CITB-ConstructionSkills action learning project –supply chain integration, logistics and e-trading

Report into the application of a logistics management system to a construction project at Ordell Road, London EC3

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1.0 Introduction

The recognition of the central role that logistics plays in the construction process was clearly highlighted in the Strategic Forum's Accelerating Change Report of 2002. The Report spoke of the considerable amount of waste incurred in the industry as a result of poor logistics. In addition, the report also highlighted the potential role of IT within construction and the barriers to its widespread adoption. These barriers included cultural inertia, lack of understanding as to the benefits of IT, lack of IT skills, perceptions of cost and risk.

This focusing on the role of logistics and IT in construction coincided with the development of a logistics management IT system. This system, known as Synchro, has been specifically developed for the construction industry using expertise acquired from the automotive sector.

Piloting the Synchro logistics system was therefore seen as a valuable contribution to understanding how effective logistics management, supported by IT and the Internet, could be promoted within the construction industry.

2.0 Executive summary

This research project identified a range of major barriers, both technical and operational, which can restrict the application of a logistics management system in the construction industry. All of the barriers identified in the Strategic Forum's Accelerating Change Report (see 1.0 above) were observed to some degree. However, there were also other barriers that emerged during the course of the research. These are explored in this report.

The key technical barrier is the difficulty of providing an interface for the user which makes the system easy and intuitive. The first version of Synchro was not sufficiently user-friendly to encourage its adoption. It was very much a prototype and this research project played a significant role in assisting its development into a usable tool.

A key operational barrier is the lack of time available to site teams. This has implications for gaining the necessary knowledge of how to use these systems and

the time to implement it on site. By their very nature, logistics management systems deal with a vast quantity of information. This information has to be input and kept up to date on almost a daily basis.

A more fundamental issue is the question in the minds of many project managers and site teams – will it help us to deliver this project more effectively or will it be a distraction and a drain on our management time?

The answer to this last point must be – it depends. The logistics system, despite the best efforts of the support team, did not become embedded into the day-to-day management operation of the research construction project. In spite of this, the project was still delivered very effectively. How was the logistics management system going to improve upon a competent site team working with dedicated material suppliers and trade contractors using traditional project management disciplines and conventional communication tools? It was not possible to test this question during this research project. However, this is an important issue and would certainly warrant further investigation.

One argument against the use of such a comprehensive and sophisticated management tool is that the level of detail it requires is far greater than can be properly utilised in a project environment which is subject to high levels of uncertainty. This argument is built on the fact that projects tend to succeed or fail based on a limited number of big events. These events normally exist outside of the area of logistics and their impact will often swamp that of any local logistical difficulty. Examples of these big events include non-performance of critical trade contractors, unanticipated site conditions, difficulties in gaining permissions etc.

The argument in favour of the use of a logistics management system is that current ways of working are inherently wasteful. By using a tool that makes the whole construction process visible to all participants, integrates material flows with site activities and allows collaboration in developing and updating the project plan, much of this waste can be removed.

During the course of the project the majority of the technical barriers were overcome through continued development and improvement of the Synchro system. The Synchro system, as now developed, provides very good functionality, particularly in the area of three-dimensional graphics and collaborative planning.

In terms of the operational barriers, these will need to be confronted on all future applications of logistics management systems, but hopefully with the benefits of the insights from this research.

3.0 Project aims and objectives

The objective of this research project was to investigate the barriers working against the implementation of a new IT-based logistics system and to understand how these barriers can best be overcome.

This research project involved the piloting of the Synchro logistics management system on a residential construction project in East London. The pilot lasted from January 2004 through to June 2005. The construction project involved the development of 146 one and two bedroom apartments in three blocks, and fourteen town houses.

In delivering this research project a support team was assembled to work with the Denne site team. This support team consisted of Stephan Jones from Synchro and Nicholas Fowler from the Centre for Performance Improvement. A third team member was recruited during the course of the research project. This was Indiren Narayna, a postgraduate undertaking a Master's degree in Construction at Greenwich University.

At the start of the research it was felt that there were four conditions that had to be satisfied for the successful implementation of the logistics software system. These conditions were:

1. The project team needed to be fully conversant with the logistics management software and able to apply it as part of the project delivery process.

2. The necessary IT infrastructure had to be in place.

3. The existence of effective supply chain relationships between the main contractor, key suppliers and trade contractors.

4. The existence of high level project management skills within the project team.

It was judged that conditions three and four were generally satisfied. Denne, the main contractor, had invested significant time and effort over the preceding five years in establishing an effective supply chain process with their key suppliers. They had also assembled a team of trade contractors who had worked on two previous projects that were of a similar nature.

In terms of project management skills, the site team was lead by Pat Leyden, an experienced project manager. The construction programme developed for the project was based on high level activities and used an established construction programming software system.

The main challenge at the initial stage of the pilot project was training, both in the use of the Synchro system and in the setting up of the IT infrastructure. This work constituted the main activities undertaken by the support team during the first part of the research. It was instrumental in the development of a new version of the software which was piloted later on in the project.

4.0 The research partners

4.1 Denne Construction

Denne was the main contractor for the Ordell Road project. They are a medium sized construction company based in Kent and specialising in residential construction.

The Ordell Road scheme was the third project that they had undertaken for their client, Berkeley Homes.

www.denne.co.uk

4.1 Synchro Ltd

Synchro is the logistics software company that developed the logistics management software system piloted on this research project. Their founder Huw Jones gained his expertise in logistics at Unipart. His first major involvement in the construction industry was at the Mid City Place development in London which featured as a Department of Trade and Industry study into logistics management.

www.synchroltd.co.uk

4.3 Centre for Performance Improvement

The Centre for Performance Improvement is a research, training and consultancy organisation. It specialises in supply chain and project management. Its role was to project manage and undertake the research element of this project.

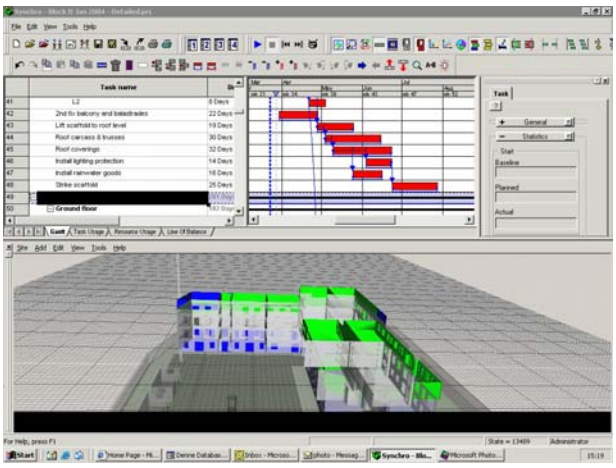
Centre for Performance Improvement

www.c4pim.org.uk

5.0 Overview of the Synchro system

The Synchro system is the first logistics management system developed specifically for the construction industry. It is based around the integration of three key components: a programming package, a visualisation tool and a collaborative interface. The concept is to allow all aspects of the construction process to be planned and integrated with the involvement of material suppliers and trade contractors.

The programming package is based on a traditional Gantt chart with the added ability to link in resource requirements against each activity or job. These resource requirements include material deliveries, building elements, plant, labour and working space.



Screenshot of the Synchro system showing 3D graphics linked to programme

The visualisation tool consists of a three-dimensional graphics package. This is linked directly into the construction programme by assigning elements of the building to the programmed activities. This allows the building process to appear graphically as the programme is moved along its timeline.

The collaborative interface is provided by the ability of the system to be accessed remotely by other participants, namely material suppliers and trade contractors. Through a system of permissions these participants can view the programme and take responsibility for updating tasks under their control. The collaborative interface also allows for material call-offs to be placed electronically and to schedule deliveries to suit work activities. If the system is to provide all parties with a complete picture of the project, it requires all parties to use it.

5.1 IT infrastructure and requirements

The IT requirements to run the Synchro system are fairly basic. The application was run on site using a standard desktop or laptop computer with a broadband Internet connection. In consultation with Denne's IT department the decision was taken to host the project database on the Synchro server and the Synchro application through Denne's network using a 'thin' client server.

This approach did cause problems, particularly with regard to the handling of graphics. Later on in the research project the decision was taken to access the Synchro application directly through an Internet connection. Changes to the system were made locally on the site-based desktop computer and then synchronised with the project database on the Synchro server via this Internet connection.

6.0 The Ordell Road project

The Ordell Road project was selected to pilot the Synchro system for a number of reasons. Work was due to start on site at the same time as the start of the research project. At £14m it was a large and complex scheme which could support a relatively high overhead in terms of site-based staff and site facilities. Being in a restricted inner-city area it would also provide some logistical challenges in terms of deliveries and storage of materials.

The project itself consisted of three blocks of flats and 14 town houses. The three blocks of flats were constructed in overlapping phases. The timing of the construction of the houses was non-critical in terms of the overall project. This meant that they could be used as a buffer to absorb fluctuations in resource levels.

Block B of the Ordell Road scheme under construction

The management team consisted of a contractor's manager overseeing the project, a full time site-based project manager and four site managers. Three of the site managers were each assigned responsibility for one of the blocks of flats and the other was given responsibility for the houses. In addition, a finishing foreman was brought onto the project to oversee the finishing trades. Handover of the first block of flats was in February 2005 with the remaining flats and houses being handed over in September 2005.

Block B nearing completion

7.0 Project case study

The principle intervention activities included training the project team and personnel from key suppliers in the use of the Synchro system, and supporting the project team in its use as a planning and monitoring tool. The starting point was raising awareness and gaining buy-in from the project team. This was followed by training and then implementation.

7.1 Raising awareness within the project team

The objective was to raise awareness of the value of a logistics management system within the Denne project management team. A meeting was held on site between the Denne contracts' manager, the project manager and representatives from Synchro. What emerged from this meeting was that there is often a gulf in thinking with regard to logistics matters between those involved in delivering projects and those that develop logistics solutions.

On the face of it there is much common ground. Those involved with delivering projects are only too well aware of the problems of coordinating site activities with information flows, materials and trade contractors. What is perhaps not obvious is how a logistics management system will assist with this coordination process.

The other factor that emerged is that the project management team had settled on using a specific programming tool and one which had been specifically requested by the client. Asking a project team to use a programming tool that they were not familiar with to deliver a £14m project was not going to be realistic.

So the decision was taken to attempt to run the two programming methods simultaneously. Clearly, this was not an ideal situation but it was the only practical option.

7.2 Getting buy-in from the other departments

It was recognised that a logistics management system could only operate effectively if all parties involved in delivering the project were familiar with it and supported its use.

Additional awareness raising activities were organised to include the office-based support staff, namely the buyers and surveyors. This activity included a discussion on the issues relating to logistics management followed by a demonstration of the logistics software. An additional session was arranged for the office-based team to trial the software on interconnected computers.

A simulation was organised with each individual assigned a role. One person was the project manager and the others were suppliers and trade contractors. The purpose of the simulation was to enable the support team to see how the system operated in connecting suppliers and trade contractors to the project. Through the software it was possible to experience the placing of orders, the calling off of materials and the possibility of suppliers taking responsibility for updating that part of the programme that they had responsibility for delivering.

Some technical difficulties with the connectivity of the computers prevented the simulation from demonstrating all those selected elements of the system. However, it did serve to raise a general awareness of what could be possible. A subsequent simulation at a technology centre involving a different group was reported to have worked successfully.

7.3 Training the project team in the use of Synchro

The objective was to train members of the project team in the use of the system so that they would be able to use it to manage the project. The idea was that two of the site managers could be trained so as to be familiar with the system and would then be able to operate it effectively.

From left to right: Indiren from Greenwich University, Nolan from Denne, Nicholas from C4Pim, Nigel from Denne and Stephan from Synchro

One of the first major obstacles was the poor state of the IT infrastructure on site in the early stages of the project. The Internet connection with the host was not reliable which meant that the system frequently crashed. The replacement computer for the laptop, which had been accidentally run over by a car, also needed upgrading. A series of connectivity problems continued to frustrate the site-based training process for a number of weeks in the early stages.

The next challenge was to find sufficient time with the site managers to train them in the various aspects of the Synchro system. This in itself proved difficult. Their involvement in managing site activities meant that they were not available for more than one hour during any session. As these sessions were scheduled to take place once each week it meant that progress was slow.

The decision was taken to recruit a student studying for his Master's degree who could support the learning process by being on site one day each week. The postgraduate student was trained in the use of the system which meant that for two days each week there was someone on hand to support and provide training to the site team.

7.4 Gaining commitment from suppliers and trade contractors

Visits were made to a number of suppliers and key trade contractors who were to be involved in the project in order to discuss the implementation of the logistics system. The purpose of these visits was to establish their degree of sophistication in using IT and to discuss how they might use the logistics system.

It was recognised that the trade contractors and suppliers who would get most value from the system would be those with a significant material supply responsibility. This included the key material suppliers and trade contractors who were involved in the design and supply of components such as trusses, windows and doors.

A training workshop was run for these key suppliers at Denne's offices. This workshop included an explanation of the system and how their element of the procurement process fitted into the overall programme. User manuals were developed and presented as part of the workshop.

One of the issues that emerged was that not all of the material suppliers had access to the Internet to allow them to use the system.

In order for these material suppliers to become fully engaged in the process it was recognised that a lot of the initial data was going to have to be input on their behalf.

7.5 Setting up the logistics management system for the project

The starting point in the application of the logistics management system was to input the construction programme onto the Synchro system. Transferring the existing construction programme by using a simple export routine was relatively straightforward. However, the construction programme needed to be expanded to include a far higher level of detail than was shown on the original programme.

The early version of the Synchro system relied on updating tasks one at a time via an Internet link to the central server. This process involved waiting for a page to refresh each time a change was made and was extremely time consuming. It therefore meant that it was carried out by the support team rather than by the site managers themselves.

The other factor that needed attending to was the creation of a complete network of logically linked tasks. Each of the individual tasks in the logistics programme needed to be linked to successor tasks in a logical sequence. Having a logically linked network is necessary in order to model the impact of changes on the performance of any task on the rest of the programme. Although this is standard programming practice as taught on construction courses it appears to be rarely carried out in practice on construction projects. The support team worked with the site managers to identify these links and included them within the logistics programme.

7.6 Provision of ongoing support

In order to make this programming exercise meaningful to the site attention was given to the creation of four week 'look ahead' plans. These four week plans involved looking at a segment of the main logistics programme for the upcoming four week period. Until this point the four week look ahead plans had been done without any computer aids by the site managers. These plans were then presented to the project manager as part of the weekly process of reviewing the construction programme.

This aspect of the system was welcomed by the site managers who found that the logistics programme saved them the inconvenience of drafting out a new hand-drawn programme each week. However, this relative enthusiasm for the system was tempered by recurring difficulties in getting the plans printed.

7.7 Inputting requirements

A great deal of information had to be entered into the logistics programme before it could be used to manage the logistics aspects of the project. The system was set to allow information to be entered by both the main contractor and its suppliers and trade contractors. Given the onerous nature of the inputting process it was decided that the support team would undertake it. The following provides a guide as to the data requirements arranged by participants.

Data input requirements from logistics project manager (site team)

- Overall programme.
- Names of suppliers and trade contractors.
- Site plan and three-dimensional model – the site plan could be imported directly from the architect's cad drawings. A three-dimensional model would need to be created by a specialist from information contained within the design drawings.
- Locations – these are graphical representations of spaces within the site. These can include unloading bays, storage areas, working areas, the position of tower cranes, site huts etc. This allowed the building to be reviewed from any angle and to zoom in to individual flats.
- Assignment of locations to jobs – each element of the building could be assigned to a job or activity. This meant that it was possible to see the visual representation of the building taking shape as the programme was moved along its timeline.

Data input requirements for a materials supplier

- Contact details of the material supplier.
- Details of materials to be supplied to the project – this includes product ID, product name, unit of measurement, pack size, price of each pack, order lead-time. These could either be entered individually or as a completed template which could be imported directly into the system.

Data input requirements for a trade contractor

- Contact details of trade contractor.
- Jobs or activities – the system allowed for individual activities to be assigned to trade contractors. The trade contractor could then breakdown that activity into sub-activities if it wished.
- Assign a type for each job – this would be from a list covering Exclusive, Non Exclusive, Design or Key Date.
- Job description – title for job, duration, number of people, proposed start date.
- Assigning jobs or activities to other suppliers – a trade contractor could create other jobs and assign these to its own suppliers or subcontractors. These suppliers and subcontractors could then be entered onto the system. This would show the project team exactly which suppliers have direct contractual relationships with the main contractor, and which are further down the supply chain.
- Assignment of resources – the system allows for all resources to be entered and assigned to individual tasks. These resources can be both labour and plant.
- Assigning deliveries to jobs – this could be on a 'just in time' basis or a fixed date. A just in time basis means that the delivery would be scheduled to arrive at a fixed interval before the start of the job. So if the job was delayed then the delivery would be delayed.

- Deliveries are automatically given two tasks – the reception of materials at a delivery point (unloading the lorry) and the moving of goods into a storage location.

7.8 Logistics management application

The overall objective behind the process of training staff, getting buy-in from participants and inputting the necessary data was to trial out the logistics system on a live project.

The piloting of the early version of the software raised a number of practical issues which prevented the logistics management system from operating effectively. These issues related primarily to the user interface of the system.

Despite having a support team working with the site team two days each week it proved impossible to give the site team sufficient confidence in the system to ensure that it was used. This meant that the logistics programme was not kept up to date. Therefore it could not provide a reliable platform from which communication between the main contractor, their suppliers and trade contractors could take place.

The main user interface difficulties related to the complexity of the updating process for tasks and other key inputs. Part of this complexity was due to the intention of providing a structured system which would support collaboration in setting programmes. As a consequence a job had to go through a total of three status updates before they were recognised by the system as being live, and a further five to be complete.

The other main user interface problem was the slowness of the system to update. Every change had to be uploaded to the remote server via an Internet connection before another change could be made. Both these issues were addressed with a new version of the Synchro system.

7.9 Graphical representation

The ability of the Synchro system to visually display the scheme in three-dimensions and link each element of the building to the work programme was a major feature of the system. Being web-based meant that this information was available to all participants involved in the scheme. This meant that participants could review the scheme in detail and understand how their element fitted in with other aspects of the construction process.

The addition of locations, site accommodation and key plant to the visual display was relatively straightforward. This was undertaken by the support team but could be managed by anyone with a bit of skill at handling graphical objects. This aspect meant that participants could review site access issues, working areas and storage constraints remotely from wherever they where on any given day.

7.10 Synchro version 2

Version 2 of Synchro was fundamentally different from the earlier version. The separate applications involving the logistics programme, the graphical representation and supplier interface were all brought into one application.

The software platform was also different. The system was no longer dependent on using an Internet browser for access, which had slowed down the whole process of entering data on the first version. The new version used a new protocol known as a 'thick' client server. This allowed for changes to be made to the logistics programme on a desktop computer and then to synchronise these with the central server at a later date.

The focus during the last stages of the research project was to equip the site team with the knowledge of using the programming and graphical applications of the new system. This would allow two of the key functional areas to be properly trialled. Testing of the collaborative element of the system would have to wait for commercial trials at a later stage.

The new version of Synchro, by providing an improved user interface, overcame the fundamental obstacle which had held up its earlier adoption by the site team. With this new version it was possible to hand over control of programme updating to the site team. Other aspects of the programme could also be dealt with directly by the site team, including the assignment of resources and the inputting of materials.

7.11 Subsequent developments

Since the completion of this research project there has been a rapid progress in the development of the Synchro logistics management system. By September 2005 version 2.8 had been released which was the first commercial offering of the software.

The experience of piloting the earlier versions of the system had provided many of the insights needed to develop a complex set of applications into a user-friendly system capable of take-up by the industry.

8.0 Lessons learnt

Important lessons were learnt from this research project with regard to implementing an IT-based logistics management system. Some relate to technical aspects of the logistics management system. Many of these lessons were taken on board during the course of the research project and resulted in considerable improvements being made in the operation of the system.

A number of these lessons are particularly valuable as they clearly illustrate the barriers impeding implementation of an entirely new way of working in an industry that still largely relies on traditional methods of operation.

1. There must be agreement that a problem exists

The most important lesson must be to ask whether or not there is a problem that this logistics management system can address. If there is no recognition of a problem then there is no basis for adopting such a system.

2. There must be agreement as to the direction of the solution

In this project there was a general recognition amongst the project management team that there was scope for improvement in logistics management. However, there was no definite agreement that an IT-based logistics management system provided the right direction for a solution.

The contractor had already invested heavily in putting together a team of material suppliers and trade contractors who had worked collaboratively on previous schemes. The contractor had also made a significant commitment with regard to preliminaries expenditure on site infrastructure and materials handling. This combination of supply chain development and improved site infrastructure was seen by the contractor as providing the necessary direction.

3. If people are to be won over then the system must operate flawlessly

The initial version of the Synchro system was very much a prototype. The basic elements were in place, but it was cumbersome to use and did not inspire confidence. This made it difficult to keep up the interest of the site team.

4. The user interface must be simple and make it easy for people to use

People on site are generally incredibly busy, often responding to short-term emergencies. The only way that they will be happy to spend time with an IT system is if they can do what they intend to do both quickly and efficiently. A great deal was learnt about the user interface issues during the course of the project. These were broadly addressed with subsequent updates of the logistics management software.

5. The IT infrastructure must be adequate for the job

As has been noted in the report, a catalogue of IT failures dogged the project in the earlier stages. These included the provision of an under-spec site computer, lack of protection against viruses, an unreliable Internet connection, a main server malfunction, as well as a host of small items such as a printer not being fully serviceable.

6. There must be an effective integration strategy

For something as complex as logistics management there needs to be an effective integration strategy. The research project wished to trial all areas of the application and so a number of activities were carried out in parallel. For example, material suppliers were being trained on the system before it had been fully set up with the project data.

A more effective approach would be to start with the site team and train them on the programming element of the system using the live project, only then moving on to include more advanced applications and involve further parties.

7. Get people on-board with some early wins

The ability of the system to produce short-term programmes was found to be of benefit by the site management team. This helped build confidence in the system and provided a platform to start introducing other elements of the application.

8. Make the logistics management system the only planning tool on the job

The fact that the principle project programme was developed and updated using a different planning tool meant that the logistics system was peripheral to the management of the project. This was the low risk strategy in that the project would not be put in jeopardy by any difficulties with the application of the logistics management system. However, it did mean that the new system did not get the attention it needed.

9. Never underestimate the lack of IT readiness of other organisations

In discussions with some of the suppliers and trade contractors it was found that a number had no access to an Internet connection. A number of significantly sized trade contractors used IT only for accounting and finance functions. One of the largest distributors had a sophisticated, networked computer system but did not provide their staff with access to the Internet from their desktop computers.

10. Never underestimate the time necessary to learn and use a new system

The site management team was effectively asked to learn to use the system on the job. Given that their time was already fully allocated to running their respective parts of the construction project there was insufficient time left for them to properly engage with the system.