' as well as what to expect to see and participate in when invited to join an improvement team. All members of all organisations directly involved or dealing with the agreement should attend in a controlled manner. This attendance should be compulsory and should include staff at both managerial and operative levels. Once the initial training is complete there will inevitably be staff churn. Newcomers need to undergo the same cultural induction as the original members of the agreement if cultural drift is to be avoided.
- 5 **Determine improvement methodologies:** at this stage in the agreement this is done at high level and is intended to provide a broad outline of how the team intend to approach improvement activities and where they might start. At this time the team will need to consider whether to adopt a broad, shallow approach or tackle an opportunity in a deeper, but narrow manner. At the beginning of a Lean transition the latter is often preferred as it provides tangible results more quickly. Consideration also needs to be given as to whether collaborative improvement activities will take place in the form of continuous improvement initiatives or whether the technique of stopping work and using a rapid improvement event should be considered. While a combination of the two is probably most effective, building

and infrastructure projects seldom employ the latter because of the perceived disadvantage of stopping work and losing time on the 'programme'.

- 6 **Create the plan:** it sounds obvious to stress the importance of creating a specific Lean transformation plan. While it is both obvious and important, it is frequently ignored. Clients and contractors that spend months developing over-complicated and unintelligible project programmes and plans will sometimes completely disregard the value of having any plan at all for improvement activities, leaving all their Lean work to date to gather dust on rolled-up flip charts or typed up and assigned to death by electronic filing. Both are enemies of any organisation wishing to embrace Lean. Indeed, those who wish to succeed with their Lean transformation should perhaps spend less time planning to deliver waste and more in planning how to remove it!

## Step 4: Lean implementation on site



### Who to involve

- ▶ customers
- ▶ client's design/specifying team
- ▶ contractors
- ▶ sub-contractors
- ▶ suppliers
- ▶ architects
- ▶ design engineers
- ▶ interior designers
- ▶ project management.

### Key inputs

Joint alliance agreements  
Agreed governance  
Trained champions  
An outline improvement plan

### Hints and tips

- ▶ don't think of BIM as a solution. It's a bit of software. The solution comes with the willingness to collaborate for the common good of the project and a lot of hard work.



### Tools and techniques

- ▶ BIM technical and collaborative workshops
- ▶ design challenge workshops
- ▶ project start-up workshops
- ▶ Lean implementation tools
- ▶ champion support system.



### Key actions

- ▶ make full use of Building Information Modelling (BIM)
- ▶ challenge the concepts
- ▶ challenge the detail
- ▶ hold project-specific workshops
- ▶ support the champions implementing the plan
- ▶ collect the results and celebrate success.

### Key outputs

A Lean design concept  
A Lean detailed design  
An improvement plan  
First round of project improvements

## 3.5 STEP 4: LEAN IMPLEMENTATION ON-SITE

- 1 **Make full use of BIM:** Building Information Modelling (BIM) is a digital representation of physical and functional characteristics of a facility. A BIM is a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life cycle, which is defined as existing from earliest conception to demolition (National BIM Standard, United States NBIMS-USTM). BIM is discussed in more detail by Dave *et al* (2013) and is mentioned here for completeness and to emphasise that the model produced will only be as good as the willingness of those invited to participate to share information openly. The right cultural climate is essential for this, which must encourage open challenge and dialogue. Modelling systems such as BIM produce enormous opportunities for successful waste elimination, but will not deliver success alone. This lies entirely in the hands of the participants. Protectionism and adversaryism must be left behind. The model is best developed over a series of facilitated workshops throughout the project where the facilitator initially uses their expertise to help participants understand the concepts involved in the actual model, and just as important as those necessary for working collaboratively to improve and drive out waste throughout every stage of a project. If run skilfully, these workshops also provide an ideal opportunity for team building. It should be noted that BIM should permit virtual construction of a project before work starts on site with the obvious potential to drive out waste of all varieties. Thinking about BIM as something to eliminate service clashes is to hugely underestimate its potential as an aid to improving collaboratively. Inputs from the main contractor, sub-contractors and suppliers are every bit as important as those from designers and architects, and clients have a key role in both insisting that this happens and then demanding the results in terms of benefits. Again attributing contractual improvement targets to the modelling process should be seriously considered by the client as big efficiencies with the consequential reduction in cost should be forthcoming from designers as well as those building the project.
- 2 **Challenge the concepts:** part of the challenge described here will come at the inception and feasibility stages of any project. Potentially this is where some of the biggest savings can be made as it might be possible to think of the scheme in a way that is easier to build or challenge the necessity of various elements of the project completely. To do this fully it is necessary to have contributions from your customers and end users and contractors and sub-contractors and suppliers where their activities have a major bearing on the project. These inputs in conjunction with using BIM to its full potential will also highlight opportunities for off-site pre-fabrication and pre-assembly. How the project is approached at this stage can also greatly assist in permitting detailed design that best affords a Lean approach. Everything must be up for constructive challenge by any party and all parties must come to the table as genuine equals prepared to learn from each other's skills and experiences. It is up to you, the client, to set the right climate for this to happen, not only by insistence, but by example too.
- 3 **Challenge the detail:** as in the concept and feasibility stages of any project the opportunities for Lean improvement during the detailed design phase are often under-exploited. Having a contractor on board (eg via an existing framework agreement or procuring the contractor for the specific building or infrastructure work in question in advance of the detailed design), will greatly assist in several ways:
  - ▶ enabling concurrent engineering
  - ▶ developing suitably market-driven performance specifications
  - ▶ identifying practical parts of the design suitable for off-site manufacture
  - ▶ ensuring that designs are cost effective in terms of keeping the number of components that need to be specially manufactured, rather than are available from stock, to a minimum.

It is recommended that, when choosing a suitable contractor, consideration is given to applicants' previous success in helping in this manner. Genuine contractors that do a decent proportion of the construction with their own direct labour and that have good,



Clients Anglian Water worked with their supply chain and used off-site manufacturing processes to create a chlorination station as a standard product for all their sites.

This enabled:

- ▶ reduced on-site construction activities
- ▶ assured visual appearance and right first time build quality
- ▶ reduced material waste and embodied carbon
- ▶ reduced health and safety risks due to less work on site
- ▶ simultaneously generated savings expected to be greater than 20 per cent.



**Figure 3.1**  
**Use of off-site manufacturing**  
**– standard product**

ongoing relationships with suitable major sub-contractors and suppliers in the area of work concerned, will usually be much better placed to give this advice than firms of construction managers that do not carry out the construction work at all and are in effect another form of consultant.

If you have chosen your architect, design engineers and interior designers wisely they will be fully conversant with the concepts of Lean design and will be experienced in working creatively with a 'Lego kit' of standard components rather than wishing to provide a design that requires its components to be created as 'one-offs'. Simplicity is often the best principle to follow for the best Lean solution and design is no exception. If you want a signature building there's no need to abandon these Lean techniques to achieve it. Adopting a Lean approach will significantly reduce your budget too.

It may be necessary to hold further workshops at the start of detailed design to support the use of BIM, introduce the new members of the team to the culture and to 'practise' working together.

- 4 **Hold project-specific workshops:** throughout the life of the design and construction of a project it can be advantageous to hold project-specific workshops even if the consultants, contractors and suppliers all have framework agreements and accordingly have gone through several workshops to establish with your client organisation already. These project-specific workshops are in some ways similar but have the project as the focus. Initially, a similar format can be followed to that outlined previously. This time the purpose will be to establish a clear, common understanding of the main reasons for constructing the project:

- ▶ creating a project specific mission statement, vision and set of values
- ▶ to construct project objectives, strategies programmes and plans
- ▶ and to identify the most appropriate people, systems and structure for the project.

These workshops may well need to be carried out throughout the life of the project or at the main points when new team members arrive on the project or when a particular project phase ends and another begins. While some of the work will have already been completed, the finished results will need to be shared with the new arrivals. Plans will inevitably be different for the different phases of the project both in terms of content and focus and adjustments may well need to be made. Individuals who are new to the project will also need to have cultural inductions to ensure they both understand and are practised at collaborative working for improved performance.

Two other important reasons for holding project-specific workshops are to provide:

**Teamwork:** these workshops provide a suitable environment for practical team-building without the necessity of having to take teams of people into the wilds to carry out exercises that have little if anything to do with the project. A skilled facilitator with a Lean construction-related background will be able to use the workshop to build teams as effectively as an event geared specifically to team-building while at the same time helping the team to produce tangible results that will aid project progress and improvement in the most practical sense. An example of such a workshop is a collaborative planning workshop (O'Connor and Swain, 2013). Although these are usually held at the beginning of the construction phase, consideration should also be given at the beginning of concept design and again at the start of detailed design. These workshops will then form the basis for ongoing collaborative project management where supply chain members are brought together on a weekly and daily basis to discuss plans for that time period. Case study 3.1 provides an example of a collaborative planning workshop.

#### **Case study 3.1 Collaborative working**



**Figure 3.2**  
*Teamwork – adopting a collaborative approach*

The discovery of an Anglo Saxon burial ground put the John Lewis Partnership's (JLP) plan to open their new store in Wallingford in jeopardy. Once the 200 bodies had been exhumed the project was nine weeks behind schedule. The main contractor, the Pearce Group Ltd, visited all suppliers' senior management, and then invited their site teams to a series of collaborative workshops. This gave the team the opportunity to really think about and understand every aspect of the project, before arriving on site. By looking in detail at the design stage together during these workshops the combined team quickly realised where significant time and cost savings could be made. The collaborative approach fostered a commitment to deliver the project programme, and everyone worked as a team at every step. The whole team showed a willingness to continue learning and applying 'Lean construction' techniques delivering the project to a delighted client with the original programme, a saving of 16 per cent.

**Improvement plan:** it is important that the client understands the improvement process so that they can be supportive on site visits by asking relevant questions. This is briefly described here for this purpose. The Lean team should consider providing more senior members of the client team who might be unfamiliar with the concepts of Lean and its application with 'cheat sheets' to prompt them to ask the right questions on site visits. One of the most positive effects that a client can have to create the correct atmosphere for collaborative improvement is to ask 'what has gone wrong today and what have you done towards putting it right?' rather than the traditional inspection where everything is expected to be found perfect in terms of time and quality.

The best Lean results will always be obtained if a well thought-out, coherent plan is developed and then deployed for a project. All too often engineers and project managers will use over-sophisticated and accordingly 'un-Lean' planning tools to plan the actual project, but will assume that improvement activities will simply happen. They won't. It will be difficult enough for the Lean champions to obtain sufficient time away from normal project activities even with a plan. Without one, success will not be maximised. Again, on the limited occasions that an improvement plan is formally developed, it is usually confined to the construction phase. Missing the design phases will significantly limit the contribution that Lean solutions could make to the project. As was stated earlier, improvement activities can either be planned on a continuous basis or where rapid improvement techniques are deployed (O'Connor and Swain, 2013). The best practice is to look at each improvement project on a case by case basis rather than trying to adopt one or other of these improvement techniques for the whole project.

There are a variety of alternative possibilities for creating an improvement plan, detailed discussion of which is beyond the scope of this guide. However, as a general outline, there will typically be four phases to the plan. The first will look at where the most benefit might be achieved in terms of areas of focus and will typically use value stream mapping (O'Connor and Swain, 2013), Pareto analysis and cause and effect analysis for the project as a whole to identify areas, phases or work packages where time spent deploying Lean tools and techniques are most likely to deliver the best results. Each opportunity will then need to be addressed through continuous improvement or by holding a rapid improvement event. Once waste has been identified for each opportunity and the root cause identified, the second phase can begin. The PDCA cycle can form the basis for this.

Here creative solutions are sought particularly from those involved on the front line in the areas in question. This work will again be managed by the Lean champion who should involve the middle management of the area of work concerned if their alienation is to be avoided. Although their participation is not strictly necessary in terms of creating the ideas, they need to be involved in some way that neither leaves them feeling left out at the periphery or that inhibits more junior members of the management team and workers on the front line from participating. In construction, middle management will have typically used a 'command and control' management style and they will need training and coaching to encourage them to adopt a more facilitative, democratic approach. Once ideas have been collected and fully discussed, the third phase can begin.

This involves drawing in the ideas together and choosing the one most likely to be successful. The idea then needs to be fine-tuned and trialled. When the results of the trial have been determined changes can be made and another trial held if success was not as expected. If this second trial still does not produce the desired benefits, then the second most liked idea can be tried and so on until the results wanted have been obtained.

The fourth phase is then to roll the new idea out to the rest of the area of the project in question or the project in its entirety if appropriate. Here proper management of the people issues resulting from change for all those involved in the change, even at the periphery, is important. As in any change, people can easily make the change a success or a failure even where the solution is a good one from a technical point of view. Like the improvement, the introduction of the change needs a comprehensive plan.

- 5 **Support the champions implementing the plan:** the Lean champions will be leading and facilitating the Lean improvement initiatives described in the previous point. They are likely to be doing this full time or for a significant part of each day. It is very easy for them to become isolated and feel abandoned, particularly if they are new to the role. They also may be working away from their own companies. To limit the effects it is important for the client to do all they can to assist in providing a Lean champion support network. This can range from:
  - ▶ providing a Lean champions' website
  - ▶ taking an active interest in what the champions are doing
  - ▶ attending workshops when asked
  - ▶ providing Lean awards and acknowledging best practice in other ways
  - ▶ regular reliable feedback with regard to Lean improvement targets
  - ▶ establishing a Lean champions' forum formally with the governance of the venture as a whole and for each specific project
  - ▶ funding evening events where Lean champions lead some Lean work alongside a social event
- 6 **Collect the results and celebrate success:** formally collecting the results and then showing how they translate into tangible benefits can easily be overlooked or underplayed in the heat of finishing a project. This is a mistake that sometimes cannot be rectified later as those involved in the project will have dispersed (Smith, 2013). While this is beyond the scope of this particular guide, readers may find the real examples helpful.

Once the results have been analysed and the benefits evaluated and communicated, then please be sure to celebrate success with the whole team.

## Step 5: multiple projects



### Who to involve

- ▶ strategic suppliers
- ▶ holders of historic cost, quality, delivery time, health and safety and sustainability data
- ▶ Lean champions
- ▶ improvement teams
- ▶ internal and external customers and stakeholders.

### Key inputs

Joint agreements  
Agreed governance  
Trained champions  
Improvement plans  
Lean designs

### Hints and tips

Don't give up on trying to collect historic data from old projects. It doesn't have to be accurate to the last digit although the QS will want it to be. It's tough because we account project by project. Make collection a routine in the future.



### Tools and techniques

- ▶ value stream mapping
- ▶ Pareto analysis
- ▶ data collection
- ▶ mindful site observation
- ▶ knowledge sharing at the point of delivery.



### Key actions

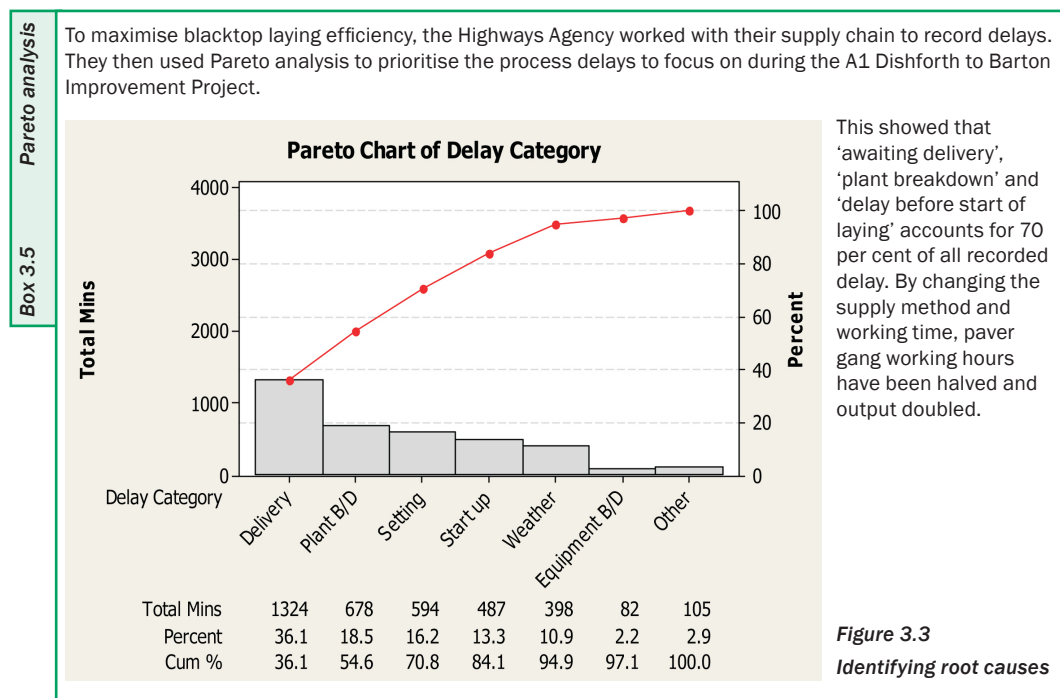
- ▶ prioritise suppliers
- ▶ Pareto the impacts
- ▶ choose projects for focus and allocate the work
- ▶ work with each project
- ▶ share knowledge
- ▶ collect results and celebrate success.

### Key outputs

Value stream maps of impacts  
Detailed annual Improvement plan for all projects  
Results

## 3.7 STEP 5: MULTIPLE PROJECTS

- 1 **Prioritise suppliers:** in the situation where a client commissions several similar projects over time, it is appropriate to consider first the consultants, contractors and suppliers involved. For example, in general framework agreements will only be administered for the most strategically important organisations in the supply chain, but even these can be differentiated by considering spend and strategic importance. At the same time the likely ease and effect of possible improvements can also be considered. Pareto analysis is another useful tool to deploy for this purpose, allowing focus to be given to the top 20 per cent of the supply chain that represents 80 per cent of expenditure. Organisations might not only be identified in terms of cost saving benefits. Accidents, environmental impacts or quality could also be used if these were considered to be the major focus for improvement activity. Organisations under consideration need not necessarily be first tier as significant possibilities exist with those in the second, third or even fourth, depending on improvement priorities.
- 2 **Pareto the impacts:** once the most important members of the supply chain have been identified in the terms described in point 1, it is important to look at the effects they each have and the waste that they generate across several projects. This task isn't as easy as it might sound as this information will be collected for each project and will then be filed – if it exists at all. Once the information has been collected, Pareto analysis and value stream mapping are both useful tools to discover areas of focus that can often be surprising.



- 3 **Choose projects for focus and allocate the work:** the next step is to identify suitable projects from those in your building and infrastructure pipeline to focus on what gives you the best opportunity for improvement. It is preferable, particularly in the early stages of a Lean transformation, to try to focus on projects that will produce the desired improvements easily and quickly rather than try to engage everywhere simultaneously so that demonstrable results can be obtained. The improvement tasks can then be given to the appropriate Lean champions.
- 4 **Work with each project:** the improvement activities can then be carried out in the manner described in step 4 on a project-by-project basis, although some improvement projects may span several building and/or infrastructure projects.

5 **Share knowledge:** it is important that knowledge be shared not only as work moves from one project to the next, but also within a project. This is always best carried out at the point of application or where the work is being carried out. However, this can be difficult as asking for help can be considered a sign of weakness in construction's competitive, male-dominated, environment. Accordingly, this must be encouraged.

6 **Collect results and celebrate success:** in the same way as for a single project, demonstrating success from project to project in real terms should be a client's main focus. Showing what the savings have been from one project to the next is much more important in terms of demonstrating that waste has been removed than showing savings against budget, unless the level of waste has been forecast alongside the budget. This is simpler for clients who commission projects of a similar nature over time. Where projects are less similar, but use some of the same elements, a shopping basket approach can be adopted. Once the improvements have been identified it is important to publicise them in terms of the benefits realised and then to celebrate success in the same way as for a single project. Once waste has been identified and removed and real saving have been made, clients might like to ensure that these saving are returned and are not spent in some other way, for example to offset an area of overspend (see Smith, 2013).

BAA plc, the main contractor and the second tier contractor partner responsible for concrete production, decided that it would be cost effective to purchase a new concrete batcher to meet the demands of their new concrete paving machine. When the batcher arrived it was unable to produce concrete at the rate that the manufacturer had claimed. As the manufacturer was unable to help, a rapid improvement event was organised. Online production was stopped following observations and measurements. Root causes for the problems were determined and modifications made. This was done without any specialist mechanical knowledge as far as the batcher was concerned. The end result was that when the batcher came back into production it was able to deliver at a 130 per cent of its stated capacity.

## Step 6: supplier performance and relationship management for sustained success



### Who to involve

- ▶ joint executive
- ▶ key supplier contacts
- ▶ key client contacts
- ▶ Lean champions
- ▶ project managers
- ▶ internal and external customers for evaluation.

### Key inputs

Performance against target  
Data from projects  
Data from pan project improvement  
Initiatives

### Hints and tips

Although it's in everybody's interests for your Lean initiatives to be successful, please avoid the temptation to join the conspiracy of mediocrity where clients blindly accept the information provided by managing consultants and main contractors. Challenge and then 'go see' for yourself!



### Tools and techniques

- ▶ balanced score card
- ▶ supplier positioning matrix
- ▶ supplier preferencing matrix
- ▶ cost-benefit analysis for improvement activities
- ▶ review meetings.



### Key actions

- ▶ develop a strategy
- ▶ differentiate your suppliers
- ▶ understand the costs and benefits
- ▶ choose the right resource
- ▶ create balanced scorecards for each supplier category
- ▶ awarding more work or letting go.

### Key outputs

Supplier and project balanced scorecard  
RAG status and targets for suppliers and projects  
Supplier league tables



### 3.8 STEP 6: SUPPLIER PERFORMANCE AND RELATIONSHIP MANAGEMENT FOR SUSTAINED SUCCESS

- 1 **Develop a strategy:** whether your organisation commissions occasional projects or has an ongoing requirement lasting several years and involving multiple projects, your organisation's ability to manage its supply chain appropriately will have a considerable bearing on the success of your Lean interventions and transformations. This step is largely concerned with how your organisation manages their suppliers (consultants, contractors and suppliers) once they have been acquired.

Before each round of sourcing, or at least annually, it is advisable to develop a sourcing strategy that, in part, will address how the performance of those suppliers, and your relationships with them, will be managed. If this has not been done, then it is important to address it before deployment on project(s). This is to maximise return on investment of effort, skill and resource in managing suppliers that you expect to be part of your efforts to Lean your supply chain as not all suppliers need to be managed in the same way. Each will require a different approach that is dependent upon the importance of a particular supplier to your organisation, the potential effect they could have on any Lean initiative, the characteristics of the marketplace and the level of interest that each supplier has in your organisation.

- 2 **Differentiate your suppliers:** although several methodologies exist to achieve this, a well-tested approach is to differentiate suppliers within your supply chain, whether they have a direct contractual relationship with you or not, into one of four types. This allows the appropriate strategy to be developed and effort, skills and resources allocated where the greatest value can be added in terms of your Lean efforts. The reason that this should be considered before sourcing is that the relationship type selected will influence the actual sourcing strategy. Once each category of supplier has been considered in terms of how important they are to your organisation, they can be placed within a matrix that plots business risk and/or Lean opportunity against expenditure. For Lean supply chains, business risk should be considered in terms of quality, sustainability, health and safety, delivery time and Lean potential as well as the more traditional financial risk. A typical supplier positioning matrix is shown in Figure 3.4, which explains the relationship type or management style that is appropriate to which type of supplier.



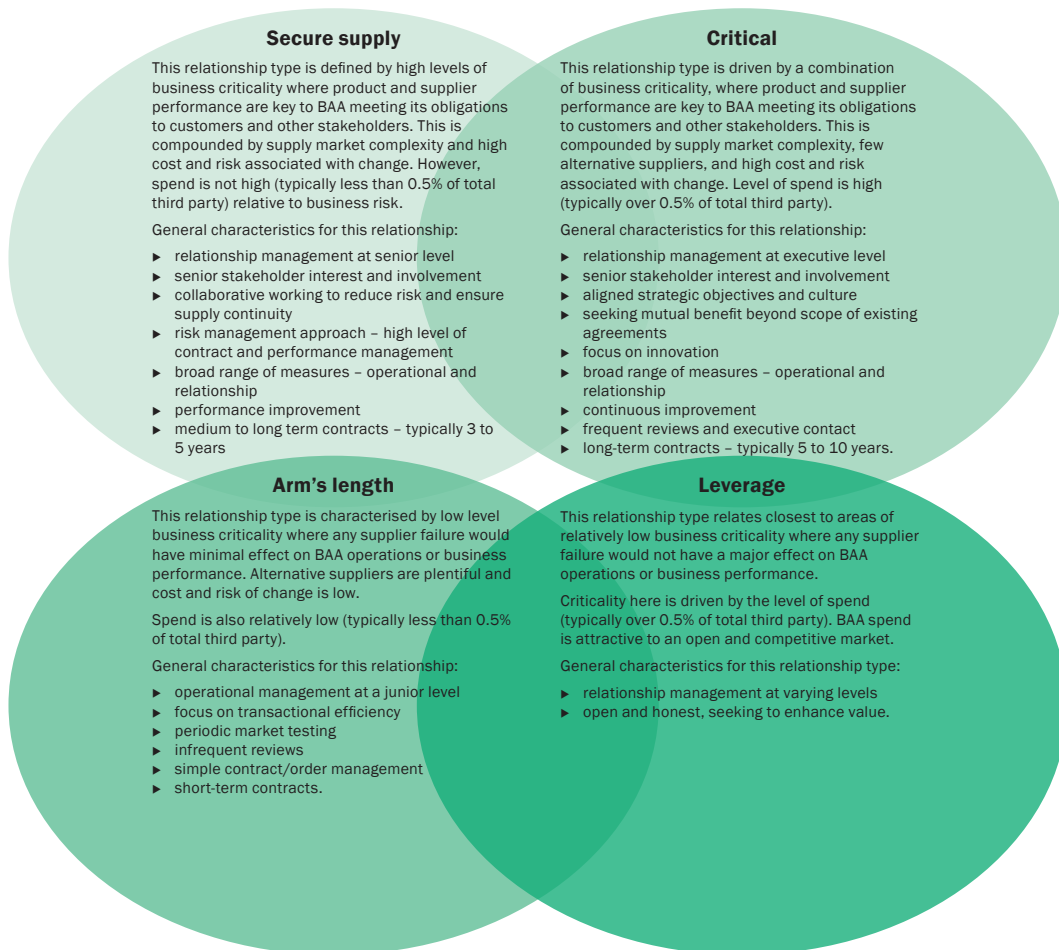


Figure 3.4 Supplier positioning matrix

- 3 **Understand the costs and benefits:** the commitment required to support suppliers in terms of Lean initiatives, whether that support comes from your client organisation, is outsourced or comes from the supplier, should not be under-estimated. It will be important to communicate both the required resource and effort to be invested in Lean initiatives and likely potential benefits. From the benefits perspective some typical deliverables from each of the relationship types are shown in Table 3.1.

Table 3.1 Benefits from supplier relationships

|  |  |
|--|--|
| <b>Secure supply</b> <ul style="list-style-type: none"> <li>◆ zero supply problems</li> <li>◆ tight performance management</li> <li>◆ comprehensive risk management</li> <li>◆ contingency plan</li> <li>◆ detailed supplier management strategy and plan in place</li> <li>◆ significant potential for Lean initiatives.</li> </ul> | <b>Critical</b> <ul style="list-style-type: none"> <li>◆ senior and strategic relationship</li> <li>◆ outstanding supplier performance</li> <li>◆ value improvement year on year</li> <li>◆ innovation</li> <li>◆ clear relationship measures in place</li> <li>◆ detailed management strategy and plan</li> <li>◆ very significant potential for Lean initiatives.</li> </ul> |
| <b>Arm's length</b> <ul style="list-style-type: none"> <li>◆ well-organised data</li> <li>◆ low maintenance management</li> <li>◆ (5 to 10 per cent FTE)</li> <li>◆ small potential for Lean initiatives.</li> </ul>   | <b>Leverage</b> <ul style="list-style-type: none"> <li>◆ excellent market analysis</li> <li>◆ real time identification of opportunities</li> <li>◆ high quality market and supplier analysis</li> <li>◆ cost modelling</li> <li>◆ cost reduction year on year</li> <li>◆ significant potential for Lean initiatives.</li> </ul>  |

- 4 **Choose the right resource:** once suppliers have been categorised as described in point 2, deploying the correct resource in terms of Lean champions and general supplier management is critical. Different client organisations will approach the task differently, some choosing to separate their Lean work from the more general aspects of managing the relationship and performance that they have with each supplier, while others will wish to combine both functions within a single role. This will also be dependent upon whether your client organisation has chosen to outsource. Most effort should be placed where the potential benefits are the greatest. Relevant mixes of skills, competencies and behaviours required to manage suppliers in each category of supplier are shown in Table 3.2

**Table 3.2 Skills, competencies and behaviours for managing suppliers**

|  |   |
|--|---|
| <b>Secure supply</b> <ul style="list-style-type: none"> <li>◆ risk analysis and management</li> <li>◆ good business acumen</li> <li>◆ market knowledge</li> <li>◆ performance management</li> <li>◆ diplomacy.</li> </ul>  | <b>Critical</b> <ul style="list-style-type: none"> <li>◆ excellent interpersonal skills</li> <li>◆ strategic thinker</li> <li>◆ senior credibility</li> <li>◆ good communicator</li> <li>◆ strong team worker.</li> </ul> |
| <b>Arm's length</b> <ul style="list-style-type: none"> <li>◆ creativity to simplify</li> <li>◆ customer service focus</li> <li>◆ process orientation</li> <li>◆ ability to delegate</li> <li>◆ open-mindedness.</li> </ul> | <b>Leverage</b> <ul style="list-style-type: none"> <li>◆ very capable negotiator</li> <li>◆ commercially aware</li> <li>◆ highly numerate</li> <li>◆ assertive</li> <li>◆ market research skills.</li> </ul>              |

Also, the following list highlights some of the soft skills necessary to be a successful Lean champion:

- |   |   |
|---|---|
| ▶ influencing                             | ▶ energising                                    |
| ▶ negotiation                             | ▶ relationship building                         |
| ▶ giving and receiving feedback           | ▶ presentation skills                           |
| ▶ leadership                              | ▶ measuring own performance                     |
| ▶ questioning                             | ▶ measuring others' performance                 |
| ▶ rapport building (body language, voice) | ▶ identifying individual/team development needs |
| ▶ team working                            | ▶ designing training and learning activities    |
| ▶ coaching                                | ▶ developing individuals and teams              |
| ▶ facilitation                            | ▶ delivering training and learning experiences  |
| ▶ listening                               | ▶ handling difficult people or situations       |
| ▶ motivation                              | ▶ meeting skills                                |
| ▶ modelling good practice in others       | ▶ personal development planning                 |
| ▶ building confidence in others           | ▶ setting and agreeing priorities.              |
| ▶ oral communication                      |   |
| ▶ process thinking                        |   |

- 5 **Create balanced scorecards for each supplier category:** as described in Sections 2.3 and 3.2 a generic scorecard for each supplier category should have been developed before starting the acquisition process. If for any reason it was not created then it is important to do it now. This will provide general weightings between criteria that are important for supplier performance. Examples are cost, quality, delivery time, health and safety, sustainability and cultural fit. It is now necessary to translate these into balanced scorecards specific to each supplier for each project that they are engaged with and then, where multiple projects exist, feed these into a balanced scorecard for individual suppliers spanning several projects.
- 6 **Awarding more work or letting go:** the balanced scorecards can then be used to generate performance improvement targets and review progress against these targets. This can be done for a single project or for multiples of projects and for multiples of suppliers. Where

more than one supplier and/or more than one project is involved, league tables showing performance can be constructed and fed back. Embarrassment can be avoided by only showing a project or supplier where they are on the table with reference to an average and top and bottom score. Other projects and/or suppliers are not named. League tables can either be done showing total score or for each criterion. The latter is particularly useful as projects and/or suppliers can see how they are doing in areas such as quality, health and safety and sustainability individually. Where multiple suppliers are engaged for a single category of work, the balanced scorecard methodology can be used for allocating work, with the most work being given to the best performers. This is a more rounded way than simply inviting tenders for each new project or assigning work on a basis of equal allocation.

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