Learning best practice: why regulated industries must adopt the principles of lean manufacturing and collaborative engineering in construction projects

A White Paper

ASITE

May 2004

Introduction

Regulated companies in sectors such as utilities are under huge pressure from shareholders to deliver financial returns. But the restrictions of industry regulators such as Ofwat mean that they don't have the same freedom as unregulated companies to build profitability through charging more for the products they provide.

The UK water industry in particular is facing new pressure from European Union directives designed to make environmental improvements to the country's water supply. The directive is expected to involve £7.5 billion extra investment to bring about the necessary improvements. Water companies will expect to finance the improvements through higher charges to ratepayers, but the Treasury is unlikely to accept inflation-busting rises – which could be as much as 20% on today's standard bills.

These extra directives mean that capital expenditure will come under enormous scrutiny. Water companies are torn between the prospect of spiralling costs and meeting the level of investment in new facilities and infrastructure required to deliver a quality service and meet EU requirements. If household bills are not to rise beyond acceptable levels, companies will need to either make significant cuts to their core billion pound capital expenditure or spend their budgets more efficiently.

There is certainly room for improvement: construction projects are often subject to huge delay and budgetary overspend. According to Sir John Egan's government-sponsored 1998 Rethinking Construction report, studies in the USA, Scandinavia and the UK suggest that up to 30% of construction is rework and labour is used at only 40-60% of its potential productivity. By implementing best practice measures, a 10% increase in construction output can be obtained with the same budget and time.

Unless they address this issue, companies who are obliged to operate within the structures of market regulators will have no option but to lobby for increased charges for their services above the rate of inflation.

But this is unlikely to be allowed to happen, because ratepayers and shareholders alike are beginning to ask why money seems to be thrown away on construction projects that fail to meet targets or deliver results.

This is in contrast to companies such as BAA (owner of seven UK airports), which whilst regulated in terms of the level of airport tax it can charge, continues to outperform its targets. BAA brings construction projects in regularly under budget and continuously improves its output against approved plans.

So where can improvements be made to processes within construction projects, such as planning, procurement and supply chain management? How can organisations use information technology to improve effectiveness, meet deadlines, maximise budgets and improve service to ratepayers? And what lessons can they learn from other sectors that are already defining and adopting best practice – and reaping financial rewards as a result?

Driving an agenda of change

There is no question that the government and the construction industry itself are aware of the wider problem caused by inefficiencies in construction projects. A series of initiatives, including the *Rethinking Construction* report, produced by the Construction Task Force, identify ways in which the construction industry can implement best practice and improve efficiency, productivity, quality of design and sustainability, and safety.

Subsequent reports, including the Strategic Forum for Construction's *Accelerating Change*, have taken this thinking further and made recommendation as to how the principles can be implemented in practice. The agenda has also been embraced by many industry bodies including Construction Best Practice and the Rethinking Construction Steering Group. Whilst this is the case, there remains some scepticism in the construction industry. This is because some view it as having only a client-driven agenda.

But used appropriately, the Rethinking Construction agenda should benefit everyone in the industry. It is generally acknowledged that the construction industry can learn lessons from industry sectors such as automotive manufacturing – particularly in the area of improving communications and information exchange between partners in the supply chain. Sir John Egan was instrumental in applying "lean manufacturing" within the automotive industry in the 10 years that he spent as chief executive of Jaguar.

Problems near to home

However, it's important to remember that it's not just the construction industry itself that needs to address these issues. Construction projects impact several different departments within a utility company, including engineering, project management and operations services, as well as partners in the extended supply chain.

Part of the problem lies in the divisions between those groups, and the fact that they have implemented disparate systems over time that work. These systems are designed to solve different problems and whilst they might use similar data, they work with different data structures. This makes it difficult to exchange and share data between divisions.

To understand the benefits that an extended supply chain could deliver to organisations engaged in construction projects, it's useful to consider how other sectors have adopted similar principles.

Learning from the automotive sector

One example is the automotive industry, a leading sector in collaborative engineering and lean manufacturing. In the past, a company bringing a new design to market would have moved through a series of well-defined stages, including initial design, prototyping, market testing, component design, sub-contracting component manufacturing, delivery of components and final build.

Those stages would have been completed in serial with many approval iterations, rather than undertaking them in parallel, working towards common goals. This meant that time to market was extended over years, and that design faults were only exposed when components were eventually built into a final production model. At this stage the faults would be extremely expensive to put right.

The introduction of technology-enabled collaborative engineering techniques has changed all of that. A design for a new vehicle can now be held in a 'soft' digital state almost until the last minute. Different teams such as design, safety, engineering and component suppliers can work on a central model built with the same data that is eventually used by manufacturing systems on the factory floor.

If the design team wants to make a change to the shape of a door in response to market or safety testing activities, then that change and its impact on components is immediately fed through to suppliers across the extended enterprise – which may spread right across the world.

And because tasks and design changes happen in parallel, time to market is reduced significantly while design flaws can be addressed before a panel is beaten or a rivet struck. Crucially, designers collaborate with suppliers instead of being led by them. This approach enables innovation in design and ensures a final product that meets the real needs of customers.

As companies move into new international arenas, as business priorities change, as fashions change, customers' end requirements will change accordingly. This means that the specification of new products that are fit for purpose becomes a constant challenge. This can be facilitated by supporting collaboration between the design team and the suppliers, promoting innovation and continuous improvement. Products in use by a design team for a particular project can be harnessed in a product library, enabling re-use rather than re-drawing of the pre-defined objects. This also helps to minimise errors within production information, reducing wasted labour through re-work on site.

Over time, IT-enabled improvements such as collaborative engineering have led to massive savings in the total cost of development and production of automotive vehicles.

It's a question of data exchange

Collaborative engineering depends heavily on enabling effective data exchange. One of the reasons for the early lead taken by the automotive sector is that larger manufacturers have been able to drive the use of closed systems, only choosing to work with component suppliers who saw the commercial value of following suit. A "closed system" is created when a group of companies is able to define the software that they want to use in common, for example specific computer aided design (CAD) applications, so that they can understand the data structure used by their respective systems for the same piece of information. In this way it can also be transferred between their systems.

Why didn't this happen in the construction industry? The answer is that it is relatively complex compared with the rather paternalistic structure of the automotive sector. It includes many different players, including architects, civil engineers, sub-contractors and government planning departments. This made it difficult to exchange data. It was not possible to adopt a set of data standards capable of supporting the diverse needs of a wide range of companies to make true collaboration and, therefore, 'lean construction' a reality.

One exception is the engineering construction sector, which is involved in building oil rigs and refineries. Because of the smaller number of oil companies and sub-contractors involved in the sector, it has been more straightforward to develop and adopt STEP, a set of standards for storing and exchanging data across the commission and decommission of facilities – often over lifecycles that span several decades.

With the introduction of technologies such as Extensible Mark-up Language (XML), this has removed the need to rely on closed systems altogether. XML allows the movement of data between systems, whether that data adheres to a standard or not. It provides a method of structuring data so that it can be moved between disparate systems. This enables them to exchange information between their systems, using the internet as the network for data transmission. Because it is flexible, it can accommodate the diverse needs of different organisations.

Despite the flexibility that XML introduces, the creation of multiple linear connections between partner organisations is still expensive to set-up and maintain as it requires agreeing a separate data structure with each organisation. Companies, such as Asite, that enable 'data logistics' can overcome this issue by providing a kind of 'information clearing' service. This enables Asite to accept data from many organisations with many different data structures and translate these into a structure which an individual organisation can understand.

So is it possible for the wider construction industry to adopt the same principles, given its disparate nature and fragmentary structure? The answer is yes, and the key to it is technology that has the capacity to connect a diverse range of systems, both within an industry and between industries, eliminating the need for formal, inflexible data standards that can take years for industry bodies and committees to agree.

The creation of "interoperability" between applications that are unable to share data seamlessly is at the core of Asite's technology. Asite is working together with bodies such as the DTi-sponsored Avanti (www.avanti-construction.org) and the International Association of Interoperability (http://www.iai-international.org), to help provide collaborative tools for design teams and their wider supply chains to enable the exchange of data more easily and reduce any rework. In translating data between organisations, Asite helps to create in essence a single data model. It is looking at more than just the development of

new technology to achieve this objective. It is also looking at how technology can be implemented to reflect best practice working procedures.

Reducing costs

There are already examples of construction projects run by organisations that understand the principles of collaboration and lean engineering. One of the best known examples is BAA, which is one of the construction industry's largest and most demanding clients. It typically spends more than £400 million on development of capital assets each year, and has adopted internet-based project collaboration tools and services from Asite that enable it to reduce project costs by an estimated 2% - equating to potential annual savings of around £8 million.

In line with its corporate aim to drive efficiency within asset developments, BAA turned to Asite to provide a collaboration solution that could be used throughout the company and provide a central repository for standard BAA product information. Asite provides a business operating system that is application agnostic, together with software and services that support a range of business-to-business processes focusing on procurement and project management.

The solution was tested with a stand-alone programme to refurbish washroom facilities at Heathrow airport. This involved five projects, 23 companies and 80 users, including clients, consultants, contractors and suppliers.

Whilst BAA had previously used collaboration tools, they had been adopted with varying degrees of success. Asite helped instil an emphasis on facilitating cultural change to maximise use of the solution, achieved through team workshops and forums to obtain team buy-in.

The success of the pilot refurbishment programme led to BAA awarding a framework agreement to Asite to supply internet-based project collaboration services. The agreement began with Asite's analysis of organisational objectives and the capture of working processes.

Different BAA project teams can now collaborate electronically, enabling them to share, exchange and re-use information. It supports a defined set of processes to request, review and exchange information, and this reduces re-working of designs and on-site errors.

The use of the standard products repository allows standard products and components to be dropped into projects where needed, thereby reducing the need for redesign and ensuring all projects adopt consistent and up to date design information.

More specifically, BAA expects to achieve an estimated 2% saving on future projects through:

- fewer delays to projects
- better transparency and improved communication
- reduced number of drawing revisions
- reduced duration of drawing approvals

Eliminating waste

Another major challenge construction projects face is ensuring the right materials are delivered to the right location at the right time. Traditionally, this challenge is met by storing materials at site until they are needed, a practice that creates significant waste. In 2003 BAA sought to implement a more efficient process to cope with the demand for materials on its terminal five (T5) and introduced a “lean” materials management strategy. This involved employing an inventory management solution that allows construction teams to be supplied with a pre-agreed range of equipment and commodity items on a “pull” or as needed basis. This means that stock levels can be kept to a minimum.

The success of this “Market Places” strategy is dependent on the development of a just-in-time (JIT) system that pulls small quantities of selected materials from suppliers on a regular basis, rather than in large batches. On-site inventory levels are optimised, while the bulk of the inventory remains at the supplier’s warehouse until it is required. In this way, only one to two days’ stock is held in stores, minimising storage space without compromising volume discounts. Product ordering is done electronically and staff collect goods from suppliers up to four times daily, dramatically reducing order lead times from two days to two hours or less.

The adoption of this “Market Places” approach has enabled BAA to achieve 95% reliability for fulfilling site requests for the 400+ products on the stock list. Production teams work collaboratively with the Market Place team to identify new products to add to the stock list, thereby improving efficiencies for future product demands. Asite’s solution integrates with the purchase ledger system of the main contractor responsible for procurement, so that it is updated in real-time.

It’s not just the buyers that benefit. Suppliers can also immediately request orders from their own suppliers via the Asite exchange, further improving efficiency. Rather than having to stock-pile supplies and incurring increased inventory risk, suppliers can keep minimum stock whilst still being able to respond to demand.

It takes more than technology

The BAA example demonstrates that there are some important savings to be made through use of technology. But it’s not just the technology that helped to make the projects effective. Softer issues also play an important role, and include the following:

- client support is essential for acceptance by all users
- an emphasis on a thorough understanding of business processes and translating these into the collaborative tool environment

- obtaining buy-in at all tiers and ensuring that everyone understands the benefits
- training sessions that are targeted at different audiences
- continual monitoring and resolution of cultural issues

Looking ahead

How can utility companies, who are also regulated, learn from the BAA experience? The first point is that senior management needs to understand the possibilities that collaboration and data logistics solutions like Asite's create. In essence, this involves providing information technology to support all business-to-business processes, throughout the management of the asset lifecycle. This includes the design, construction, maintenance and refurbishment stages as well as procurement and inventory management.

Asite is leading the development of this field. It has developed a business operating system that can integrate with all applications, enabling the flow of data between one tool and another. Typically, software applications have been developed to address different processes, without enabling data to be reused between the tools. This introduces the risk of inconsistent data.

Asite also advocates that partners in a construction project should 'celebrate the differences' between IT systems. Asite's business operating system can support all applications, enabling them to exchange information seamlessly. This means companies can use the technology systems that they are comfortable with rather than forcing them to make further investment in new IT. Indeed, it means they drive more value from their investment by integrating their IT systems with a wider group of partners.

As proven by BAA, the big win from this approach is that organisations can improve the efficiency of their Capex programmes, maintaining their levels of construction output whilst still bringing them in on budget and on time. As regulated companies cannot set prices above the levels set by regulators, they have no choice but to do this if they are to avoid continually playing financial catch-up.

By streamlining processes and improving information management internally and across the integrated supply chain, companies can reduce bottlenecks and reduce barriers between disciplines. And, learning from the example of automotive manufacturing, organisations can begin to change the way they look at designing facilities.

Instead of creating a final design in isolation, the design team can consult with not just one another, but also other members of the integrated supply chain as well. This reduces the occurrence of spatial conflicts and improves the ability of the supply chain to be responsive – to changes in fashion, construction environment or some unexpected event, like a change in planning permission.

It also means that the design specification can be created in draft form so the design can be easily amended to accommodate design changes, avoiding the need for costly changes at the production stage. Efficiencies can also be made by using a library of pre-defined products and components for use on serial projects, as shown by BAA.

But this vision will never become a reality without strong leadership. As the BAA project demonstrates, it is vital to get buy-in from every level of the organisation and to break down barriers between different departments and teams before internet-based collaboration and procurement tools can be used to achieve financial savings.

Conclusion

There is an inexorable march towards using technology to support integration between supply chains in the construction sector. And there is no doubt that collaboration solutions enable organisations to reduce overspend and project timescales – the evidence exists in the form of hard cost-savings achieved by organisations like BAA.

So the question is not *whether* collaborative working in the construction supply chain will become a reality, but *when* it will happen. Leaders of organisations in

the utilities sector owe it to their ratepayers and shareholders to reduce project overspend and improve services – those who don't will come under increasing pressure to answer why not.