Offsite Construction Skills

Final Report

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Executive Summary

Developing offsite construction capability is a key priority to address poor productivity in the sector and meet government housing targets.

The primary purpose of this project was to develop the capability and capacity of the construction industry training network by developing, and making available, a range of high-quality training materials that are freely available for trainers, and through the upskilling of existing and new trainers. This includes 14 new and 13 updated industry CPD modules, and two short programmes to train trainers and upskill technicians and apprentices.

This project has been funded through a CITB grant and matched by the partners. It was led by The Manufacturing Technology Centre [MTC] and supported by two main delivery partners, the Supply Chain Sustainability School [School] and the National Open College Network [NOCN]. Through close cooperation with industry experts, it has produced a range of learning materials and upskilled trainers to allow them to continue to deliver benefit to the construction industry. Despite challenges and a delay of a year during the worst of the pandemic, the project has risen back to its feet to deliver a modified, but still engaging and beneficial offering that is more accessible to the construction industry, examining skills in offsite management, logistics, modern methods of construction and lean manufacturing to name but a few. These are offered in a combination of learning methods including learner led online content, virtual classrooms and some face to face opportunities. Pilots of the two short programmes have been completed with overall positive feedback, and the Industry CPD modules have already been completed by well over 1000 people in the two years that they have been available.

1 Introduction

1.1 Objectives

The main objectives were to:

- Develop training programmes for professionals through short duration courses
- Develop training for students in apprenticeships and vocational training [VQ] courses
- Embed the training into existing courses aligned to existing and emerging relevant qualifications
- Develop the capability of trainers of VQ students, apprentices and professionals.
- Improve the overall offsite competency of those entering and those already in the industry and their supply chain.

Our overall approach was to develop consistent training materials for professionals and students alike and to upskill trainers to deliver these. The effectiveness of the offering was tested through a series of pilots with feedback from users, as well as through an assessment of trainers to validate the approach. The project focused on the following topics: an introduction to offsite; design for manufacture and assembly; common materials and systems; and behaviours and soft skills.

1.2 Project Timeline

The project began in April 2019 with a planned completion of June 2020. School completed on time, managing to finish their online courses during the first lockdown, but MTC were unable to run their scheduled face-to-face courses due to COVID lockdown restrictions.

As restrictions eased and the construction industry gained some sense of normality the MTC resumed this project in October 2021 with two Train the Trainer [Upskilling Learning Professionals in Offsite Construction] sessions and the Assembly Operator training remaining.

The project completed in February 2022.

2 The Project

2.1 Stakeholder Engagement

As well as the early activities of assembling an advisory group and mapping the interested parties, much work was carried out to engage providers and employers in the pilots of the courses.

During the course of the project there have been many organisations that have supported it in some way, whether this be attending one of the engagement sessions or advisory group meetings, providing guidance on the material and subject matter to be included in the training or providing candidates for the training pilots. A full list of organisations that participated in any capacity can be seen in Appendix A.

2.2 Standardised Body of Knowledge

The project determined the requirements for a Standardised Body of Knowledge [SBOK] and identified an existing, substantial document that already existed for CITB by Edinburgh Napier University [Mila Duncheva, 2019].

Although still in draft, this was adopted by the project since it did everything required and no need was identified to duplicate this work.

2.3. Industry CPD Modules

The intention at the outset was to create a range of seven learning modules that would be aimed at specific professions: Designers, Quantity Surveyors and Cost Consultants, Procurement Specialists, Logistics Managers, Project Managers, Site Managers and Site Assemblers.

For each module, there would be two outputs:

1. A PowerPoint slide deck complete with a Speaker Guide and Notes. This would be used by facilitators to present short-duration workshops of approximately three hours in front of 'live' audiences.
2. An e-learning module of approximately 45-60 minutes duration, including a knowledge quiz with an 80% pass score.

As a result of the project the School have created and made publicly available 6 new classroom-based training courses with all the materials to run a full day of introductory training for key construction management functions. These classroom courses are now being delivered virtually using a "flipped classroom" learning approach.

The approach was to gather together industry experts in a series of two-hour workshops to establish, through brainstorming and discussion, what they felt should be the key learning points for each profession. The fundamental underlying question at each workshop was, therefore, 'What do I need to do differently when delivering an offsite project?'

In each of these workshops, the attendees were from a wide range of companies and all of them had experience in offsite as well as traditional construction. Furthermore, each of them was willing to share those experiences, both good and bad!

The outputs from these initial workshops were used to determine the key learning points and to

think about the appropriate combinations of pure teaching and interactivity in the form of exercises. These ideas were submitted back to the groups as the materials were refined until the project was satisfied that the materials were sufficiently developed to present them as pilot courses.

Once the pilot courses had been run and feedback received, the final versions were used as the basis of storyboards to help design the respective e-learning modules.

The project has developed 8 accompanying e-learning modules. These focus on the same 6 construction functions as the classroom based courses with two additional, overarching modules that deal with fundamentals of various offsite systems, and how offsite can be applied to various sectors. One of the original six titles has been replaced by two modules (as agreed by CITB). The modules are:

1. **Offsite fundamentals - Systems** - This e-learning was agreed to replace the assembly module.
   https://learn.supplychainschool.co.uk/mod/scorm/view.php?id=3989
2. **Offsite fundamentals - Sectors** - This e-learning was agreed to replace the assembly module.
   https://learn.supplychainschool.co.uk/mod/scorm/view.php?id=3991
3. **Introduction to Offsite - Design**
   https://learn.supplychainschool.co.uk/mod/scorm/view.php?id=3864
4. **Introduction to Offsite** - Procurement
   https://learn.supplychainschool.co.uk/mod/scorm/view.php?id=4039
5. **Introduction to Offsite - Cost Consultants** (for Quantity Surveyors/Cost Consultants)
   https://learn.supplychainschool.co.uk/mod/scorm/view.php?id=4126
6. **Introduction to Offsite - Logistics Managers**
   https://learn.supplychainschool.co.uk/mod/scorm/view.php?id=3943

7. **Introduction to Offsite - Project Management**
   https://learn.supplychainschool.co.uk/mod/scorm/view.php?id=3949
8. **Introduction to Offsite - Site Management**
   https://learn.supplychainschool.co.uk/mod/scorm/view.php?id=4128
9. **Assembly module - not developed.**
   Change agreed with CITB.

2.4. Offsite School Updates

As well as developing new materials the project also updated 6 e-learning modules that focused on offsite through the construction phases of: design, manufacture, logistics, assembly, and maintenance.

Stakeholder engagement paid dividends in the creation of the Industry CPD modules with over 20 major contractors and design practices providing input into the development of the CPD modules. These attended a number of content workshops to develop and review the material.

The project team also updated 7 modules that deal with the management skills required to deliver offsite; collaboration, leadership, change management, supply chain management, project management and quality. Working with subject matter experts such as the Institute for Collaborative Working and the Get it Right Initiative, GIRI. On the subject of quality management, working on the advice of the Get it Right Initiative the project also created a new e-learning module, jointly with GIRI, on Right First Time.

In total, therefore, 28 learning courses have been created by School. This includes 22 e-learning modules and 6 classroom courses. All are publicly and freely available on the School's web site, https://www.supplychainschool.co.uk/topics/offsite/. They are all listed on the opposite page (Figure 1).

New training courses developed over the last 12 months

Offsite Fundamentals: (e-learning)

1. Offsite systems
2. Offsite Sectors

Job function: (e-learning & classroom)

3. Design
4. Project Management
5. Procurement
6. QS & Cost Consultant
7. Logistics
8. Site Management

Construction lifecycle: (e-learning & classroom)

9. Design for Manufacture & Assembly
10. Design: Product & Process
11. Offsite Manufacturing
12. Logistics
13. Onsite Assembly
14. Maintenance

Management topics (e-learning updated)

15. Leadership
16. Change
17. Collaboration
18. Supply Chain Management
19. Quality Management
20. Get it Right First Time [New with GIRI]
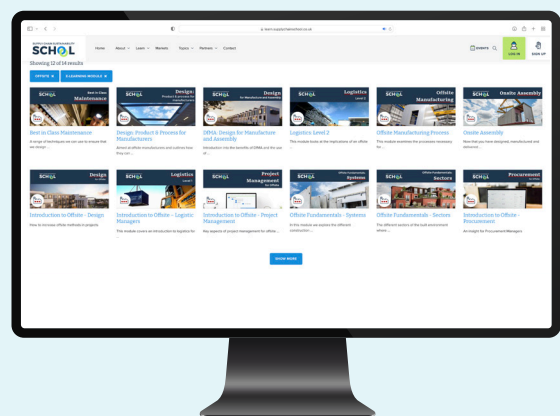21. Project Management
22. Marketing

Figure 1. List of new training courses.

To date

▸ More than 40 sessions have been held across the range of the Industrial CPD modules
▸ Over 1100 people have attended these sessions
▸ Of those trained, nearly 900 were by trainers that had undertaken Industry CPD modules prior to delivery.

2.5 Development of trainer capacity for School courses

The project has developed a list of 10 trainers to be able to deliver the new School courses.
This is in addition to the objectives of the course.

The original intention was that these trainers were to attend the MTC's week-long Offsite Train the Trainer course that would equip them with a knowledge of the fundamentals of Offsite such that they could teach the material.

Due to COVID19 this was no longer possible and the most pressing need for our trainers was how they could deliver the training in a virtual environment. As a result, School devised a Train the Trainer course over a 3-week period that aimed to equip their trainers to "deliver engaging content in a virtual world".

This was well received by the 10 trainers who participated in the two cohorts.

2.6 Train the Trainer

The Train the Trainer programme is designed for trainers who intend teaching Offsite Construction and Modern Methods of Construction to others. Its intent is to provide these trainers with enough information on a number of relevant topics so that they can teach and/or design learning programmes on the subject for others, including delivery of the Assembly Operator programme. It is not intended to make these trainers experts in the subject as this can only come with immersion and experience in the field, but it is intended that they will complete the programme with a much more rounded understanding than

they did prior to attendance.

The Train the Trainer pilots consist of a number of elements. These include a diagnostic tool, pre-course online learning, seven modules taught face to face over five days, and learner feedback to allow the course to be continually improved. The diagnostic tool assesses learners both before and after training in order to measure the success of the course. The components, their stage of use and the method employed are shown in the infographic of Figure 2. Train the Trainer pilot configuration.
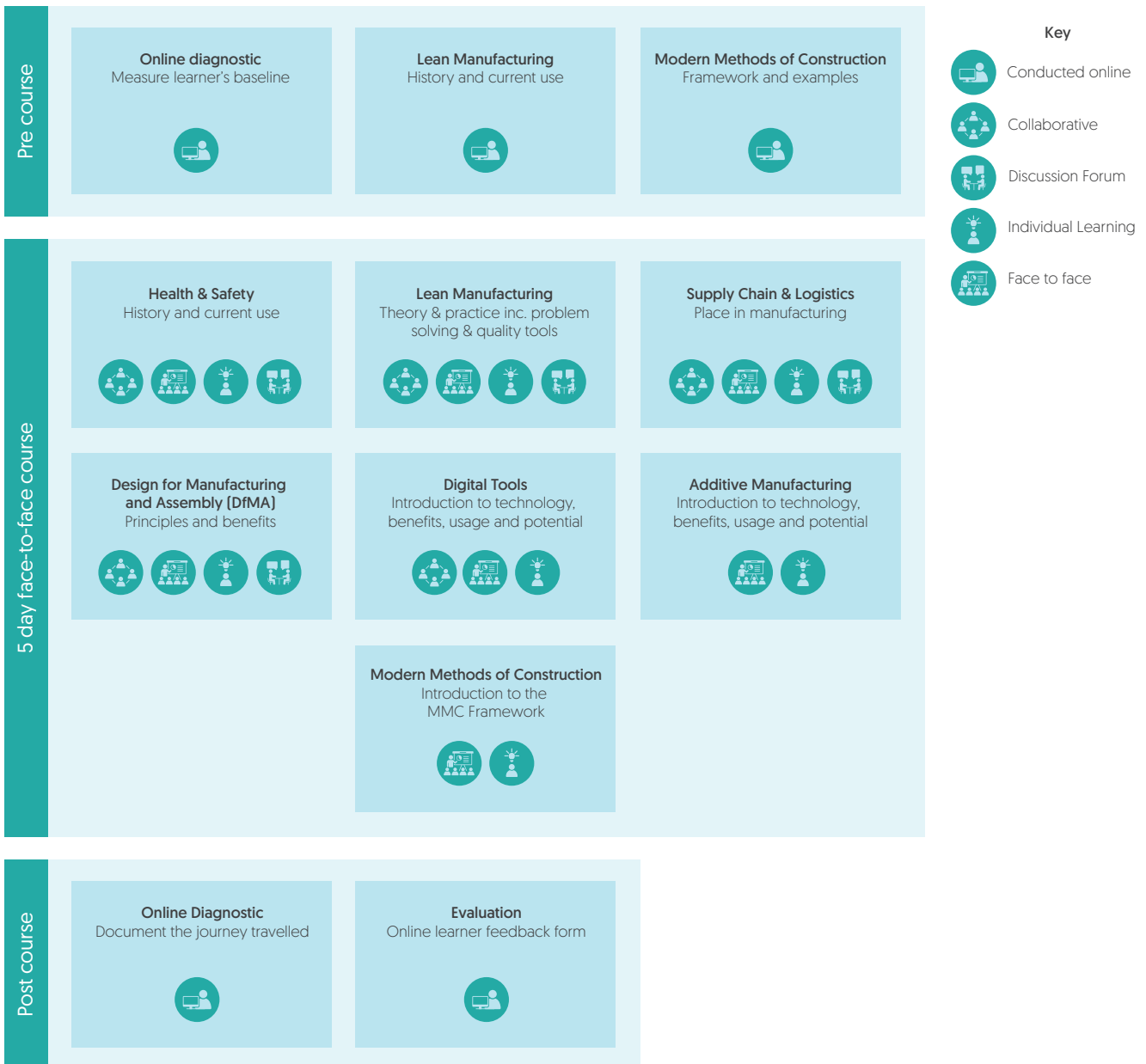

Figure 2. Train the Trainer pilot configuration

Of the 32 delegates that undertook the Train the Trainer workshop across the four cohorts, 20 were from nine FE organisations that participated, the rest were from construction industry organisations that may also carry out training.

It can be seen from Table 1 that 26 organisation had at least one delegate booked onto one of the eight planned workshops, with a total of 57 trainers booked in total, but unfortunately this did not reflect the actual attendance. Two courses were cancelled very early on as there were no bookings. There were 15 trainers booked onto another two courses that did not run due to the initial Covid lock-down; only 3 of these were from FE organisations.

	Organisations Booked	Organisations Attended	Individuals Booked	Individuals Attended
FE	15	9	30	20
Industry	11	4	27	12

Table 1. Breakdown of Further Education and Industry bookings and attendance for TtT workshops

The Train the Trainer course has been created as a five day face to face offering with two supporting pre-requisite online learning modules that give a foundation to allow the main workshop to focus its attention on the application rather than the background of offsite techniques. The material for the course was determined through consultation with industry. Not all the workshop participants completed the two accompanying eLearning modules. Of the 32 workshop attendees only 24 completed all the eLearning modules but all completed at least some.

The table below, Table 2 Average feedback ratings for Train the Trainer workshops, shows the average satisfaction rating for each of the workshops based on the end of course learner feedback forms, where 100% is fully satisfied and 0% is not satisfied at all. It can be seen that the satisfaction levels were high across all cohorts that ran. The slightly lower scores on the later workshops is understood to be because the learners already had some of the knowledge being taught and so felt that a shorter duration would have been better.

Worskshop start date	Average feedback score
27 January 2020	88.19%
3 February 2020	91.56%
18 October 2021	85.9%
31 January 2022	85.1%

Table 2. Average feedback ratings for Train the Trainer workshops

From the trainer's point of view the training delivery improved organically as the trainer's knowledge also increased and is something to be considered by future trainers. It is believed that keeping the workshop as a five day event and face to face was the right thing to do. Further refinement of the material and participant feedback has backed this up.

Prior to participating in the training and after completion, each delegate was asked to complete the diagnostic assessment to determine the effectiveness of the training for them and also of the programme. In total 73 people completed the pre learning assessment.

Only 29 of the 32 workshop attendees completed the post-learning assessment as three delegates were unable to gain access to the OTNAS that hosted it. The figure below [Figure 3] shows the overall result of the diagnostic. The results generally show a positive trend indicating that the training is effective as far as the participants are concerned. What cannot yet be ascertained is how well the trainers and learning professional then go on to influence learners with regard to offsite construction. This would require further follow-up analysis of a different nature once the trainers have run sessions at their institutions which, is out of scope of this project.

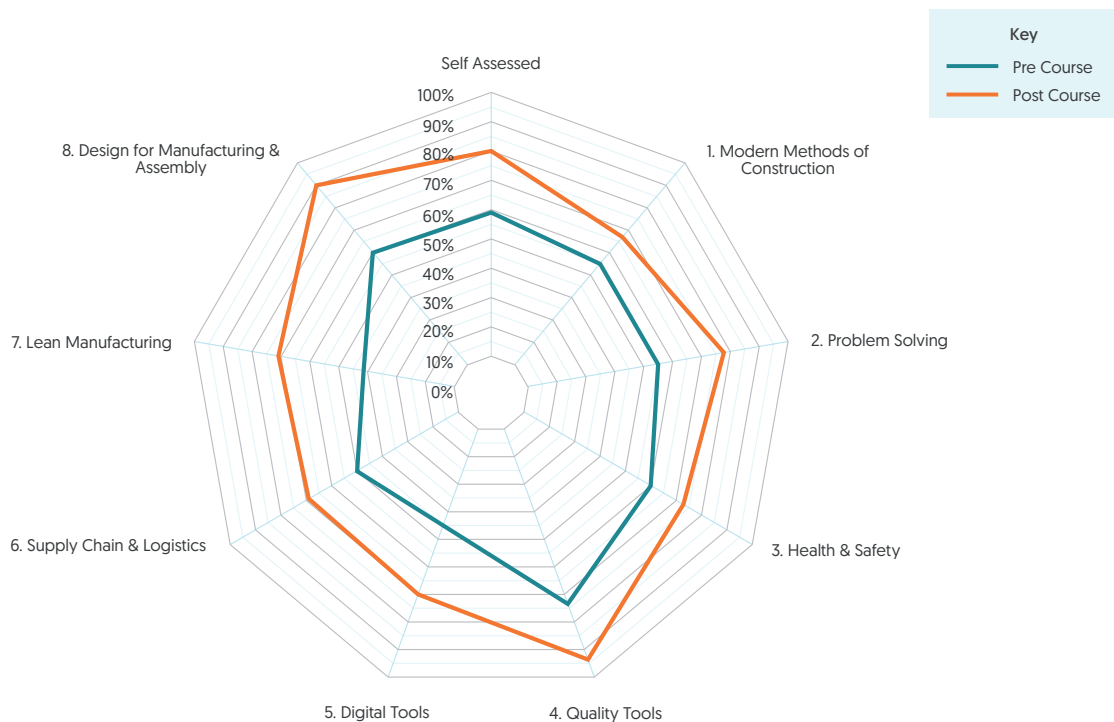## Overall Average Across 73 Pre Respondents & 29 Post Respondents

Figure 3. Comparison of pre and post course diagnostic assessment results for Train the Trainer

2.7 Diagnostic Tool

The diagnostic tool is part of an Online Training Needs Analysis System [OTNAS] that is used both prior to learning commencing [formative] and post learning [summative]. The formative assessment determines potential weaknesses the learner may have. The summative assessment indicates whether the learning has improved that person's understanding. It allows the effectiveness of the training to be determined to understand, in this case, whether the Train the Trainer course has increased the Learning Professional's understanding of the material required to deliver Offsite Training.

The tool can be found at tna.the-amtc.co.uk

Note that registration is necessary to access the tool. Once registered, log in to see three options. Select "View All" in the "Individual" section. In "Current Analyses", click the "New Analysis" button at the bottom right of the page then in "Details" select "Offsite Construction" from the "Subject Area" drop down field. The remaining fields will have only one option available; select them to continue the diagnostic. Readers accessing the tool for observation only should use an email address such as a CITB registered email address or other created name that indicates such intent in order to allow real users to be separated from those investigating the platform and thus prevent obscuring of the results.

2.8 Assembly Operator Programme

The MTC's Assembly Operator [AO] programme aims to increase the numbers of people with knowledge of offsite construction methods. Predominantly aimed at apprentices, the programme covers a range of topics relating to modern manufacturing processes and offsite construction including the impact of Lean manufacturing, logistics and transportation, digital technologies and much more.

During the development phase MTC carried out a series of mapping exercises to establish any relevant fits to any current apprenticeship standards which would provide accredited providers with the possible funding streams with employers. Whilst there was the draft Level 2 Construction Assembly Technician Apprenticeship Standard ST0265 of June 2018 [later released in 2019 and updated in 2022, after development of this programme, to the Construction Assembly and Installation Operative apprenticeship standard [Institute of Apprenticeships, 2022]] it was felt this would not provide employers with all the operational excellence competencies to move their business forward. We also mapped the programme to the Lean Manufacturing Operative which in our experience of manufacturing processes provided a better fit and would enable providers to use the £6,000 levy route.

Developed as a blended learning programme incorporating knowledge assessments, virtual classrooms with guest speakers, individual learning and a five day face to face workshop, our programme's concept was developed to cover as many relevant topics as possible in a varied and engaging blend of formats where learners can both study alone and participate with one another. However, as a result of the COVID-19 pandemic and to suit customer requirements and the availability of delivery staff, all the topics were converted to run online.

There are seven key modules with an introductory session and a post course assessment. The infographic of Figure 4 below gives a more in depth overview of the programme, breaking down the main modules into topics and indicating the four key learning modules that include a virtual classroom [VC].

EMPOWER 1 hour delivered via virtual classroom	ENGAGE Series of self directed learning modules, with a supportive blended distance learning solution incorporating, collaborative/social activities and self development tasks. Highlighted modules would commence at dated intervals and headlined by virtual classrooms.							EVALUATE Close the course
Module 1 [w1] Program Induction	Module 2 [W1] Communication is Key	Module 3 [W1] Stay Safe! Understanding H&S	Module 4 [W2] Impact of Lean Manufacturing	Module 5 [W3] Understanding SC&L On The Road To Success	Module 6 [W3] Engineering a Solution	Module 7 [W4] It's a Digital World	Module 8 [W4] Construction Manufacturing	Formal Course Evaluation
LMS [Learning Management System] Guidance	Effective Communication and Teams	Health & Safety	Lean Organisation Techniques in Business	Introduction to Supply Chain	Basic Engineering Drawings	Digital Tools, Industry 4.0	How Buildings Are Constructed	Learning Log Submission
Skills and Knowledge Assessments	Behaviours, Attitudes and Dealing With Conflicts	Safe Lifting and Handling	Business Improvement Tools and Techniques	Introduction to Logistics	Use Of Tools/ Power Tools and Calibration	IT Tools/Digital Design Software	Mmoc, Current, New and Emerging Technologies	Self Evaluation How has delegate personally improved
	Problem Solving and Reviewing Performance	PPE	DfMA [Design for Manufacture and Assembly]	Transport Regulations and Risks	Numeracy & Measurement	Digital Communication	Manufactured Off-Site & Onsite Assemblies	
		Factory Specifics i.e. COSHH	Quality Tools	Order of Sequence	Geometrics Dimensioning and Tolerancing	Design Codes and Standards	Environmental Impact	
							Reports i.e. Farmers. Why the Change?	

Virtual classroom sessions are short, structured training sessions and Q&As delivered live and online

Figure 4. Assembly Operator programme schedule

It has not been possible to find students studying an offsite specific qualification to pilot the course. However, 27 learners from the wider construction industry, all from Countryside Properties, signed up to the Construction Assembly Technician Upskilling Pilot [Assembly Operator programme]. Unfortunately only some of the delegates completed the full programme.

The chart below, Figure 5, shows the completion rate for each of the nine modules with Table 4 listing the module descriptions. Modules 2 to 8 are the core learning modules. The rate is given as an average of the percentage of tasks for each module that the 27 delegates completed. Each module is made up of a number of tasks, as shown in Table 3.

Module Number	1	2	3	4	5	6	7	8	9	Total
Number of Tasks	3	5	13	7	11	25	24	22	3	113

Table 3 Number of separate tasks per module of AO programme

Average task completion by modules
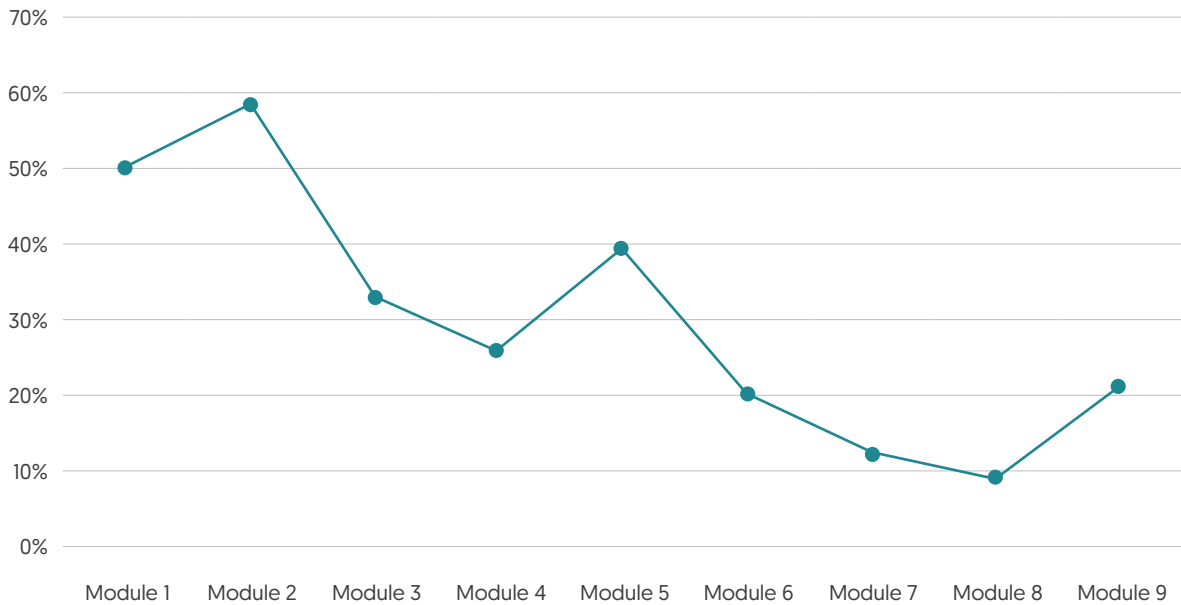
Figure 5. Module completion rates for AO programme

Module Number	Module Name
1	Introductory VC
2	Communication is Key
3	Stay Safe - Understanding H&S
4	Impact of Lean Manufacturing
5	Understanding Supply Chain & Logistics (SC&L) - on the road to success
6	Engineering a Solution
7	It's a Digital World
8	Construction Manufacturing
9	End of Programme Assessment and Evaluation

Table 4 Module list and descriptions for AO programme

There was a general decrease in completion as the programme progressed with only 21% completing the final assessment. In total, nineteen of the twenty seven delegates completed the initial module that included the first virtual classroom and two other tasks; 'introduce yourself' and 'starting your learning log journey'.

Module 2, the first of the learning modules, had a similar level of engagement across its five tasks. From that point onwards the results were more disappointing. There is a trend whereby the modules with the highest number of tasks received a lower completion rate.

This may be due to a number of factors, such as learners skimming the material and not completing the check box at the end of a unit as per instructions but also potential configuration anomalies within the Learning Management System (LMS). None of the Module Objectives tasks (Task 1 of modules 2 to 8) recorded a single completion yet the last tasks of each module, the module evaluation and the delegate reflective learning log, recorded the highest completion rates. Ten people completed the 10 question end point assessment of Module 9, 90% of whom received a perfect score.

3 Project Learning

3.1 Initial Schools Workshops

The industry experts at the early workshops were enthusiastic supporters of the project and they felt that there was a great need in the industry for this type of guidance. They saw offsite construction as key to a successful construction industry in the future and there were some common remarks across the modules:

1. We should not assume any prior knowledge of the subject when presenting the materials. [This was borne out in the first few pilot courses when we were surprised by some of the very basic questions being asked by attendees]. The consequence of this was that a number of topics became common to each module and between them formed some 'fundamental' learning, e.g. The MMC Definitions and the benefits of offsite. [In fact, the Supply Chain Sustainability School has since created a series of 'Fundamentals' webinars for this very reason.]

2. The topic was extremely important and required much knowledge to be imparted. The courses should not, therefore, be compromised by lessening the content to fit into the 'short format' of three hours or so. If it took longer to deliver the essential learning points, then so be it.

3.2 Schools' Pilot Courses

Two pilot courses were run for each module, except Site Management which benefitted from only a single on-line pilot presentation [due to coronavirus]. We endeavoured not to make the pilot courses too 'London-centric', but we found that generally more people attended the London sessions than elsewhere [although Birmingham was well supported too].

We learned that if a course was marketed as a 'Pilot' course, the numbers attending would be low. If no mention was made of the nature of the course in the marketing, then the number of bookings would be substantially higher!

In terms of venues, it is always difficult to predict what proportion of the people who book onto a course will actually attend. On one occasion, the 'drop-off' was extremely low resulting in the room being very crowded; there was, indeed, 'standing room only!'

It was very encouraging to note that several people attended more than one workshop and that they were prepared to attend sessions that were aimed at professions different to their own. We concluded that this was evidence that one of the core messages – the need for a wider knowledge amongst all professions about the whole Design for Manufacture and Assembly [DfMA] process – was absolutely correct.

Of all the workshops, it seems that Logistics generated the highest number of attendees. This may be because it is a topic that is rarely considered in traditional construction but will most likely be extremely important in an offsite project.

One of the common themes from the Industry CPD feedback forms is that delegates wanted to see more real-world projects in the form of Case Studies. They asked us to provide facts about

projects which could clearly demonstrated the advantages of offsite and Modern Methods of Construction.

Such case studies have since been included in every CPD module and, in fact, a further improvement has been implemented, as follows.

All the CPD pilot courses were delivered on the basis that they should be as interactive as possible. Therefore, as well as providing exercises and tasks for the attendees during the course, the facilitators were particularly keen to foster group discussions on the basis that in any group of attendees there would, inevitably, be a large number of skills and experiences that would be worth hearing about and sharing. The result was that often one or two characters in any group would share their knowledge at length if given the time and space to do so and this was the basis of our second major improvement.

We recognised that instead of the facilitator simply talking about a particular case study during a workshop, it would be far more interesting and impactful if the person who had provided us with the case study in the first place were invited to present the facts themselves. After some thought – and with the advent of the coronavirus problems – we decided that we should invite a number of suitable candidates to either:

1. Join our main presenters in any on-line workshops in the form of a guest speaker
2. Be recorded on video talking about their projects so that the content could be used in either 'live' or on-line workshops, as well as being a resource in the School's library
3. Attend as a guest speaker when – or if – we can once more organise live events.

This idea will be implemented from now on.

3.3 Train the Trainer programme

The needs of trainers differs depending on their background. Those from the academic world are generally proficient in the art of delivering training but are less likely to be familiar with the subject matter content required whereas new trainers from industry, such as team leaders for example, will be generally more familiar with the subject matter but require training in training techniques (especially via virtual learning). This programme focused on teaching the content whilst the School identified the industry trainer need and provided a module to help improve the delivery skills. The pilot group for the Train the Trainer programme was not selected according to their background, more to their willingness to participate and appraise the course.

Originally the project targeted 60 attendees on the Train the Trainer programme but a number of key challenges meant that this was not achievable and it was reduce to 30 trainers from industry and FE education. The first challenge encountered was the lack of training industry appetite. FE colleges were not keen to engage when their customer base was not asking for offsite construction courses. Further barriers for the FE provisions were cost and time. Although the project was offering free places on the course, the travel and subsistence costs would have to be borne by the organisations. This combined with the cost of the trainers' time meant that the colleges could not afford for trainers to attend. This and the more obvious fact that every day a trainer was attending one of our workshops was a day they were not delivering to their current students. Many training organisations were unable to be convinced that this would be a worthy investment. One organisation was keen for trainers to attend until they realised that the workshop was five days and not one. The result was that none of the initial planned six programmes were booked to capacity with two

receiving no bookings at all and were therefore cancelled. Of the two of these that did run they were poorly attended with one event having two delegates turn up for the first morning and walk out after determining that the course 'wasn't for them' [note that these two individuals have not been included in the count of attendees].

In March 2020 the project was put on hold due to COVID meaning that the two workshops planned for spring 2020 had to be postponed. The project was restarted in autumn 2021, this time with a renewed engagement effort from the MTC and CITB resulting in the running of two full capacity Train the Trainer pilot workshops

and enquiries for more. A different strategy of populating the cohort from just one or two employers provided a better outcome regarding attendance. Those booked onto the spring 2020 courses did not reengage when invited. Since most of these were from industry it is likely that this is due to the change in focus of the construction industry in the aftermath of the numerous lock-down restrictions and the need to operate with reduced resources and tight budgets. It is also not known how many of these are no longer working for those employers after changes brought about by the impact of the pandemic.

CITB TtT Delegate Bookings Per Course

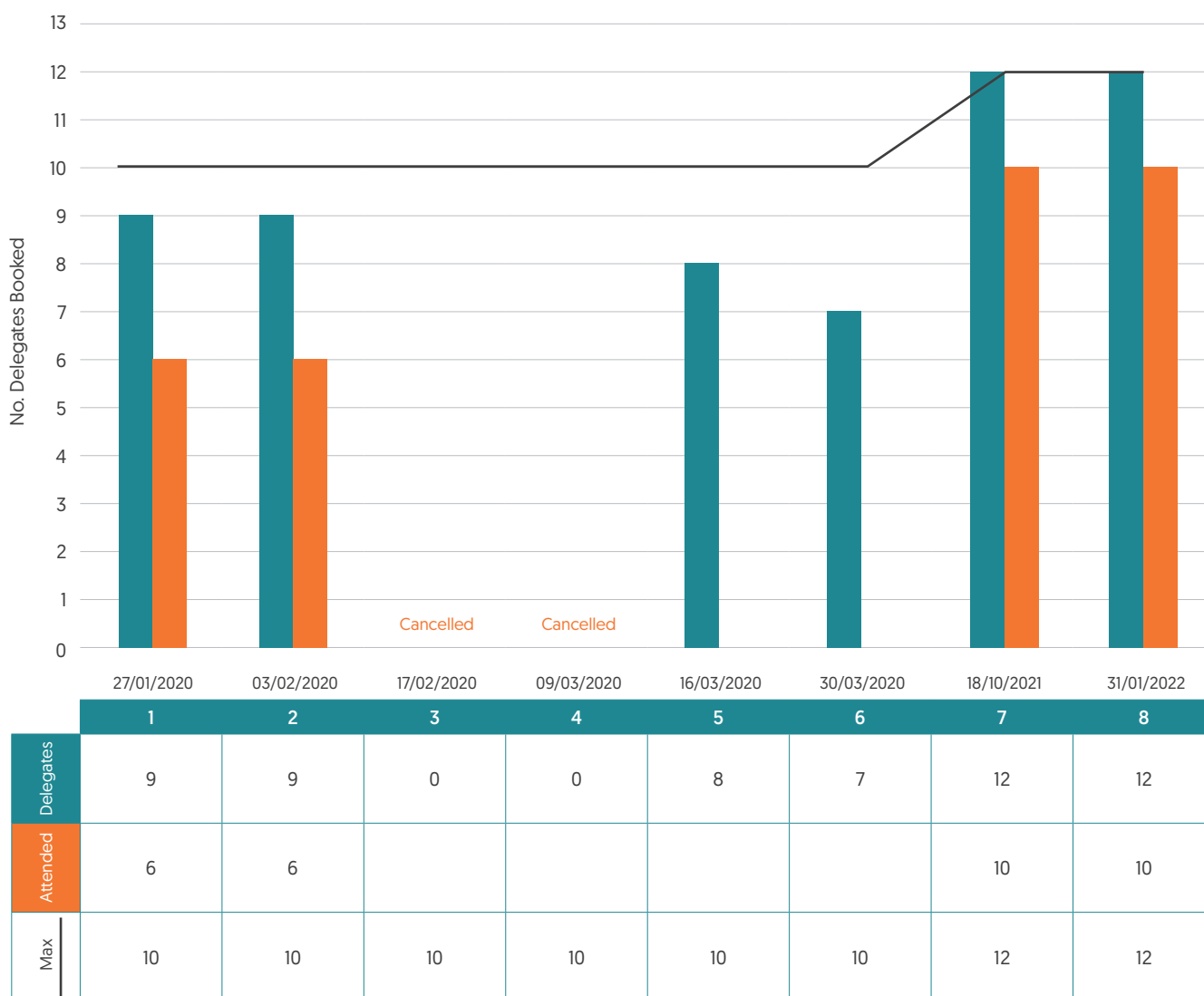|	27/01/2020	03/02/2020	17/02/2020	09/03/2020	16/03/2020	30/03/2020	18/10/2021	31/01/2022
	1	2	3	4	5	6	7	8
Delegates	9	9	0	0	8	7	12	12
Attended	6	6					10	10
Max	10	10	10	10	10	10	12	12

Table 5 Delegates undertaking Train the Trainer workshops

On restarting the project new challenges arose. This first of the new five day workshops was split into two three day workshops due to a positive lateral flow test from a learner on day three. Despite this, the course ran well. The second ran without such a hitch. The chart Table 5 shows the number of delegates booked per workshop along with their actual attendance.

Feedback collected regarding the Train the Trainer course was generally positive. Anecdotal feedback during delivery was very positive, particularly from college lecturer delegates.

The activities, learner engagement and practical application of lean tools were particularly popular with learners. The breadth of topics covered on the course was also commented on by leaners who felt that the interrelated nature of the topics provided a realistic view of all the contributing factors to an offsite manufacturing operation.

There was some feedback to suggest that some learners would have preferred more construction-oriented material in the course. However, we believe that the key learning this course needs to impart is around the benefits of manufacturing. It may be necessary to focus more closely on contextualising the course when learners are being selected.

The 'build game' activities which allowed groups of learners to incrementally apply and see the benefits of lean manufacturing tools were very popular as well as being effective. Many lean programmes use 13 amp plugs for this; however, we chose to use clockwork dancing robots [Marvins] as they provided greater complexity to the challenge due to number of components, fitting of components and a demonstrable function to be tested. To answer the feedback regarding a better connection to construction,

it may be of value to explore systems used to create model buildings that could replace the Marvins in these activities.

The last instance of the Train the Trainer course was populated by learners already working in an offsite manufacturing environment who were mostly at the supervisor/manager/ Head Of level. Whilst they all felt they learned something, some of the content was existing knowledge to them all. It is important to ensure that learners proposed meet the target audience requirements to get the best out of the course. Whilst organisations may at times wish to include a learner with experience to examine whether the course suits their needs, this should be strictly controlled and 'observer' opportunities offered instead.

To support the Train the Trainer programme, the project committed to developing a diagnostic tool to identify skills gaps and benchmark progress. This was done using an existing platform, the Online Training Needs Analysis System [OTNAS] tool that the MTC had previously commissioned under another funded project.

For this project the OTNAS tool's facility was manipulated to allow criteria for each aspect of offsite construction to be assessed for the individual without giving any recommendations directly to the user. Whilst this worked to collect the data, analysing the results is a lengthy and cumbersome task. The users also found it troublesome and some had to be led through it for the formative assessment. This was because it is not as intuitive as it would be hoped, partly due to it not being the intended purpose of the tool. A propriety tool may have been available and should be investigated should a similar project arise with the same diagnostic requirements.

3.4 Assembly Operator

The first challenge for the project was agreeing what an Assembly Operator is. One partner suggesting that it is someone who constructs components in a factory ready for shipping to a building site and the other, a person that assembles the prebuilt sections on site. Both are logically sound definitions and important roles in the lifecycle of offsite manufacturing processes. In the end it was decided that the Assembly Operator is defined as anyone working on the production line at an offsite manufacturing facility. It is aimed at a level two function, i.e. an operator as opposed to a supervisor.

The Assembly Operator programme was then formed from initial conversations with Ilke Homes and TUCA. However, these employers are very different to Countryside Properties that piloted the programme and their feedback demonstrates that each employer may have different needs. Whilst it is not practical to rewrite the programme and adapt the delivery method for each new employer, training local facilitators from their business to support the learners with accessing and using IT, using the LMS, time management and understanding content would likely be beneficial. A recommendation would be that a number of supervisors attend the programme first, as well as an additional unit on facilitating the AO programme.

As with the Train the Trainer course, getting learners for the AO programme has been a challenge. Despite this the project managed to engage with Ilke Homes and TFL to schedule in sessions, including the virtual classrooms, online learning, and 5-day face to face module. Unfortunately the pandemic put pay to the running of theses and on restarting the project these organisations were no longer able to participate. After more industrial engagement and support from CITB to engage with organisations, one cohort of 27 trainees from

Countryside Properties were put forward for the now online only programme.

Following the pilot of the Assembly Operator programme with Countryside Properties a feedback meeting was held with the managers of the delegates. This provided some indication as to the possible reasons for the low response rate overall to the programme. These can be summarised as:

▶ A proportion of selected learners not being IT literate
▶ A proportion of selected learners not being suited to distance learning (in one instance a learner was withdrawn by management due to stress caused by participation)
▶ A proportion of learners not managing their time, failing to complete modules on schedule
▶ Functionality of the LMS making it difficult to complete a task without the learning material available (an IT savvy learner may have opened the task in a new window to allow this)
▶ All the above causing learners to lose interest

An assumption was made that most of the learners would likely be under 30 years old and that nearly all people from this age group would be IT literate since they are used to devices such as smart phones, tablets and games consoles. However, there were a number of delegates whose understanding of IT was so low that they were not even aware of what an email was which led to challenges setting up learner accounts as well as issues with hardware. This also meant that they did not know how to use multiple tabs in a browser or how to access multiple application at the same.

Besides IT challenges and literacy, other challenges included the shift patterns of the workers making attending the virtual classrooms a challenge as well as managing and scheduling

in the additional learning time required. Despite these challenges, the feedback from the managers was that running over an eight week duration was suitable for the programme.

Other suggestions to improve the learner experience and maintain engagement include:

▶ Providing a hardcopy of the supporting materials, so that learners can reference these throughout
▶ Having group activities facilitated locally rather than online.

The management of Countryside Properties initially set up scheduled learning times, where learners congregated in a training room to work through the self-driven learning content. However, it seems that along the way some learners were scheduling their own time, to the detriment of production. It will be important to

work with future participating organisations to ensure their production needs are understood and a plan developed and managed locally by a trained facilitator to safeguard against impact on production.

It is worth noting that some learners were still completing material on the system more than two weeks after the course end date. This is seen as a positive in that they are still keen to complete, although it cannot be known whether their supervisor or manager persuaded them to continue.

Overall, the feedback from Countryside Properties was that there was an overall benefit and they would be interested in using the programme in the future, especially if some of the issues experienced on the pilot were to be resolved.

4 Conclusions

The collaboration has worked well and there has been a good relationship with CITB. All the Industry CPD KPIs set for the project were achieved with the material now being available and accesses by the construction sector for over a year and their reach far exceeding the KPI targets. Despite the numerous challenges experienced throughout the project, particularly with industry engagement, the KPIs for the Train the Trainer and Assembly Operator programmes have also largely been met albeit with a reduction (by variation) on the number of trainers attending the Train the Trainer pilot.

We believe this project would have been completed as originally planned had the pandemic not hit. The pandemic resulted in the project being put on hold for over a year as the country came to a halt with lockdown restrictions, significantly impacting the construction industry and the project audience's ability to take part.

Evidence shows that the Train the Trainer course is effective and targeted at the right audience. The five day investment in the duration of this is also correct. We believe the diagnostic results provide a good baseline of data on the current capability of trainers and the knowledge shift gain from our upskilling programme.
Going forward, it still remains to be seen how the colleges will make use of this new knowledge and roll it out beyond the current offerings. Since there is a potential route of funding via the lean manufacturing operative route it remains to be seen if the colleges will be innovative and proactive in using this route. It is worthwhile pointing out that this programme was always to pump prime the sector with the knowledge required and was not a full blown apprenticeship. However, by providing some baseline knowledge it moved the construction sector into the realms of what is possible using proven manufacturing techniques and therefore improving an organisation's productivity and competiveness and its quality, cost and delivery.

It is encouraging that enquiries are being received for further courses from modular offsite manufacturing organisations, and we will continue to promote these programmes and where possible provide case studies.

5 Recommendations & Further Work

The Manufacturing Technology Centre has made all material available to CITB. The programmes will also remain on our LMS and be offered through our relationship and business development managers. Work continues in the Liverpool region and BUCKS LEP with CITB where we are positive the current programmes will be used in the future.

It is clear from the initial pilots on the Train the Trainer programme that just because we were offering a Free of Charge programme does not mean the colleges will be queuing to attend. We believe that this would be more attractive to FE providers if there is a source of funds from either CITB of DfE which would fund the release of their staff. It was clear during the engagement activities from heads of departments and vice principles that funding release was their main obstacle.

6 References

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We would like to thank the organisations that willingly piloted the material, including Merthyr Tydfil College, Countryside Properties, Top Hat and Urban Splash.

8 Appendices

A.1 Organisations providing early input

- Balfour Beatty
- Berkley Homes
- Berkley Modular
- Ilke Homes
- Laing O'Rourke
- Legal & General
- Mace
- North Kent College
- NuBuild
- TFL & partners
- TUCA
- Urban Splash

A.2 Advisory group meeting

- Build Offsite
- CITB
- CSIC
- Gala Homes
- Ilke Homes
- McAvoy Group
- MTC
- NOCN/CPCS
- NPTC
- Offsite School [SCS]
- SD Modular
- Semta Group
- Stewart Milne Timber
- Structural Timber Association

A.3 Attending organisations at our open event

- Barking and Dagenham college
- Basingstoke College of Technology
- Bedford College Group
- Bridgend College
- Brooksby Melton College
- Building Heroes
- Central Beds College
- CITB
- Cleraune Plant Training Ltd
- CPCS
- Dudley College
- ECITB
- Elliott Group
- Gateshead College
- Groundwork Greater Nottingham
- Haven Gateway Partnership
- J&D Pierce (Contracts) Ltd.
- KILNBRIDGE
- Leeds College of Building

- Medite Smartply
- Moulton College
- National College for Advanced Transport and
- Infrastructure (Formally NCHSR)
- NOCN
- Nottingham Trent University
- NPTC group
- NWSLC
- Construction Plant-hire Association
- SBS Ltd
- South Lincolnshire Group Training Association
- (SLGTA)
- Stephenson College
- Supply Chain Sustainability School
- Total Construction Training
- University of Liverpool
- University of Surrey
- Walker Timber Engineering Ltd
- West Herts College Barnfield Campus

Appendix B Credits for Schools' Modules

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Logistics	David Emery
QS/Cost Consultants	Steve Fozard/David Emery
Project Management	Stuart Brisbane
Site Management	David Emery/Ian Heptonstall

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