

An aerial night view of the London skyline, featuring prominent skyscrapers like the Gherkin and the Shard, with city lights reflecting on the buildings and streets.

*build*offsite

# Buildoffsite Review 2012

The business  
case for offsite



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## *Promoting offsite construction*

Buildoffsite acts to promote significant improvements in quality and value within the UK construction industry. Our focus is on achieving sustained growth in the use of offsite solutions.

Buildoffsite is the only organisation dedicated to support (and challenge) the offsite industry to deliver continuous improvement in the quality, value and understanding of its offerings for all market sectors.

Buildoffsite is a membership organisation and we aim to deliver tangible business benefits to our members. In turn and to get best value from their membership it is essential that the members participate fully in the Buildoffsite work programmes and activities.

The membership of Buildoffsite is drawn from across the client and supply chain community and from other stakeholders.

Buildoffsite believes that by working together it is possible to demonstrate and promote the business and project case for the increased use and development of offsite solutions at a scale and with a visibility and impact that would be difficult for clients and suppliers to achieve if they were working in isolation.

By working together members are much better placed to connect and collaborate with leading like-minded clients and suppliers to develop innovative solutions and to sustain continuous improvement.

For more information on Buildoffsite and our Membership Scheme contact Anna Whiting on:

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**Website: [www.buildoffsite.com](http://www.buildoffsite.com)**







## **Mission statement**

Buildoffsite's mission is to work to bring about a step-change increase in the use of offsite construction solutions in support of a more productive industry delivering better value to clients and customers.

## Chairman's review and introduction

I am delighted to introduce the Buildoffsite Review for 2012, which provides an overview of the Buildoffsite work programme and also important information on our Members.

It also includes, for the first time, a substantial illustrated guide to the range of project and business reasons behind the decisions of clients, designers and constructors to increasingly turn to offsite solutions to deliver construction projects that offer significant benefits in terms of quality, value for money, sustainability and other considerations. We think that in making the case for the increased use of offsite solutions it is really important that clients and their suppliers should have access to hard evidence of the tangible achievements that others have already realised and are therefore better informed in order to benchmark their current practice and performance accordingly.

I am acutely aware that the economic context against which this Review is being published is likely to represent some of the most challenging trading conditions that we have faced in a generation. Companies will want to take steps to help their business and the services they offer stand out from the competition.

What is clear is that challenging times inspire innovative thinking and innovative solutions – particularly where these innovations will increase productivity, eliminate waste, improve value, raise company profile in the market and justify fresh investment. What is certain is that for the construction industry it will definitely not be a case of business as usual, solutions as usual, waste as usual, poor productivity as usual and dismal client value as usual. The pressure will be on for new construction solutions that can lever a significant impact in terms of disrupting the status quo – solutions such as a fundamental increase in the understanding and exploitation of offsite construction methods.



*Richard Ogden, Chairman*

As you will see Buildoffsite is maintaining a significant work programme that has been crafted to promote the case for offsite solutions, to increase understanding amongst clients and suppliers and to engage with obstacles and outmoded perceptions. We are a small organisation but with the active participation of our membership we are making a significant contribution to improving the performance of our industry.

The guide indicates that there is a wide spread of tangible benefits that offsite solutions can deliver. The challenge, as knowledge and experience grows, is for offsite manufacturers and suppliers to be able to demonstrate innovative solutions that increase the proportion of project value being delivered through the use of offsite solutions on the basis that this makes sound project and business sense.

It is important to bear in mind that it seldom makes sense to regard offsite solutions simply as an alternative to onsite construction. To take this line will be to miss the opportunity to rethink the delivery process for the entire project and to identify and eliminate those processes and activities that add complexity, risk and cost but which may not add much, if anything, in terms of client value. There is also the opportunity to seek to remove from the critical path those activities that so often give rise to cost and time overruns as well as compromising levels of right first time quality and productivity.

## *The Buildoffsite vision*

I hope that you find this unique but simple guide a boon to reviewing your organisation's approach to the exploitation of offsite solutions and the consequential opportunities to make a real difference to your performance, your competitive position and to the bottom line.

Expert clients and suppliers already understand the case for offsite solutions. The challenge for Buildoffsite is to help make a compelling case to the industry at large. Our work programme illustrates how we are going about our task.



*Peace Bridge (courtesy Tekla)*



The Buildoffsite work programme has been developed to deliver the following objectives:

- to promote increased awareness of the business case for the increased use of quality offsite construction solutions in all market sectors
- to provide information and services that will encourage clients, constructors and other decision takers to be better informed regarding the opportunities to increase their use of offsite solutions as a construction method of choice
- to act as a focal point for the sharing of knowledge and best practice on the use of offsite solutions
- to work to eliminate any negative perceptions regarding the use of offsite solutions
- to provide services to the Membership that will deliver tangible commercial value
- to promote the offsite value proposition to Government, leading industry professional bodies, insurers and other influencers.

In support of these objectives the current work-programme includes:

**Discovering offsite tours (UK and International):** a managed programme of visits to Members' manufacturing facilities and to construction sites to provide information on the state of the art in terms of market offerings and to provide opportunities for delegates to gain first-hand knowledge of the practicalities and the project benefits.

**Lean production:** briefings and workshops on the use of Lean production techniques to identify and eliminate non-value adding processes and to deal with constraints in order to improve the overall efficiency of the design and construction process. The use of offsite construction solutions will typically simplify the critical path and reduce risk.

**Networking opportunities:** regular opportunities for Members and Guests to meet privately and take

part in business to business discussions in support of collaboration and commercial activities. The range of the Buildoffsite Membership provides a forum for networking for a wide spread of clients and suppliers

**Technical and project information:** assessable through the Buildoffsite website [www.buildoffsite.com](http://www.buildoffsite.com) we maintain a data base of information that supports the use of offsite solutions. This includes an expanding portfolio of project case studies, along with Guidance material designed for clients and other users on the use of offsite solutions.

**R&D Tax Credit Service:** the development of offsite construction solutions often involves considerable expenditure on research and development. This Buildoffsite service provides access to highly effective no win no fee consultancy support to recover investment on research and development through specialist advice on the workings of the UK Tax Credit system. An increasing number of Members have recovered significant resources through this service which would not have been achievable through traditional accountancy services.

**Buildoffsite Property Assurance Scheme:** the Buildoffsite Accreditation Scheme, operated by Lloyd's Register EMEA, is a process based assessment scheme designed to ensure that accredited organisations meet the benchmarked standards expected by clients who procure from the offsite industry.

The scheme focuses on ensuring that accredited organisations have robust systems and procedures underpinned by a risk based approach which enables them to competently, and safely, deliver products or services which meet the requirements of their clients.

The scheme assessment evaluates Buildoffsite organisations against best practice in terms of competency, configuration management, procurement arrangements and process control, across their business and on a project specific basis. All such processes being tested against the arrangements for sustaining integrity



## Buildoffsite work programme

and quality of product/service delivery, dealing with environment and project changes and risk identification and mitigation.

**The Buildoffsite Registration Scheme**, covers design, manufacture, construction and project management activities and focuses on assuring delivery in each of these areas as well as ensuring integration between each element of the construction process. The scheme serves as the vehicle for the standardisation of best practice across the offsite construction industry.

**The Buildoffsite Property Assurance Scheme:** innovative construction techniques are recognised as being the only means of delivering the UK Government's sustainability agenda but the perceived risks associated with such construction systems potentially represent a barrier to their adoption by the industry.

In recognition of the concerns of the lenders associated with offsite and innovative construction technologies Buildoffsite, The Royal Institute of Chartered Surveyors (RICS), Lloyd's Register (LR) and BLP established a working group with the lenders comprising; Lloyd's Banking Group, Santander, RBS and Nationwide.

The output of the working group was an assurance process, which comprised the following:

- a 60 year durability assessment providing homeowners with the assurance of no structural maintenance costs for 60 years and the lenders with the assurance of durability for two mortgage terms
- a 10 to 12 year latent defect insurance that the homeowners may access directly from day one of occupation providing the assurance to all stakeholders of protection against significant fault or failure
- innovative manufacturers/constructors to be accredited against good practice to provide assurance to all stakeholders including the warranty provider of consistent performance of the structural systems

- the development of a web based data base providing information of main structural components of each property by postcode
- the assurance process has been piloted and the lenders satisfied that the rigour of the process serves as a major mitigating factor in relation to the innovative construction risk profile
- the Buildoffsite Property Assurance Scheme will be available to the market from early 2012.

**Delivering disruptive change:** Buildoffsite has delivered a number of workshops to provide opportunities for the Membership to engage with the challenge of developing, in collaboration with serial clients, value propositions that would deliver projects in ways that would challenge traditional industry norms and expectations regarding time and cost. The ambition on the table is to establish propositions that will deliver time and cost savings of not less than 30 per cent without impact on project margins – a case of collectively working smarter to add value and cut out waste. The next stage of this initiative is now being explored with serial clients.

**Engaging with RIBA and RICS:** Buildoffsite is working closely with RIBA and the new President – Angela Brady – to collaborate on a programme to promote increased awareness of what offsite solutions have to offer to the design community. This activity will help to establish the information needs of architects regarding the appropriate use of offsite solutions without compromising on the opportunity for architects to apply their skills to deliver design excellence. Buildoffsite is working closely with RICS on the development of the BOPAS scheme.

**Building Information Modelling (BIM):** Buildoffsite has long recognised that the increased use of BIM within the construction sector will serve as an incentive for the increased use of offsite solutions. It is hardly surprising that the design and construction of most high end building is already undertaken using BIM software. In parallel

the need for the adoption of engineering grade levels of manufacturing accuracy, design for manufacture and assembly and a precise data set confirming manufacturing and sustainability performance has resulted in the wholesale replacement of traditional construction detail with increasingly complicated offsite manufactured and tested components. The application of BIM within high value new build is effectively a done deal. The challenge for Buildoffsite is to organise itself to support the Government's ambitious plans to require the use of BIM for potentially all public built assets and also to encourage the application of BIM as a matter of routine for design, construction and asset management within the client community at large. Buildoffsite is establishing a Group to engage with this ambition and to connect with the Government's own BIM Group.

**Engaging with Clients:** Buildoffsite recognises the importance of connecting with clients and in particular with serial clients and to rehearse the case for offsite solutions. Buildoffsite has a long established Client Advisory Group through which these contacts are maintained along with regular meetings with individual client representatives from both the private and public sectors

**Design for Manufacture and Assembly (DFMA):** clients are looking to their advisers and suppliers for fresh ideas that will help deliver the quality and sustainable buildings they require but at a significantly lower price and with assured delivery times.

This is a significant challenge and it is entirely likely that if the industry is to rise to the challenge it will need to adopt new ways of working collaboratively.

The practice of DFMA has been adopted by other industries as a proven technique to ensure effective and informed communication and collaboration between those developing the design and those who will deliver the vision.



*Colchester Hospital (courtesy Yorkon)*

DFMA does not compromise the ability of designers to demonstrate design flair and innovation. However, it does require them and other members of the professional team to be prepared to work more closely with constructors and suppliers to establish the optimum methods to deliver the client's vision whilst minimising risk.

Buildoffsite has delivered breakfast briefings to promote the message of DFMA. More information is set out on page 12.

### Strategic and organisational benefits

Intuitively we all know that there are positive reasons why the construction industry should make much more use of offsite solutions.

It would be difficult, even perverse to argue that there is something so special about construction as a manufacturing sector that it needs to continue with the arcane process of assembling labour and materials and sequencing works to construct from scratch on a site – and that this is the only way to be certain of offering the client quality and value. Yet curiously this in effect is precisely the consequence of decisions being taken in design offices, board rooms and construction sites every day of the year.

Despite the fact that offsite construction has been a staple of the industry for a very long time there is still a tendency for many to regard offsite construction as something new, potentially risky and therefore best avoided if at all possible. Much better to stick with the highly fragmented

and hierarchical approach to procurement and to keep to those practices which so often deliver low levels of productivity, inconsistent and often poor quality, significant waste of materials and cost and time over-runs. Decisions that this is a better, more certain way, to deliver a project will always be taken on the basis that this is in the interests of the client. Well, in any event, the client will end up paying for the results of the decisions that have been taken – whether good or bad.



Harrogate Hospital (courtesy Yorkon)

Some may also claim that the only way to ensure design quality is through the use of bespoke construction methods and materials. This view would seem to deny the ability of designers to harness the best construction solutions to deliver a quality built environment.

Serial construction clients and their supply chain partners are becoming increasingly aware that traditional construction practices are unlikely to deliver the improvements they are looking for. Indeed over recent years costs have increased significantly but site productivity has remained stubbornly at a level that would not be tolerated in any other industry. The alternative strategy being adopted typically involves the application of Lean production techniques to identify and eliminate those design and construction practices that do not add value, the application of standard solutions, the use of a Building Information Model to ensure design efficiency and buildability, the adoption of simplified supply chains and the early engagement with specialist suppliers, integration of design and construction and the increased use of offsite solutions.

This approach represents a package of mutually supporting measures. Individually each element will deliver just so much but collectively the benefits can be significant.

The inevitable shift away from traditional methods of construction will provide fresh opportunities for those designers and constructors who recognise that by adopting new ways of working they will be able to develop their service offerings, become less dependent on lowest price tendering and grow their reputation and businesses.

There are other drivers that support the case for a shift in favour of offsite solutions:

- the increasing demand for a step-change in the performance of buildings is something that traditional construction methods struggle to deliver. To ensure high levels of performance requires a high degree



of accuracy in the construction process. This is expensive to achieve through traditional construction methods and the inevitable reworking and additional use of materials and investment in additional levels of supervision. This approach is costing money and eventually all such additional costs will accrue to the client and ultimately added to the bills of customers. Adopting an approach to construction based on the assembly of components manufactured in factories to a high level of accuracy offers a realistic and much more certain approach to achieve the required levels of performance. The uncertainty and inconsistency of traditional methods does not



*Thorp Precast Artists Impression (courtesy Tekla)*

- traditional construction methods give rise to significant waste of material whether as a result of the common practice of over-ordering, “shrinkage”, reworking to remedy defects or poor quality, or damage on site. No matter what the cause the client and the customer ends up paying for every scrap of material that is wasted and paying again for landfill. Aside from the

financial cost this practice has a significant impact on the environment. There is no sign that the traditional construction industry has been able to effect any significant improvement in practice and frankly as the cost is simply passed on to the client and end user what would be the incentive for things to be done differently? The manufacturing and assembly of offsite construction solutions gives rise to very little waste to landfill. Manufacturing waste is modest, readily measureable and in almost all cases collected for reuse and recycling. Not our words – this is what WRAP say

- the traditional construction site can be a hazardous place. Falls from height is the major cause of serious accidents and deaths. Although the use of offsite construction solutions does not eliminate the risk of accidents the processes involved and therefore the risks are more predictable and as such can be more effectively managed during the design and construction processes. Again not our words – this is the view of the HSE
- leading clients, designers and constructors are increasingly adopting Building Information Modelling (BIM) tools within the design process to ensure that the design is efficient, accurate, predictable in terms of performance and fully meets the client’s needs in terms of cost of ownership. The same model can be used to manage the construction process and as necessary the maintenance and operation of the building in use. The creation and use of an accurate Model is dependent on the use of accurate construction details. The required level of accuracy is best achieved through the specification of factory made components. The role of BIM is likely to be significantly enhanced as a direct consequence of the decision by Government to require the use of BIM on public sector construction contracts.



### Design for Manufacture and Assembly (DFMA)

In the context of the construction industry, Design for Manufacture and Assembly (DFMA) is an approach best described as 'improving quality through the application of efficiency.

Seeking to find the most efficient way of delivering a project inevitably reduces the resources required (whether this is measured in cost, time, carbon, waste or labour) while increasing positive aspects such as health and safety, quality, certainty. In other words, DFMA breaks the traditional relationship between cost, quality and time: a DFMA solution can be achieved to a higher quality at lower cost and in less time.

DFMA takes a number of forms, but the common factor is the application of factory (or factory-like) conditions to construction projects. This is critical for many reasons including:

- health and safety – factory condition are 80 per cent safer than site conditions
- cost – site labour is approximately 2.2 time more expensive than factory based labour
- productivity – factory productivity reaches 80 per cent compared with 40 per cent for a typical site
- sustainability – waste is reduced to just two or three per cent in efficient factories.

A DFMA solution starts by understanding the end product – site, brief, constraints and key drivers – draws upon the range of suppliers and systems available. Varying degrees of “granularity” can be used according to the project requirements. Volumetric solutions create as much of the finished product as possible in the factory, with on-site labour completely minimised. “Flat pack” or panelised create a kit of parts that can be quickly assembled on site.

Often prefabricated sub-assemblies (M&E services, for instance) are deployed in conjunction with more traditional build elements. In all these instances, the factory may be remote from site or located in an adjacent or nearby facility.

For some situations, traditional build elements are used (dylining etc) but the site is effectively turned into a factory. Pre-packed “fit out kits” are delivered to site with everything required for the element of the works, eg for an apartment this might include pre-cut boards and studs, tested and terminated ‘plug and play’ wiring looms, volumetric or flat pack bathrooms and prefabricated services units (comprising boiler and water tank, under floor heating manifold, electrical distribution board, whole house ventilation unit etc). Waste is virtually eliminated, together with the most common causes of delay on site, eg lack of materials, follow on trades and reworking.

DFMA also allows for building to be deconstructed more safely, with components or even entire buildings able to be reconfigured or redeployed elsewhere. This is the ultimate form of sustainable construction; re-using available parts expends far less resource than creating new ones.

### Lean production

The term “Lean” is used in many ways but at its core is essentially concerned with the elimination of waste in all forms. The mantra is simple: understand the product, understand the process and seek to eliminate all those activities and events that do not add value and to engage with those constraints that get in the way of more efficient processes.

The principles of lean are now well accepted in just about all manufacturing industries and the application of lean thinking has become accepted as business as normal. In those industries lean is not special...it's simply how things are organised. The results are evident in the step-change in productivity, in product value and the increase in product quality that we see every day in the market place.

However, the construction industry has to a very significant extent still to recognise and adopt lean thinking to any significant extent.

Within the construction sector there is plenty of innovation but it tends to take place around the delivery of a particular project – typically either to deal with a specific problem or a delay that has arisen or where the client or circumstances demand something better, something faster, something more affordable and so on. In such circumstances it is most unlikely that the detail of the innovation will be captured to be used next time the problem re-emerges.

Lean production techniques are rarely to be found in the context of the process of construction where generally traditional ways of organising and doing things still reign supreme.

It is almost certainly the case that the really big wins in terms of increased value for money for clients and improvements in time, cost, sustainability and other factors will emerge from the application of lean production coupled to continuous improvement within the construction process.

For some time now Buildoffsite has worked with Lean experts to promote a wider understanding of the subject and to illustrate the key messages with actual examples of lean thinking being applied to real projects to deliver real benefits. These workshops and briefings have typically included contributions from clients who have shared their experiences of the process and the benefits that have resulted.

We have been doing this because we understand just how unproductive traditional construction methods can be. We also recognise that the process of construction has become excessively complicated with additional layers of bureaucracy added to manage risk – or at least to pass risk down the supply chain without necessarily delivering any substantive benefits to the client.

The identification and engagement with those processes and activities that add little if any value tends to lead to the simplification of project processes and to reduce the number of suppliers involved. In turn it also tends to support the adoption of offsite solutions in place of traditional methods of construction and a fundamental shift in favour of project delivery through the assembly of components rather than on site construction from a set of basis parts. If all other industries have gone this way – why should construction be exempt?

Buildoffsite in collaboration with Member experts has delivered a number of programmes of knowledge sharing events in support of lean and additional activities and programmes are planned.

## The role of Building Information Modelling (BIM)

BIM has its roots in CAD and CAD/CAM as a highly cost effective software tool to plan and to control the detail of manufacturing processes. The application of BIM to the construction industry has taken a long time but has now arrived and is being developed and exploited at different levels of complexity across the industry.

The construction industry clearly has a long way to go and it is curious that so much of the industry is still almost totally dependent on 2D paper drawings even if these have to be delivered from an otherwise paperless software environment. Is construction alone in still thinking that this is good practice?

BIM has typically been used at the design stage of a construction project to enable the design brief to be tested and the proposed construction solution to be changed at minimum cost. At the detailed level the Model has typically been used to optimise design solutions, to avoid clashes and to require issues of buildability to be dealt with well before work and spending starts on site. Use of a BIM

## Drivers for offsite solutions

model is also a very convenient device to engage with client requirements for a sustainable building, minimisation of waste, embodied carbon and predictable cost of ownership.

However, a BIM model has the potential to deliver so much more and increasingly leading clients, designers and constructors are starting to use BIM as a project management device to support the management and delivery of the construction stage. Before any work starts on site the project team will enjoy a very high level of certainty as to precisely how the building will actually be built, the associated issues relating to logistics, health and safety considerations, environmental considerations and also time and cost.

At the cutting edge the digital model is also starting to be used as an asset management tool to support the operation of the building in use by the FM Team.



*Silverstone Artists Impression (courtesy Tekla)*

Buildoffsite is very supportive of the implementation and growth in the exploitation of BIM because of the opportunity to embed increasingly complex offsite manufactured components and assemblies into the design and construction process. BIM is a tangible way to encourage the consideration of offsite solutions as early as possible in the project planning process.

To be fully effective a BIM model is dependent on a database of project related information that is as accurate as possible in terms of the performance characteristics of individual materials, components and assemblies, their dimensions, environmental characteristics, use characteristics and requirements, durability and maintenance issues, cost, and so much else. It goes without saying that materials, components and assemblies manufactured in a factory under controlled conditions are much more likely to be supported by reliable data sets than those constructed on site by disparate teams to the levels of accuracy that are generally accepted as normal for on-site trades.

Our simple contention is that the more that BIM is taken up by the construction industry the more this will favour the use of offsite solutions. At the same time it is likely to embed in the minds of clients and designers and other professionals positive messages about the added value, project certainties and collateral benefits to be gained from the use of offsite solutions, which on site construction methods simply can not match. It comes down to a simple question: are the interests of the client and the project best served by using offsite solutions or by the use of traditional construction methods? Clients and building users will decide for themselves.

Buildoffsite is actively supporting the work that is underway to give effect to the Government's decision to require the use of BIM in public sector construction projects.

## Sustainability

Tangible examples of contributions to bring about a more sustainable construction industry have been incorporated throughout this Buildoffsite Review.

It is much more than simply avoiding waste of materials – it is much more than reducing carbon on site or in use. It is also about minimising waste in all its forms, minimising waste of capital and resources, improving health and safety, minimising risk, simplifying the critical path and ensuring that the industry has the appropriate skills.



The Buildoffsite work programme is geared to support a holistic approach to the consideration of sustainability.

There is nothing fundamentally new about the manufacture and use of offsite construction components, assemblies and other solutions to assemble a building or structure on either a permanent or a temporary site. Recognition that significant elements of a building or civil engineering structure can be accurately pre-manufactured and then brought together for a quick fit final assembly and use is as old as construction.

The use of pre-manufactured elements is just as much part of the tradition of the construction industry as is site based building using a set of basic components put together by those with the necessary craft skills. It is not a case of one approach being inherently better than the other but it is all about the need to meet the specific requirements of individual projects and in particular to satisfy quality, cost, speed and other business and operational needs.

Although the Buildoffsite organisation exists to support the development and increased use of quality offsite solutions this in no way means that we are apologists for offsite solutions, nor would we claim that all construction projects should be wholly delivered through the use of offsite solutions. There is clearly a significant and indeed vital on-going role for traditional forms of site based construction. However, what we would suggest is that in many market sectors and in particular the new build sector the balance between those building elements that can best be delivered through the use of offsite solutions and those that are best delivered through the use of traditional site based processes is rapidly shifting in favour of the former. There are a number of compelling business and project reasons for this including:

- the increasingly demanding performance requirements for buildings and the need for much greater accuracy and quality in their construction
- the need to significantly improve the levels of productivity within the construction sector including, in particular, productivity achieved on site which are currently amongst the lowest of any industrial sector. Just remember that it is initially the client but subsequently the customer and ultimately the wider economy that pays the economic and social price for such poor performance
- reducing the levels of waste of materials and other resources. It is difficult to think of any other industry that regards it as entirely normal to plan on the basis of wasting such a significant proportion of increasingly expensive materials delivered to construction sites and subsequently landfilled
- simplifying construction processes to reduce the number of trades on site and to minimise project delay and risk. Again it is difficult to think of another industry where it is common place to regard increasing the numbers of workers on site as a virtue
- the increased application of Building Information Modelling – including in particular the compulsory use of BIM within the public sector estate
- the need to find a permanent solution to periodic shortages of labour and associated and uncontrolled escalation of rates
- action to improve overall health and safety. There is no getting over the fact that a construction site can be a dangerous place. Excellent management and project planning can make a real difference and the increased use of factory made components and assemblies by trained teams can also make a major contribution to maximising safety on site
- the opportunity to quantify risks and to significantly reduce the overall cost of ownership for building ownership as a result of incorporating offsite manufactured components and assemblies into construction projects.



# The business case for offsite project solutions

We do not believe that these considerations will go away anytime soon indeed we anticipate that the drivers for change and business and project imperatives will continue to favour the use of offsite solutions for more and more construction applications.

There are of course serious obstacles to the increased use of offsite solutions. In large part these are associated with the ability of the design and construction community to respond to the opportunity and new ways of working rather than to any fundamental shortcomings in the offsite solutions that are available. These obstacles need to be recognised and addressed by those who advocate the increased use of offsite construction solutions. They include:

- lack of knowledge among the design community of the solutions that are available and uncertainty as to how to integrate offsite manufactured solutions into an otherwise traditional construction project. Some designers will also have a deep-seated enthusiasm to design projects from scratch rather than to recognise that it is perfectly possible to demonstrate superb design flair whilst still taking advantage of the use of factory made components and assemblies and also to make use of previously proven solutions
- the tendency on the part of some to continue to want to separate out the design process from the construction process. This inevitably can mean that decisions about the building form are taken before the constructors are able to propose the project case for offsite based alternative methods to be considered. It is difficult to see how this practice can really be presented as being in the client's best interests
- the tendency on the part of some construction professionals to see offsite manufactured components and assemblies simply as direct alternatives to traditional onsite construction methods. This may well not be an appropriate view and it is likely that the mind-set will risk missing out on the added value and project simplification that offsite solutions can deliver



*Shrublands Health Centre, Shrublands Park, Gorleston, Norfolk (courtesy ISG)*

- a tendency from some members of the client's professional team to regard the use of offsite solutions as something novel, unknown and therefore inherently risky and best avoided. This attitude is unlikely to be acceptable to serial clients but it may be that infrequent clients are missing out on those practices that serial clients regard as entirely normal and which have contributed to their efficiency gains.

## The hard evidence

Although there is a strong anecdotal evidence for the increased use of offsite solutions there is really no substitute for justification based on the hard won experiences of leading clients and suppliers in terms of tangible business and project benefits.

What follows here is a first attempt by Buildoffsite to provide a set of project based case studies that illustrate some of the tangible project and business benefits that offsite solutions have enabled. In all cases it is most unlikely that the same level of performance would have been possible through the

# The business case for offsite project solutions

use of traditional construction methods. The case studies cover a range of building types but we have deliberately not set out to cover every type of building or to illustrate every type of benefit. What follows is intended to give you an insight into what has been achieved. If you want more information you will need to contact the identified contacts to find out more about how offsite solutions might make a real difference to your project needs and challenges.

For convenience we have constructed a reference framework that illustrates the range of benefits we have considered and which in turn can be used to identify those case studies that are of most interest to the reader. The Framework comprises the following five principle categories of project benefit:

- project cost benefits
- project time benefits
- quality benefits
- sustainability benefits
- health and safety benefits.



Shrublands Health Centre, Shrublands Park, Gorleston, Norfolk (courtesy ISG)

In each case the reference projects includes information on the tangible benefits that have been delivered. There are other more holistic benefits that could have been addressed such as simplifying supply chains, stimulating a reassessment of the construction process and the associated impact on skill levels within the business. However, these programme or organisational benefits are much more difficult to separate out – particularly in the context of a set of individual projects but this is something that we will keep under review as we continue to monitor and report on exemplars of effective use and exploitation of offsite solutions.

Many of the projects referenced below are one-offs but some reflect a strategic approach by leading edge clients to design and construction to integrate offsite solutions as a core component of continuous improvement. It is in these cases that the commercial and project benefits of adopting offsite solutions will be maximised.

We are not claiming that the featured projects represent the best applications of offsite solutions. The projects that have been featured represent a snapshot of what the offsite industry is doing at present in the context of routine and replicable construction. Our approach demonstrates that offsite solutions have a relevance to everyday construction projects and are not simply for use in highly complex construction applications for leading-edge expert clients.

## Next steps

The Buildoffsite website [www.buildoffsite.com](http://www.buildoffsite.com) is being developed to include a reference section where our members can add their latest exemplar projects and can describe the business and project benefits that they have delivered.

# Matrices

[illegible]

## Case study 1: John Perryn Primary School, Buchan Concrete

### Benefits

**Time:** reduced construction time on site

**Sustainability:** improved air-tightness, reducing energy in use

**Quality:** very high quality finish to precast concrete requiring only painting to finish

### Client: London Borough of Ealing

### The project

Buchan Concrete designed, manufactured and erected the precast concrete structural components for the new John Perryn Primary School, for main contractor Willmott Dixon.

The construction of the new school building replaces the Victorian school that, while still in use, was partly demolished to release space for the new school to be built, with minimum disruption to the school's curriculum and without the need for additional, temporary accommodation.

The two storey educational facility has eight classrooms, a staff room and toilets on the first floor. On the ground floor, there is open plan nursery provision, hall, dining room, IT suite, reception and a further six classrooms for three to six year olds including toilets, administration and plant room space.

The design of the school required flexibility and this has been facilitated by Buchan through the use of precast portal frames for the school structure. These were 6.5m long and some 3.6m in height, being delivered and installed as a single unit. Running at right angles to the main corridor at ground and first floor level, the portal frames, along with the 150mm thick outside walls and

180mm thick cross walls, carry the hollow core floor units.

The panels were lowered into position and carefully aligned with the aid of lasers, before the holding down bolts were finally tightened, and the series of wire loops set into adjoining ends were spliced with a reinforcing bar and grouted. The solidity of this solution not only offers aesthetic benefits but also contributes significantly to the airtightness of the building which is well below the current target figure of: 10 m<sup>3</sup>/m<sup>2</sup>/hr. **The official BRE air tightness test at John Perryn School achieved: 1.98 m<sup>3</sup>/m<sup>2</sup>/hr.**



Willmott Dixon asked Buchan to deliver a structure of such precision that the cast surface would predominate as the final finish internally. This was achieved by using Buchan's battery mould manufacturing process with steel face shuttering on all internal sides – a process producing a very high quality finish – enabling a straight paint finish to be applied directly onto the concrete surface.

A total of 479 units were erected by Buchan's own erection team at a total of 16 no. units per day during the erection period. A one week reduction on the contract programme was achieved (seven weeks instead of eight).

This precast school is considered innovative because it is all manufactured off-site, which:

- minimises the safety risks of constructing a new building a few metres from a live school environment and a live railway line





- reduces waste and therefore costs
- reduces the number of deliveries to site (and associated traffic, noise pollution, safety risks etc, which is especially important in such a built up area as Acton)
- increases the speed of construction, enabling the project to be delivered in accordance with programme constraints, which is vital to school construction.

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## Case study 2: Gibraltar Barracks, Minley, Surrey, Caledonian Modular (CM)

### Benefits

**Sustainability:** 82 per cent reduction in vehicle movements to site

**Sustainability:** elimination of waste to landfill

**Time:** reduced construction time on site

**Cost:** increased certainty of project cost

**Health and safety:** 75–80 per cent reduction in the number of workers required on site

## Client: Royal School of Military Engineering

### The project

CM has won a £42m contract with Holdfast, to construct eight new accommodation blocks for the Royal School of Military Engineering (RSME) on three different training sites by 2013.

The modular approach allows a considerably shorter project time-frame, a high quality of construction, greater certainty of project costs and significantly reduces the number of deliveries entering the construction site.

This case study focuses on the delivery of modules to the RSME Minley, located at Gibraltar Barracks in Surrey, and describes how the supply chain has helped improve waste minimisation and management.

CM construct approximately 73 per cent of the project's value at their Newark facility, resulting in minimal disruption on site. Materials on site are reduced which has

an effect on reducing waste. Labour is reduced to 20–25 per cent of that required for traditional build. Additionally, as the construction happens under a roof, materials delivered to site are stored within the facility away from the elements, minimising waste through unnecessary damage. The reduction of waste, delivery vehicles, handling and on site trade all have a significant health and safety benefit.

### **Waste minimisation and management**

Waste from construction is one of the principal waste streams to landfill sites. Manufacture in a factory allows for better management of the waste stream, as materials can be used more efficiently, exact amounts of materials can be ordered and materials can be carefully stored.

CM has a corporate responsibility to apply many initiatives within its operations to reduce the impact of its activities on the environment. Although the primary driver for CM's move towards more sustainable operations is an ethical one, the company also realises tangible cost benefits and savings.

CM currently reduces, reuses and recycles 100 per cent of its waste, and has proactively taken steps to minimise waste through its supply chain before it reaches its facility.



Initiatives being implemented include the segregation of materials into waste management containers (currently CM segregate wood, plastic, cardboard, metal, plasterboard and residual waste) and the use of balers for plastic and cardboard packaging to minimise the use of space and ensure that only full skips are being sent off site.

Full utilisation of the skips provides a cost saving in itself, but the use of balers means that all cardboard and plastic become valuable resources that can be sold back to the waste contractor. CM report that this covers the cost of removing the waste from site.

### **Identified ways to minimise packaging:**

To reduce over-packaging, CM has worked with suppliers to reduce and eliminate packaging. In addition, after completed modules have been delivered, the packaging is returned to the factory for use on future projects after delivery to the site.

### **Call-off deals with major suppliers:**

CM has instigated deals with major suppliers for shorter lead times – within four weeks of starting a project, which reduces the time material is stored on site.

### **Cut-to-size components and design modification:**

Materials such as flooring and plasterboard are supplied in sizes specifically requested by CM to align with the module design, therefore reducing the amount of off cuts.

CM maintain good relationships with their suppliers by hosting regular meetings with the supply chain to identify new initiatives that could assist in reducing the amount of waste and deliveries to site.

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### Case study 3: St Helens & Whiston Hospitals, NG Bailey

#### Benefits

**Time:** opened six months ahead of schedule, an achievement supported by early design freeze

**Cost:** £120m M&E package delivered within budget

**Sustainability:** no impact on the operation of contiguous existing hospital services

#### Client: St Helens and Knowsley Teaching Hospitals NHS Trust

#### The project

St Helens and Knowsley Teaching Hospitals NHS Trust provides a full range of patient and emergency services to the local communities across the North West.

In 2006, the Trust, one of the top performing NHS Trusts in the country, awarded a £350m PFI scheme to the New Hospitals (Innisfree/Taylor Woodrow – VINCI Construction UK) to rebuild St Helens and Whiston hospitals as flagship, state-of-the-art, healthcare facilities. NG Bailey had been awarded the £120m M&E contract.

The four-year Whiston redevelopment required a fresh approach to partnership, collaboration and on-site sequence, allowing the project team to stretch the boundaries of off-site construction.

The challenge for NG Bailey was to deliver its largest ever project, with little on-site storage, working on the same site as the existing hospital.

Following a recommendation from NG Bailey, it was agreed that a large percentage of the project would be completed through the use of off-site construction, putting it at the centre of one of the UK's biggest and most exciting modular M&E installations.

Following in-depth consultation at the design phase with all parties, detailed data sheets were compiled for each room covering lighting levels, air conditioning and specialist extraction systems. An early design freeze was put in place and NG Bailey used its 53,500sq ft factory to manufacture and store each part. This careful planning allowed 90 per cent of the high level engineering services to be prefabricated, with 65 per cent of the installation completed on the first site visit. Each of the electrical and mechanical elements brought their own challenges, including the sheer size of the prefabricated ventilation plants that needed to be transported to the site.

The project won the Off-site Construction Award for the best project in the healthcare sector and during the build not a single clinic or operation was cancelled. Most importantly, and unlike many construction projects of this scale, the hospital opened in April 2010, six months ahead of schedule and within budget.

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## Case study 4: T5C Nodes, Heathrow, London, NG Bailey

### Benefits

**Time:** substantial saving in site installation time

**Sustainability:** elimination of waste on site. Avoidance of disruption to the client

**Cost:** substantial increase in productivity on site

### Client: BAA

### The project

Having already installed off-site manufactured primary plant corridor modules and core service risers, at



Heathrow's Terminal Five Concourse (T5C), BAA and Carillion knew at first hand what NG Bailey's off-site capability had to offer. As a result, NG Bailey's development team was approached about building 12 nodes to see if they could be produced cheaper and quicker, with the added advantage of being manufactured in a safer working environment – compared to a traditional on-site build.

Nodes are structures that connect departure lounges to aircraft, such as the new Airbus A380, to facilitate the



quick and easy loading of up to 500 passengers through three separate aircraft doors. Measuring 10m wide by 10m high by 15m long and weighing a total of 90 tonnes once assembled on site, the sheer size and scale of a node presented a unique engineering challenge to the off-site team.

After weeks of careful planning and design, the team set about getting to grips with the detail, creating a prototype to identify, log and resolve issues. The nodes were created using a hybrid of off-site manufactured elements including a volumetric reception area, panelised wall sections and several modular components – including a plant room, lift shaft and stair unit. All of the components were manufactured at the NG Bailey off-site manufacturing facility in Bradford.

Transportation posed another challenge, taking three months of intensive logistical planning, including a trial run to ensure the convoys could clear all the motorway bridges. The nodes were delivered to Heathrow and each erected within a week, compared to a traditional on-site build that would have taken up to half a year to complete.





Not only did this method of manufacture realise significant savings in terms of time, labour and waste on-site, it also presented a huge cost saving to the client through minimal disruption and downtime at the airport – testament to the “value add” that off-site manufacturing can bring.

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## Case study 5: Rose Lodge, Hospital Drive, Hebburn, Laidlaw Solutions

### Benefits

**Time:** fast installation on site

**Quality:** visual appearance and assured long term performance

## Client: Northumberland, Tyne and Wear NHS Foundation Trust

### The project

Rose Lodge is a specialist in-patient centre for the assessment and treatment of working age adults with a range of learning difficulties.



The £6.1m centre provides intensive help and treatment for health problems such as epilepsy, and is supported by a team of health professionals and specialists who determine each individual's complex needs.

The scheme provides 12 en-suite bedrooms for all the specific needs of Acute, Enhanced and Supported Care incorporating a “Swing” bedroom layout to allow flexibility of admissions. Activity/day space plus quiet and therapy rooms are also provided.

## Getting the message across

Laidlaw Solutions has worked alongside Laing O'Rourke as main contractor and specialist architects MAAP for many years on Foundation Trust projects. Laidlaw Solutions' range of specialist stainless steel door furniture was chosen to match the architect's brief to create modern and safe facilities that respect the privacy and dignity of service users. The local NHS Foundation Trust also required the building to be future proofed to a "medium secure" level, so special products including bedroom, washroom and communal room locksets along with primary or secondary barricade features were incorporated.

This installation was the Winner of Winners in the RIBA/Guild of Architectural Ironmongers, Architectural Ironmongery Specification Awards 2010/2011.

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The building will be subject to intensive use, so the selection and performance of the door furniture was fundamentally important. Laidlaw Business Development Manager Clint Robertson commented: "The interior emphasis in such secure environments has changed dramatically and the extended range of co-ordinated Orbis door furniture has provided greater design scope. Long-term performance of door furniture for our client is critical, so the 10-year guarantee is invaluable."

### Case study 6: Colchester Hospital, Children's Centre, Elective Care Centre and Surgical Ward, Yorkon

#### Benefits

**Time:** reduced overall project time. The seven month build time represented a minimum of six month time saving over traditional site based construction methods

**Sustainability:** working on a very constrained site without disrupting existing services. An assessed 90 per cent reduction in material waste on site

#### Client: Colchester Hospital University NHS Foundation Trust

#### The project

Colchester Hospital University NHS Foundation Trust had a requirement to increase capacity in time for the peak winter period. The new (5,600m<sup>2</sup>) building would accommodate a paediatric department on the ground floor, and an elective care centre and surgical ward on the upper floor.

#### Main drivers and constraints

- a highly constrained hospital site
- a challenging programme – there was only a short window for construction and the building had to be fully operational in time for the busy winter period
- the building had to have a high standard of aesthetics as it is prominently located near the main entrance to the hospital

- the shape of the site demanded a very complex modular layout.

Kier Eastern was appointed as Principal Supply Chain Partner to provide the new facility. Kier then awarded a £10m sub-contract to Yorkon for the off-site construction of the new building, which was due for completion after just 10 months on site.



Yorkon manufactured and fitted out the building off site in York, and installed it in two phases to allow an existing ward facility on the site to remain in use for longer.

The new Yorkon pre-installed concrete floor was used in all 148 modules – the first time this latest technology has been used for a complete building. The high performance floor is an innovative modular solution for high traffic areas and accommodates sensitive hospital equipment.

The building has deeply articulated façades finished in a palette of materials, including white render, vertical bands of rain-screen cladding and curtain walling, for an attractive appearance.

## Key facts

- the scheme was completed after just 10 months on site, reducing the overall build programme by around six months
- 148 steel-framed modules – up to 14m long by 3.3m wide and up to 12 tonnes in weight
- module lifting into position in two phases totalling 14 days
- the phased installation of the building modules allowed an existing ward building to remain in use for longer – a key requirement for the client
- off-site construction helped to address the issues of little space for material and equipment storage on the site
- the approach provided safer working conditions on the site
- a reduction in material waste of around 90 per cent
- quality of design and construction.



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## Case study 7: Birmingham 1 – new student halls of residence, Birmingham, Tata Steel Products

### Benefits

**Time:** much faster than traditional reinforced concrete for the construction of structural cores. Estimated to have saved five weeks on the planned 86-week construction programme

**Cost:** contributed to an improved gross to net ratio

**Quality:** improved accuracy and buildability

This structure was part of a complex for a private hall provider (Opal) open to all students in Birmingham (rather than being associated to one specific university in the area).

## Client: Opal

## The project

Birmingham 1 is an impressive student halls of residence scheme in southwest Birmingham. The 18-storey tower is the centrepiece of the development that has accommodation for over 600 students, in four blocks, and includes a luxury leisure suite and an internet café.

The core of the tower was constructed using Corefast, an off-site, modular construction system that enables structural cores to be created up to six times faster than traditional reinforced concrete cores. Corefast is a proven core construction technique that uses Bi-Steel. Bi-Steel panel is fabricated from two plates of steel which are separated by friction welded transverse bars. These panels are then quickly assembled on site and the void between them filled with ready-mixed concrete to create a robust structure with outstanding strength and stiffness.



## Getting the message across

The project was located on a busy intersection of the A38 Birmingham to Bristol road that presented some difficult access and exit issues for site vehicles. Also the scheme had to be completed to a tight schedule and had to be ready for students to take up their accommodation at the start of a new university year. Completion therefore had to be 100 per cent guaranteed and speed was very much of the essence.



Henry Smith (constructional engineers) the steelwork contractor for the project, had worked with Corefast before, and suggested that this method of constructing the structural core should be investigated. This was primarily because of its speed of erection and structural robustness, as it was an off-site modular system and would eliminate the need for a separate trade to construct the concrete core. The main contractor, Ocon Construction, selected Corefast to form the structural core on the basis that this would save time on the original 86-week construction programme.

Each two storey high section of core consisted of 10 modules of varying size, resulting in 166m<sup>2</sup> of core being constructed in each phase. The standard panels were

manufactured by Tata Steel at its Scunthorpe plant and fabricated into the required modules by Hallcalm, a pre-approved Tata Steel steelwork fabricator. During fabrication, provision for door, window and service openings were made, plus fixings incorporated for fin plates and floor angles for beam and slab connections. Connections for lift and stair units were also incorporated.

On site the panels were quickly erected. The first phase of construction involved the installation of ten 15m high modules, which formed the first four floors. This work was completed in just five days. The modules were lowered into position onto the starter bars set into the concrete foundation. As each module was placed it was bolted onto the previous module. Once the lower modules were installed the surrounding steelwork was erected around the core. This cycle was repeated – steelwork was erected and fixed to the core, decking was laid and used as a working platform to place the concrete to the core. The floor slabs were concreted after concreting the core. These floor slabs were used for access to erect the next level of Bi-Steel.

The void between the panels was concrete filled at the appropriate stages to create a core with outstanding strength and stiffness.

Overall, Ocon Construction estimated that they saved five weeks on the planned 86-week programme by using Corefast.



Due to the Bi-Steel panels being fabricated off-site high levels of accuracy and quality control are possible. This was evidenced on site where bolting panels together took place. Connecting steel to steel is also much simpler than connecting steel to concrete.

Corefast's slimmer walls means that more lettable floor space is released. This could increase rental income and enhance the building's capital value

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## Case study 8: The Headrow, Leeds City Centre, SES PRISM

### Benefits

**Time:** substantial saving in hours worked compared to traditional *in situ* installations

**Sustainability:** reduced vehicle movements and reduced environmental impact because of fewer operatives on site

**Quality:** significant use of Building Information Modelling (BIM) to plan the works and the efficient installation of services

## Client: Developer, Capital and Counties

### The project

The project involved the installation of 3km of heavily congested services within the ceiling void of an existing building. Over 90 per cent of the horizontal services distribution was modularised, however, this was not straightforward due to complex co-ordination challenges with existing and new steelwork within the service zone. Extensive use of Building Information Modelling (BIM) was required to overcome these challenges.

The logistical challenges of delivering large numbers of modules to the centre of Leeds out of normal working hours required careful planning and management.

A difficult mounting surface required the innovative use of a wire hanging system for suspending the modules.

### Results

The solution resulted in saving over 20,000 hours from the site programme by carrying out the works off site to an excellent quality standard.

Reduced labour at this city centre site resulted in reduced emissions and carbon footprint as a direct result of minimising the number of material deliveries and daily personnel commutes.

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## Case study 9: Gare de Gallieni, Toulouse, France, Tata Steel Products

### Benefits

**Time:** significant savings in site construction time – completed within two weeks of initial delivery

**Cost:** project savings estimated at €215,000

**Health and safety:** no cranes or machinery required for the installation

### Client: SNCF

### The project

In September 2009 Tata Steel Projects were approached by French Train Operator SNCF regarding a proposed new station near Toulouse.

The station was required to be opened by mid-December and, as it was located on a busy single track railway, access was difficult.

Tata Steel Projects worked alongside an experienced local contractor, Connex Infra, to construct the station.

The station consists of two platforms: 125m and 115m long and 3m wide on a ~500m radius curve. They were constructed either side of a level crossing to enable the crossing to be kept open whilst trains from either direction were stopped at the platforms.

Tata Steel Projects designed the steel superstructure and anti-slip surfacing, and then fabricated the platform at the Tata Steelworks near Wolverhampton. The entire platform was then transported to Toulouse within six weeks of the order. Tata Steel Projects then trained and supervised the Connex Infra operatives in the platform construction.

Some of the key features of the platform design meant installation went very well and both platforms were largely constructed within two weeks of delivery: several weeks ahead of Connex's initial estimates. These features included:

- the lightweight components meant no cranes or machinery were required to install the platform
- the front leg position enabled the main structure to be built behind a fence that separated the workforce from the railway and allowed construction whilst trains were running
- the adjustable height and lateral position allowed quick adjustment to tight tolerances.

Christian Dubost, Regional Director of Réseau Ferré de France, confirmed: "These modular structures were manufactured in a factory and assembled on site. We can add at will to the platforms which are 115m long. This system has saved €215,000."

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## Case study 10: Little Rays Nursery, Moira, County Armagh, McAvoy

### Benefits

**Time:** reduction in overall build time from an estimated nine months to just three months. An additional six months of income generation

**Sustainability:** 90 per cent reduction in material waste on site

**Health and safety:** reduced number of deliveries to site

### Client: Little Rays Nursery Group

### The project

Little Rays Nursery Group is a multi-site day care operation, with progressive and ambitious owners keen to constantly innovate and expand their extremely successful company. Their strategy has seen the company grow from a single site nursery providing places for a few dozen children, to a multiple location organisation with over 250 child places and over 100 staff. The latest part of their investment strategy required the provision of a new building at their Moira site to accommodate additional places and demand for "after school" services.

The proprietors commissioned local architects Knox & Clayton to design a modern, contemporary building. The architects produced a design of high quality which would normally be constructed using traditional building methods.

### Main drivers and constraints

- the most pressing project challenge was that the Nursery is situated in a very busy location in terms of traffic movements



## Getting the message across

- the need to have the facility operational in a very short time period in order to accommodate prospective pupils
- to maximise the revenue potential. There was only a short window for construction and the building had to be fully operational in time for the busy summer period
- the building had to be to a high standard of design to “fit” with the existing Grade II listed building and to comply with the strict guidelines set down by the Northern Ireland Environment & Heritage Service.



### The solution

The client's key requirements were a commencement to completion programme of 14 weeks, zero disruption to the daily operation of the main nursery, a high quality finish both internally and externally, enhanced site safety, and a highly efficient and sustainable building with low running costs.

McAvoy proposed a two-storey steel framed structure with a “Tegral” Rainscreen cladding system on the first floor and stained hardwood timber on the ground floor,

complemented by a PPC Aluminium framed glazing system and a “Kingspan” insulated roof system.

McAvoy was responsible for the turnkey package including mechanical, electrical and civil works, as well as compliance with statutory guidelines from Social Services.

### Key facts

- the scheme was completed in just 12 weeks, reducing the overall build programme by around six months
- 13 steel-framed modules – up to 14m long by 3.3m wide and up to 12 tonnes in weight
- module craneage in one phase totalling one day.

### Additional benefits of an off-site solution

- off-site construction helped to address the issues of limited space for material and equipment storage on the site
- the approach provided safer working conditions on the site
- a reduction in material waste of around 90 per cent
- quality of design and construction
- fewer deliveries to site.

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## Case study 11: Sainsbury's Extension, Biggleswade, Bryden Wood Limited

### Benefits

**Cost:** minimum commercial impact on an existing retail outlet

**Time:** significant (15 per cent) reduction in construction period

**Sustainability:** reduced waste, use of renewable materials

**Quality:** greater accuracy of components as a result of factory manufacturing

**Health and safety:** designed for construction on site with health and safety in mind

### The solution

In partnership with the RG Group, Bryden Wood Limited designed, fabricated and erected a structural timber prefabricated panel. This was erected four weeks quicker than a traditional solution. The extension was designed with prefabrication in mind from the beginning. This in turn minimised the need for changes during both the detailed design phase and the build.



### Client: Sainsbury's

### The project

The existing store received planning permission for an increased floor area, a new café, and additional back up space. To ensure that the existing store was able to remain open for business, the works had to be carried out with minimal impact. Prefabrication was the obvious solution.

### Main drivers and constraints

- the store was required to trade as normal during the works
- the construction site needed to be contained in a small area
- the new section of the building had to blend with the existing building
- a requirement for a sustainable building solution.



### Key facts

- a small site team of six was able to erect the extension four weeks faster than a traditional solution. The key to the time saving was the ability to deliver a water-tight building before the cladding was complete, thereby allowing the interior fit-out to progress in parallel
- the fact that the extension is prefabricated is not evident in either the external or internal appearance of the building
- the use of timber construction techniques and the development of composite timber floor and wall cassettes helped to reduce the project's environmental impact.

### Additional benefits of an off-site solution

- reduced impact on a trading store
- a higher standard of quality assurance due to factory requirements
- safer working conditions as a result of factory fabrication
- reduced material wastage.

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## Case study 12: Circle Reading, Bryden Wood Limited

### Benefits

**Cost:** 28 per cent reduction in capital cost compared to a previous project in the programme. On target to achieve a 50 per cent reduction in capital cost by project number four

**Time:** 20 per cent saving on implementation programme compared to the previous project

**Quality:** no reduction in design and build quality whilst delivering continuous improvement in time and cost. Assured quality of final construction

**Sustainability:** reduced embodied carbon

**Health and safety:** safer working conditions on site

### Client: Circle

### The project

Circle Reading is the second of the healthcare provider's framework of new build hospital projects. The 10,000m<sup>2</sup> hospital will provide elective surgery through GP referral, both on a private basis and as part of the expansion of patient choice within the NHS. The project started on site in January 2011 and is due to open in July 2012. Circle Reading is part of a framework of healthcare facilities across the UK in both the private and public sector – Circle will be delivering 25 new hospitals.



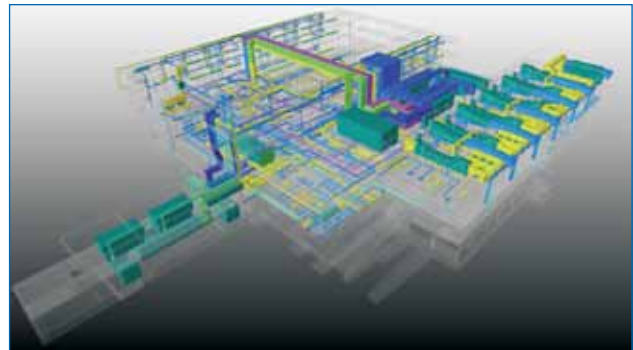
## Main drivers and constraints

- a system build approach is necessary to drive down time, cost and embodied energy, while maintaining the exceptional quality standards of Circle's existing facilities
- the establishment of operationally tested Circle design components and a design technology platform, to fully integrate with medical equipment and facilities management requirements
- Circle target to deliver new build hospital number four in the programme of 25 at a 50 per cent capital cost saving compared to hospital one – with no reduction in the quality of design and build.

## The solution

Circle Reading has retained Bryden Wood Limited to develop a set of standardised components and construction techniques that will be adopted across the UK rollout programme. The building will make extensive use of design for manufacture techniques – 75 per cent

of the Reading project will be built using components that will then be deployed again on future projects. Lessons learned at key design, construction and operational phases will be captured to inform and continually improve the efficiency of design and construction, and the quality of the end product – while also improving cost and programme certainty.



Based on Reading, Bryden Wood has created a Design Guide for use by the Circle approved panel architects across the framework. This guide covers Circle's optimised patient flows and clinical adjacencies, as well as structural and MEP "golden rules". This allows the architects to focus on the project specific parts of the site requirements to create a fantastic patient experience, knowing that much of the functional content has already been rigorously tested and refined.

## Facilities at Circle Reading

- five operating theatres
- one endoscopy theatre
- imaging suite (2 no. X-rays, MRI, CT)
- eight no. Stage 1 recovery beds
- 18 no. Stage 2 recovery positions
- 29 in patient en-suite bedrooms



## Getting the message across

- consultation and treatment rooms
- Reading Orthopaedic Centre (ROC).

### Key facts

- 28 per cent like for like capital cost saving compared to the first new build hospital (traditional build)
- 20 per cent saving on implementation programme from hospital one – with improved content and larger size
- 75 per cent of components are standardised elements that will be deployed on future projects.

### Additional benefits of an off-site solution

- certainty of brief – securing efficiency gains for all teams
- reduced embodied energy
- reduced site-based construction time
- safer working conditions on the site as “assembly” works reduced
- accuracy/dimensional tolerances of components, related assemblies and installations much improved
- assured quality/durability standards of final construction.



### Comment from the client

Mark Cammies, Property Director at Circle, commented: “Circle Reading is the next project on our journey to creating the UK’s most efficient implementation process for our new build hospitals. Our first project in Circle Bath reset the benchmark on design and operational standards for hospitals, and our patient feedback as a result is excellent. Our on-going development programme of new hospitals in multiple UK locations gives us the perfect scale to achieve our high ambitions of providing patient care and facilities that are second to none – at a cost that is as efficient as any in the UK.”

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## Case study 13: HMP Dovegate Expansion, Skanska

### Benefits

**Cost:** significant saving in preliminaries

**Time:** project handed over 14 weeks ahead of schedule. 40 per cent improvement in programme for structural frame and 50 per cent improvement for roof construction

**Quality:** zero defects on handover

**Sustainability:** waste generated on site equated to less than 0.25 per cent of overall contract value. The majority was recycled. Reduction in vehicle movement on site

**Health and safety:** no lost time accidents

effective custodial project. Early involvement of specialist trade contractors and suppliers ensured uncertainties were reduced, initial design concepts developed and full ownership taken of each part of the project with a complete understanding of life cycle implications.

Development of the design solutions over a series of custodial projects resulted in reduced labour and materials in the initial build, reduced prelims due to much shorter programme time than an on-site solution would have offered, plus reduced maintenance needs for the building in use.



## Clients: Ministry of Justice and Serco

### The project

With Skanska as main contractor, the HMP Dovegate Houseblock Expansion project called for the design and construction of an expansion of the existing facilities at HMP Dovegate. The project included a new 260 place accommodation block and activities building within an extension to the secure perimeter wall to support the new expanded facility, along with associated services, car parking and landscaping improvements.

Serco, Skanska and the design and trade contractor partners operated a totally integrated supply chain leading to the successful delivery of HMP Dovegate Houseblock Expansion. Innovative solutions including in particular the use of off-site walling systems, cells and services together with lessons learnt from previous custodial projects were captured and distilled into an efficient, cost

The move from 60 per cent to over 85 per cent standardisation in panels effectively reduced mould costs and factory set up time. In addition multi-use rooms were included into the design, enabling flexibility and change of use. These rooms used a standard cell size that could be adapted to create a range of solutions such as secure cells, meeting rooms, laundry rooms etc, dependant on client requirements. Standardisation throughout the cell blocks with regards to mechanical and electrical risers allowed the components to be assembled together with plant room packages off site. These were craned into final position prior to roof coverings being installed. Prior knowledge of the product and further use of BIM allowed savings to be generated within the cell risers. Co-location of equipment enabled use of alternative solutions including pipe work manifolds where previously individual mixer valves had been utilised. BIM modelling of the ventilation and ductwork enabled off site manufacture of sectional units to be assembled with simple on site connection and erection.

## Getting the message across

A number of features have reduced the need for maintenance, such as simplified cell risers, reduced mixer valves and cisternless WCs. Shelves incorporated in the precast walls improve robustness and programme time, as do shower trays incorporated in the precast floors.



The nature of the offsite precast solution with many incorporated services such as gullies, shower heads and conduits, eliminated most of the construction waste. Attention given to recycling of existing materials also reduced waste on site: cut and fill was balanced, and arisings were recycled in road construction and crane mats. Water usage was reduced by electronic control of water for flushing and taps.

Use of BIM reduced the space wasted in service risers through better co-ordination and tighter packing of the services.

The team maintained overall control of waste generated to enable a full review of the types of waste and amounts generated. Overall waste generated on site equated to less than 0.25 per cent of the overall contract value, the majority of which was segregated and sent for recycling.

An improvement on the contract programme of 40 per cent was achieved for the frame and 50 per cent for the roof.

The net result was hand-over to the client 14 weeks earlier than the contract demanded.

The project was handed over with zero defects. It was highly commended by local government building control at the Quality in Building Awards and was a finalist in *Building* magazine's Supply Chain of the Year Awards.

The high use of off-site manufacture resulted in fewer vehicle movements on site and contributed to the project winning the Gold Considerate Constructors Scheme (CCS) National Award.

Reduction in energy usage has been achieved through improved air-tightness and continuity of insulation.

The entire project was constructed without a single lost time accident. This is a tribute to the approach which reduced the need for temporary works and potentially dangerous activities on site. Examples include early installation of balustrades, prefabricated plant rooms and lifting eyes in the pre-cast panels. Use of large roofing sheets craned into place minimised joints and reduced manual handling risks.

The client MOJ and Serco (David Kirkham, Project Director) commented: "The thoughtful and expertly delivered design includes generously proportioned spaces that are well lit and attractively decorated. The vocational training rooms and the multi-faith room are particularly impressive. They contribute to the building having a "wow" factor that impresses lay and expert visitors. Not only is this a high quality building but it was delivered to the prison 14 weeks early. I have been enormously impressed with the way Skanska strived to deliver the highest standards on site. It was always clean, well organised and safe. Off site, Skanska took great care to minimise any adverse impact the project had on the immediate environment and Dovegate's neighbours."

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### Case study 14: Carclaze School, St Austell, Cornwall, Pipe Center Modular Engineering

#### Benefits

**Time:** faster installation time on site

**Quality:** right first time performance

#### Client: Cornwall County Council

#### The project

The new Carclaze school in St Austell will bring together the 420 pupils from the existing infant and junior schools within a state-of-the-art building, with open plan learning and sustainability as key design factors.

Pipe Center's Modular Engineering was selected to design and build a complete modular mechanical and electrical services installation. The off-site assembled modular design covers pipe work for all heating, chilled water, domestic water and electrical containment systems required for the 2,400sq m school.

Building services consultant EIC South West specified the modular approach from Modular Engineering due to its significant cost, time and quality advantages. Main contractor on the project was Kier Western.

George Cox of EIC said: "We are convinced of the benefits of modular off-site assembly. We have employed Modular Engineering on a number of projects to date and it is proven to dramatically reduce the time required for installation on site, while ensuring an exceptional quality result. It is a transformational approach. The multi-service



modules are built off-site in clean factory conditions and pre-tested. This means that once delivered to site, completed modules can be very efficiently connected up to create a fully tested system."

Bob Hughes, who heads Pipe Center's Modular Engineering facility, said: "Carclaze School provides another excellent example of how a modular off-site approach to building services can transform the speed and quality of the end result.

"Once clients see the compelling advantages of off-site modular engineering, they are convinced and there is no going back. With ever-shortening lead times on projects and pressure to increase quality, we believe that all commercial building services projects will one day be delivered in this way."



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### Case study 15: Bonded warehouse installation, Accio Group

#### Benefits

**Cost:** reduced project cost compared to alternatives

**Time:** rapid construction time

**Sustainability:** potential for easy reconfiguration to meet changing needs

#### Client: Sainsbury's Supermarkets Ltd

#### The project

Accio Group installed a temporary bonded warehouse for Sainsbury's Supermarkets to facilitate the timely expansion of their existing facilities.

The 30m x 100m temporary structure, which stands 6.2m high at the eave and 11.2m at the apex is the largest



temporary facility that Sainsbury's have developed and is believed to be the largest of its kind in the world. The 3,300 m<sup>2</sup> structure was constructed in three weeks.

With a build schedule of just three weeks, the speed of installation allowed Sainsbury's to manage their expansion plans quickly and effectively, minimising disruption both at the site and ultimately to the customer.

Processing an estimated £30m–£40m of dutiable goods every week, the structure provided Sainsbury's with a highly secure and versatile space, which has the potential to be reconfigured and expanded as and when required with state of the art internal fit-out.

For a time lapse demonstration of the build, go to:  
**[www.acciogroup.com/group\\_news.asp?nid=165&newsid=410](http://www.acciogroup.com/group_news.asp?nid=165&newsid=410)**

This warehousing solution supports the business case for off-site building methods as the structure is formed from pre-manufactured standard component parts that:

- are delivered directly to site and rapidly assembled to form the building envelope in a matter of days

- ensure minimum impact on the site and on the build schedule
- allow for rapid installation times, which significantly reduces costs
- provide the flexibility required in highly reactive dynamic marketplaces such as retail.

During the past four years, Accio Group has supported Sainsbury's expansion plans by working closely with their construction and delivery team to install a diverse range of storage facilities, as well as store extensions, replacements and cafés. Accio Group is the nominated supplier to Sainsbury's and will be supporting the retailer's commitment to providing new jobs, and an increase in operational and retail space throughout 2011 and 2012.



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### Case study 16: HMP/YOI ISIS, Thamesmead, South East London, Interserve Construction Ltd

#### Benefits

**Cost:** more rapid construction on site leading to cost savings in preliminaries and more efficient working on site

**Time:** substantial reduction in construction time on site

**Quality:** right first time quality adding to zero defects at completion

**Sustainability:** reduction in waste

**Client:** Ministry of Justice

#### The project

Under the MoJ Strategic Alliance, Interserve recently constructed a 480 place Category C (built to Category B standards) secure training prison for young male adults (18 to 24 years) on the unused sports pitches and farms and gardens area of HMP Belmarsh, South East London.



The £115m project comprised:

- a 480 bed house-block with integral sanitation and showers
- combined gatehouse, entry block and visitors' centre
- prisoner reception and discharge unit
- kitchen for 500 meals per sitting, three times per day
- education department
- workshops
- care and control block (segregation)
- sports facilities and external works.



Outside the secure perimeter a single storey energy centre housed a combined heat and power plant, biomass and gas boilers and meters.

During both the design and construction phase there were a number of challenges including very poor ground conditions, confined working areas and working next to Britain's most secure prison.

The project achieved BREEAM "Excellent" for all of its constituent parts.



### The construction

An integrated supply chain and design team both with a track record on similar projects included HLM architects, Arup, Tier structural engineers, and building services design and build contractor SPIE Matthew Hall. Their long term relationship with Interserve facilitated continuous improvement in support of process and product innovation.

For this project the vast majority of building components were manufactured off site and delivered “just in time” for installation on site.



The houseblocks are constructed using precast concrete modular units that provide a number of benefits including reduced time and number of operatives on site. A precast core is typically erected in three weeks using six operatives as opposed to 11 weeks with 40 operatives for a cast *in situ* core on site. The level of co-ordination included casting in of window bars, cell door frames, building services containment and builders’ work holes. This achieved significant reductions in manual handling, working at height and materials stored on site.



Manufacturing under factory conditions gave reduced material waste and a finished product that was ready to receive decoration.

Prefabricated service riser frames consisting of structural steel elements provide the structural stability to the modular units. This is in addition to the association space balconies that are fully loaded with “plug and play”

distribution boards, lighting control, hot and cold water manifolds, ductwork and plumbing, further reduces safety risks and increases programme gains.

The external façade to the Entry, Central and Sports buildings is constructed using TIMS (Thermally Insulated Modular System) panels, which were developed by Interserve to reduce typically high risk activities on-site such as brick and blockwork. The panels were cast off-site and delivered “just in time” to be erected.

TIMS panels provide programme gains on milestone activities such as a watertight building, enabling following trades to start sooner and reducing the overall construction programme.

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### Case study 17: Countryside Properties Development, Saxon Park, Warrington, Sheffield Insulation Group (SIG)

#### Benefits

**Cost:** compared to a traditional raft foundation, for this site there was an estimated saving of >£500/plot

**Time:** reduced construction time on site

**Quality:** right first time thermal performance including minimisation of thermal bridging and excellent air tightness results

**Sustainability:** reduction in site waste and reduced carbon in use

#### Client: Countryside Properties

#### The project

Countryside Homes has used SIG's Insulslab to help them achieve an additional 25 per cent enhancement of performance above the requirements of the Building Regulations on their new build housing project at Saxon Park, Warrington. The use of Insulslab also delivered considerable savings in cost and time compared to, in this case, a traditional raft foundation solution as well as delivering right first time quality that traditional methods would be hard pressed to match.

Insulslab is a foundation system that utilises EPS (expanded polystyrene) pods, manufactured within the SIG Group, covered by steel reinforced concrete to achieve U values of typically 0.1–0.12 W/m<sup>2</sup>K. The system is BBA approved.



Used in conjunction with a standard open panel timber frame system at Saxon Park, Insulslab offered improved air tightness and with excellent integration of the two systems, virtually eradicated thermal bridging at the junctions.

Various site challenges were also resolved since the system requires minimal ground excavation and no trenches, and easily accommodated the sloping parts of the site and a stepped construction of 2.2m.

Andrew Fox of Countryside Properties commented that the excellent thermal performance made it easier to meet the required performance without having to increase floor depth or wall insulation. In comparison to traditional raft techniques the plot foundation was completed within three days rather than the anticipated week – a 57 per cent reduction in site time. Manual handling issues were also lessened.

For masonry walls the system can be used up to three storeys and for timber frame up to 4/5 storeys.



Mark Gray, Business Development Manager of SIG, concludes: "Insulslab is specified for three reasons: time and cost saving, together with excellent thermal performance."

For further information please visit: [www.insulslab.com](http://www.insulslab.com)

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## Case study 18: Hull Royal Infirmary, Clinical Skills, Dermatology and Ophthalmology Unit, Hull Royal Infirmary

### Benefits

**Cost:** a cost saving to the client as a result of the reuse of refurbished modules already in the Trust's ownership

**Time:** a six month reduction in construction time on site

**Sustainability:** the on-site dismantling, refurbishment and reuse of 50 existing modules already in the ownership of the Trust rather than opting for a wholly new build solution led to a considerable saving of resources and capital and also minimised waste to landfill and transport costs.

## Client: Hull and East Yorkshire Hospitals NHS Trust

### The Project

Hull and East Yorkshire Hospitals NHS Trust needed a new state-of-the-art outpatients and medical training facility at Hull Royal Infirmary for up to 90,000 patients each year, as part of a £7m investment to help meet the increased demand for its services and replacing some out-dated buildings. The project, which involved a very constrained site, required the construction of pile foundations and also the removal of asbestos.

The new building required an ophthalmology department on the ground floor, dermatology services on the first floor and a clinical skills centre that provides high quality training facilities for doctors on the upper floor.



Key requirements for the project were to incorporate the structure of an existing two-storey modular ward block (50 modules) into the new scheme, to minimise disruption to the adjacent hospital building, and to deliver the facility in the shortest possible timeframe to the benefit of patient care.

*Portakabin* was appointed design and build contractor by the Trust with design by HLM Architects. *Portakabin* developed a bespoke design solution for the project, taking responsibility for:

- design, including bespoke structural design and space planning
- planning submission and approvals
- refurbishment and relocation of the existing modular building
- ground works, including foundations
- off-site manufacture
- M&E design and installation
- fitting out
- final commissioning.

The innovative and highly flexible approach from *Portakabin* combined 50 specially manufactured steel-framed modules with 50 units from the modular building that had become surplus to the Trust's requirements. *Portakabin* recycled and fully refurbished this structure, which included stripping out each module and installing new windows, upgrading the floor and re-lining internal walls.



This approach to recycling and reusing an existing modular structure for a completely new, purpose-designed facility made the project both highly sustainable and cost effective – and demonstrates the flexibility of modular construction when a building is no longer required.

The *Portakabin* solution successfully reduced the programme time, which then minimised disruption to patient services – a key issue for the Trust because of the close proximity of the scheme to the main hospital.

*Portakabin* delivered the 3000sqm (200 room) facility to a challenging programme, handing it over after just seven months on site.





## A sustainable building solution

In addition to its partially recycled structure, the scheme has a number of other sustainable features, including:

- a central atrium, which runs the full length of the building, maximising natural light and ventilation and reducing the reliance on artificial lighting while creating a high quality and welcoming patient environment
- heating and hot water for the ground and first floor provided by an existing steam system
- windows to all perimeter rooms to allow natural ventilation
- movement and daylight sensors to control the high frequency lighting
- air source heating and cooling pumps for the first floor
- partial heat recovery ventilation
- internal solar shading to every window to reduce heat gain
- hard wood from sustainable, certified sources
- a Building Management System (BMS) to monitor and control the building's M&E services for optimum energy efficiency



- the modular approach ensured fewer vehicle movements to site and less material waste to further improve the building's carbon footprint.

## The Trust's perspective

Duncan Taylor, Head of Estates, Hull and East Yorkshire Hospitals NHS Trust said: "Speed was the principal reason for using modular construction for this project, which enabled us to reduce the programme time by around six months. The *Portakabin* solution also allowed us to reuse the structure of an existing modular ward building, minimising both cost and waste sent to landfill.

"The result is a really excellent scheme with facilities we are very proud of. Feedback from staff and patients has been extremely positive since the building opened."

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## Case study 19: Accommodation “Village”, Sullum Voe, Shetland Islands, Caledonian Modular

### Benefits

**Time and cost:** completed to time and cost in an isolated and often hostile working environment

**Quality:** met demanding client requirements in a challenging and remote location

**Sustainability:** design and construction with a view to dismantling and relocation in approximately five years. Renewable energy through pre-installed solar panels for domestic hot water

### Client: Petrofac

### The project

High quality modular accommodation and amenity buildings for 850 workers constructing a new processing



plant at Sullom Voe for the Laggan Tormore offshore gas field being developed by Total.

Caledonian Modular was awarded the contract by main contractor Malthus – a specialist contractor for the oil and gas industry.

The project involved the construction of 424 twin ensuite bedrooms arranged in five interconnecting hotel style blocks plus a 3,200 m<sup>2</sup> amenity block and 4,000 m<sup>2</sup> of offices. All buildings had been designed and constructed to meet the exceptionally severe local weather conditions with wind speeds that can exceed 140 mph.

Distance, weather conditions and lack of local labour meant that maximum use was made of offsite construction methods to ensure productivity, quality of the finished buildings and to facilitate rapid installation on site.

The village was constructed from 482 modules constructed in Caledonian's factories in Newark, Nottinghamshire and at Driffeld, Yorkshire and delivered to site using the Aberdeen to Lerwick roll-on roll-off ferry.



The project was designed and constructed to allow for easy dismantling and relocation in five years. The division of the building into separate zones with their own plant and services will allow for the building to be shipped to other sites and as necessary used as smaller buildings without having to be refitted.



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## Case study 20: PodSolve, Leeds East Academy, Interserve Construction

### Benefits

**Cost:** over 30 per cent reduction in school building costs. Cost per sq m: £1,470

**Time:** over 30 per cent reduction in school building time

**Quality:** high quality materials reduce noise and allow for enhanced "passive supervision"

**Sustainability:** well sealed, well insulated buildings incorporating combined heat and power plant, lighting control systems and photovoltaic panels. An adaptable solution. Relocatable for refurbishment or at end of life

**Client:** The E-ACT Leeds East Academy,  
South Parkway, Seacroft, Leeds LS14 6TY

### The project

The E-ACT Leeds East Academy accommodation, a new school building in Leeds for 1,100 pupils, is set to provide a benchmark for future school building programmes. It is the first to be built using the new Interserve PodSolve concept, which offers a competitive build cost and reduced installation time, while providing high-quality teaching accommodation.

PodSolve comprises a series of steel-framed rooms or classrooms that can be easily fitted together to create a modern, fully-flexible school environment. It has been developed in a partnership between Interserve, Maber Architects, Norwood (the pod manufacturer) and Arup.



PodSolve can ensure that Britain's children continue to benefit from improvements in the school learning environment. Crucially though it is a built environment that offers local authorities and academies a cost-effective option, regardless of the funding pressures they are under.

## Main drivers and constraints

- government cuts of £1bn from the schools' budget and the cancellation of £55bn *Building Schools for the Future* programme
- recommendations in the James Report *Review of Education Capital* that time and cost savings in new build projects were possible, and that new buildings should be "based on a clear set of standardised drawings and specifications that will incorporate the latest thinking on educational requirements and the bulk of regulatory needs".

## The solution

Interserve believes PodSolve is the answer to providing more for less, with the initial project being constructed on behalf of the E-ACT operated Leeds East Academy.

- the original estimate for Leeds East Academy (1,100 pupil capacity) in June 2010 was £19m. Following the programme revisions, the budget was reduced to £14m. The PodSolve solution beats even this lower figure – it will cost just £13.65m
- the building is a state-of-the-art design and will be delivered in just 60 weeks – compared to traditional methods, which typically take up to 80 weeks to construct. The improved building and construction time should help schools make an extra inflationary cost saving
- the Pods are manufactured from composite panels within a rigid steel frame. These materials and toughened glass greatly reduce noise and allow for enhanced "passive supervision", ensuring the built environment is as conducive to learning as possible
- the shape and layout of the school removes the traditional school corridor and regimented classroom approach. This is replaced with the creation of Pods that can be moved, added or removed in just five days per Pod to cater for changing school requirements







- the flexible building style allows for sections of the school to be separated from others. This opens up the possibility of allowing the local community to benefit from the facilities
- the Pods can fit in with more traditional construction – as is the case in the Leeds East Academy where the assembly hall, science laboratories and a gym form the north side of the building
- the PodSolve school is environmentally friendly, with photovoltaic panels, a well sealed, well insulated building, a combined heat and power plant, and lighting control systems.



intelligent way to go forward was to use the new concept building, which offered us so many opportunities that the other two options didn't. I've been able to work closely with the architects to plan the building round our new curriculum and we've been able to build a great school environment, with a very tight budget, in a very short space of time."

The project is set for completion in March 2013 and installation of the Pods will start in October later this year.

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## Comment from the client

Helen Lane, Principal of Leeds East Academy, has been closely involved in the project: "we originally had £19m of BSF money that was reduced to £14m following the post education budget reviews. We looked at the options provided by refurbishment of the existing buildings and by building a traditional school, and clearly the most





## Case study 21: Project Allenby/ Connaught, Wiltshire and Hampshire, Ormandy Group

### Benefits

**Time:** the programme for each building was reduced from a planned 37 weeks to just 14 weeks (a 62 per cent reduction in overall time)

**Cost:** reduced site supervision and management plus reduced labour on site

**Quality:** defect free on commissioning

**Sustainability:** reduced material waste

**Health and safety:** no reported accidents on site

## Client: Aspire Defence Ltd / MoD

### The Project

Project Allenby/Connaught is the £8bn services and accommodation rebuild project for the army garrisons around Salisbury Plain and in Aldershot. This is the largest modular construction project so far in the UK. The construction budget is £1.2bn.

Ormandy's multimillion pound contract included the supply of 153 fully fitted plant rooms including boilers, calorifiers, pumps and controls. The modules also included renewable energy installations including solar and CHP plus rainwater harvesting. All modules and installations were tested at Ormandy's works in Halifax West Yorkshire prior to delivery to site and installation into Junior ranks single living accommodation.

Challenges for Ormandy included:

- a significant reduction in the timescale allowed by the client for the design of the initial units

- integrating production within Ormandy's existing manufacturing facility
- controlling the weight of the finished units
- construction of 14 plant rooms before first commissioning.

The first installation commenced on site in November 2006 with the final module installed in June 2011.

The key factors that influenced to client's decision process to go with the off-site solution where as follows:

- speed of construction
- reduced requirement for site labour and security clearance
- the lack of skilled labour available in the local area
- finished quality with plantrooms tested prior to delivery
- onsite health and safety benefits
- reduced site supervision and management.

Manufacture of plantrooms in Halifax

Lifting and positioning of plant rooms onsite

Initial phase of construction with one building commencing each week

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## Case study 22: The Shard London Bridge, Ormandy Group Ltd

### Benefits

**Time:** the use of offsite manufactured and tested building service installations ensured programme certainty meaning that these components could be taken off the critical path allowing the client to focus on logistics and sequencing

**Cost:** reduced site supervision and management plus reduced labour on site

**Quality:** defect free installations

**Sustainability:** reduced material waste

**Health and safety:** no reported accidents on site, no hot work on site

- offsite construction de-risks aspects of health and safety onsite, many of the construction interfaces with other building trades such as brick layers, plaster boarders are eliminated
- manufacturing quality is vastly improved in a controlled factory environment. All trades such as controls, electrical and insulation are completed and verified offsite, this ensures that when the package gets to site it is a complete finished article ready for installation and incorporation into the project
- built in programme certainty, the offsite elements can be taken off the critical path. The client just needs to control logistics and sequencing.

For further information or enquiries, please contact the Ormandy Group on: 01422 350111, email: [sales@ormandy ltd.com](mailto:sales@ormandy ltd.com)

## Client: Mace MEP

### The Project

At just under 310 metres this is the tallest building in Europe. Ormandy's contract required the supply of packaged pump assemblies, packaged heat exchangers, packaged DHW calorifiers along with heat interface packages.

The client's approach to M&E installations was modelled on the use of offsite manufactured installations from initial concept. The client requirement was to simplify the engineering sequence, improve quality, de-risk the project programme and minimise onsite M&E interfaces.

Installations were scheduled for completion 1 month before delivery date. Sign off was carried out at the Ormandy facility.

The three main benefits of off-site manufacture identified by the client were:



Chilled water pump set package



Chilled water plate heat exchanger package

## Case study 23: HMP Oakwood, Featherstone, West Midlands

### Benefits

**Cost:** capital savings estimated at £5m – attributable to maximising the use of offsite solutions for structural elements, roofs, services and Energy Centre

**Time:** delivered to time and judged to be substantially quicker to build than a traditional construction project. 76,000 man hours of construction activity saved from using pre-cast solutions

**Sustainability:** substantially reduced waste on site, significantly reduced manpower on site BREEAM Excellent

**Quality:** excellent quality of factory made components. Right first time fit of walling panels and roof cassettes

**Health and safety:** during the 2.7 million man hours worked on the project there were only three reportable incidents. Pre-casting of concrete panels with finished external façade minimised the need for scaffolding limited the need for working at height

## Client: Ministry of Justice (MoJ) on behalf of NOMS (National Offender Management Service)

### The Project

The scheme consisted of the design and build of a new generation £200m self-contained prison complex, to be built on a site that is adjacent to two existing custodial facilities. The completed new prison occupies a site in access of 20 hectare with over 7km of security fencing. Designed and constructed as a stand-alone facility, but with potential to share facilities and staff with the existing prisons, if the need arises.





The design and site layout is configured to enhance levels of security, whilst reducing the requirements for operational staffing. The completed prison provides 1,605 prisoner places in four storey house blocks, with each element designed to create carefully controlled community sizes and maximising prisoner flow, in a secure and controlled environment.

When fully occupied, this new prison will rank as the largest in the UK and the second largest in Europe.

The construction team was formally appointed in June 2009, with multi-phase development with work commencing in January 2010 and all works fully completed by June 2012. Kier was the main contractor with Balfour Beatty Engineering Services delivering the prefabricated service modules and a collaboration of six pre-casting companies delivering the pre-cast walling products on a 'just in time basis', with PCE acting as a central integrator, co-ordinating all the pre cast manufacturers logistics.

Considerable input from MoJ, acting as the 'intelligent client', provided effective client leadership during all

phases of the construction project.

The MoJ was supported by client representative, Faithful+Gould, lead technical assessor, Aedas and cost consultant, WT Partnership. The client and Kier's project team undertook day to day monitoring of the design and construction activities using class leading 'Lean' management practice.

## Main drivers and constraints

As project brief called for the operation of the prison to be competitively tendered, so it was paramount that the built environment was delivered to achieve the MoJ specific technical requirements and on time.

Now completed, the scheme is the most substantial project the MoJ has undertaken to date and is viewed as an exemplar demonstration of team working and increased client value. This was achieved by open communication, team ethos and combining effective design with maximum use of offsite solutions to reduce whole life cost. This has achieved substantially reduced operational costs, which is now being used as a bench mark across the MoJ estate.

The Project demonstrated the MoJ's capability to deliver a traditionally procured public sector build 'on time' and 'on budget'.

## The solution

Standardisation of walling and flooring solutions required the supply chain to deliver 15,000 precast concrete panels to consistent high quality and excellent visual appearance. Windows, security features and service ducts all cast *in situ*.

PCE, acting as the offsite concrete system integrator, thus managing and quality and production outputs from six separate sub-suppliers. This approach formed the strategy which successfully 'de-risked' this critical element of the project.





## Key facts

15,000 pre cast components, 77% of the pre cast components within the house blocks alone.

- 12,500 conduits assemblies, including shower heads and drains incorporated within the precast concrete panels – reducing 5,000 site hours
- Unistrut cast in to the precast concrete panels for the support M&E services – reduced 40,000 builders work holes and 1,250 site hours
- 4,416 under floor heating mats incorporated within the floor panels – reducing 1,500 site hours
- 240 prefabricated vertical risers with pre insulated ductwork and pre installed wiring looms – reducing 32,300 site hours.
- 30 air handling unit skids including ductwork, pipe work, insulation, wiring and controls – reducing 4,800 site hours
- 40 domestic hot water skids including pipe work, insulation, wiring and controls – reducing 12,800 site hours
- only three reportable incidents in more than 2.7 million man hours worked
- record levels of reduced on site material wastage.

## Additional benefits of offsite solutions

The use of precast concrete panels and prefabricated and pre-tested mechanical and electrical (M&E) systems reduced the impact on the local environment with reduced vehicle movement and labour levels on site.

## Comment from the client

Oakwood is a demonstration of effective public sector delivery. We the MOJ, as the client, led the project with a focus on realising the benefits of a modern 'fit for

purpose' prison establishment, that are cost effective to run and provided an environment that supported effective rehabilitation of its occupants, while also providing a great place for staff to work.

In addition is showed how class leading 'Lean management' can be used to support a collaborative working arrangement between the client and every member of the delivery team.

Offsite manufacture was also a key component in the success of this project. The MoJ encouraged and supported this approach through all stages of the project as offsite manufacture sits very firmly within the lean ethos of reducing waste.

The final project delivered an excellent facility meeting all the set objectives of time, cost, quality and safety. Of course there are lessons to learn, these include even more effective use of lean practice and process across all areas of the project. However, we will not change our total commitment to maximise the use of offsite construction methods.

This was a great project and a credit to all those who worked on its delivery.

# Members and Governance

## About

**Buildoffsite** is a not-for-profit organisation wholly focused on the development of UK off-site construction.

**Vision:** a commercially viable UK offsite industry, achieving national construction objectives, competitive internationally and delivering quality, predictability, value-for-money and a sustainable built environment.

**Mission:** to bring about a step change in the exploitation of offsite applications in construction.

## Governance

Buildoffsite is an independent, Membership based, Membership driven, organisation managed by an executive group drawn from its Members.

## Buildoffsite Executive Group

The executive group draws on advice and support from two key Buildoffsite managed groups namely, the client executive advisory group and the direction group. These groups provide direction and insight into the potential opportunities and challenges for the development of the UK offsite industry. These groups have a rotating Membership drawn from the Membership and industry to help support continued development of the organisation and its activities.



Richard Ogden (Chairman)

**buildoffsite**  
formerly  
McDonald's  
M4I



Nigel Fraser



Bill Healy



Ian Pannell



Cal Bailey



Roger Bayliss



Keith Blanshard



John Miles



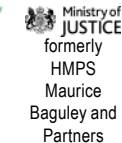
Nick Whitehouse



Giles Price



Terry Stocks



Anna Whiting



### Buildoffsite members

Accio  
AcerMetric  
Anglian Water  
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Bryden Wood Limited  
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Donban Ltd (Vision)  
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IBP (Integrated Building Products)  
IFPI  
Interserve  
Invest Northern Ireland  
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McAvoy  
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Mott MacDonald  
NG Bailey  
One Creative Environments Ltd  
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Portakabin  
Premier Interlink (Waco UK Ltd)  
Sainsbury's  
Saint-Gobain  
SealEco  
SEGRO plc  
SES Ltd  
Shepherd  
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Skanska  
Stewart Milne Timber Systems  
Structex  
TATA Steel Products  
Tekla  
TotalFlow  
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### Associate members

British Precast  
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Concrete Society  
Construction Products Association  
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Liverpool John Moores University  
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RIBA  
RICS  
SCI  
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