Information Technology in the Reinforcement Supply Chain

1.0 Introduction

Designers, detailers, engineers, contractors, fabricators and reinforcement producers are recognising the benefits of exchanging electronic reinforcement information to improve supply chain efficiencies and improve on-site productivity.

Reinforcement is a major part of any concrete construction project. Effective management of this is crucial if projects are to be delivered on time and on budget. Part 9 of this Guide describes the most recent developments in the use of various forms of information technology in the reinforcement supply chain. It describes a number of case studies of major projects that have benefited from the effective implementation of coherent IT strategies.

Over recent years, the Internet and the reduction in the costs of computer hardware have made the exchange of electronic information a reality. At the same time, reinforcement standards have changed to accommodate electronic data exchange developments. The reinforcement industry is now coming to terms with the benefits associated with electronic information exchange and the take up rate is increasing. Collaboration between parties in the supply chain, including CARES, is removing the traditional barriers to progress and delivering cost effective supply chain solutions. Fragmentation, bespoke solutions, inertia and high set-up costs are being avoided by this collaborative approach. Innovation without integrated information flows would be, at best, limited. The reinforcement supply chain is seeking to adopt a common approach to electronic data exchange and CARES intends to operate its certification scheme to incorporate any such developments in order to cut out wasted time and money from the key business processes.

Construction of Wembley Stadium

2.0 Electronic exchange of reinforcement information

A best practice guide produced by the Concrete Centre, Improving Rebar Information and Supply, highlighted the benefits to all parties in the rebar supply chain by the adoption of a common data exchange format to permit the exchange of electronic information. This has now become a commercial reality with the availability of a number proprietary products.

The key areas of use are:

- Reinforcement drawings and schedules transmitted by e-mail directly from the contractor/detailer to the reinforcement fabricator.
- Efficient management of 'call-offs' using bespoke software.
- Bar coded product labels, in use throughout the entire supply chain from steel mill to the reinforcement fabricator and delivery to site.
- Central storage of product test data, deposited and retrieved via a secure web based database.

3.0 Case studies

The following case studies describe the benefits of effective implementation of coherent IT strategies by firms involved in major construction projects. Firstly, the innovative integrated project team of a major project joint venture at Heathrow Airport and secondly the traditional multi-firm project teams as used at Wembley Stadium and Dubai Airport.

3.1 Heathrow airport, London, Terminal 5

The new Terminal 5 building at Heathrow Airport, commissioned by BAA, is expected to use around 150,000 tonnes of steel

reinforcement. Major challenges facing the project team arose from a number of planning restrictions placed on the movement of materials by road and limited hours of operation. An innovative 'lean manufacturing' approach focusing on the 'just-in-time' delivery of materials and products has been implemented to ensure the reinforcement production, fabrication and delivery is driven by the construction programme and involves close working relationships between reinforcement producers, the reinforcement fabricator, designers, detailers, engineers, contractors and the client. Express Laing O'Rourke Limited have formed a unique partnership to supply the reinforcement required and re-engineered the key business processes as described in the following sections, 3.1.1 to 3.1.4.

3.1.1 Reinforcement scheduling

The traditional way of posting or faxing reinforcement schedules was not a feasible option because of the short time interval between the development of the schedule and the need to deliver the reinforcement to site to achieve the optimum concrete pouring sequences. The use of electronic information exchange as the means of communicating reinforcement scheduling information was an important part of the business process re-engineering. Reinforcement is rationalized by pre-construction replication using bespoke design engineering and analysis software. Thereafter, detailed reinforcement drawings produced by the Contractor, via a detailing firm, are deposited into a single drawing database for the whole project. The accumulation of all schedule data into a single database that incorporates "version control" can be accessed by all applicable users, including the detailers, site managers, engineers and rebar production as well as steel producers. The absence of manual intervention ensures the accuracy of the scheduled information and expedites the ordering process. The Application Program Interfaces (API's) have been developed to such an extent that they can interface various formats of exchange files, however it has been found in the industry that these files must be kept as simple as possible to accommodate various scheduling programs and techniques.

Reinforcement production planning

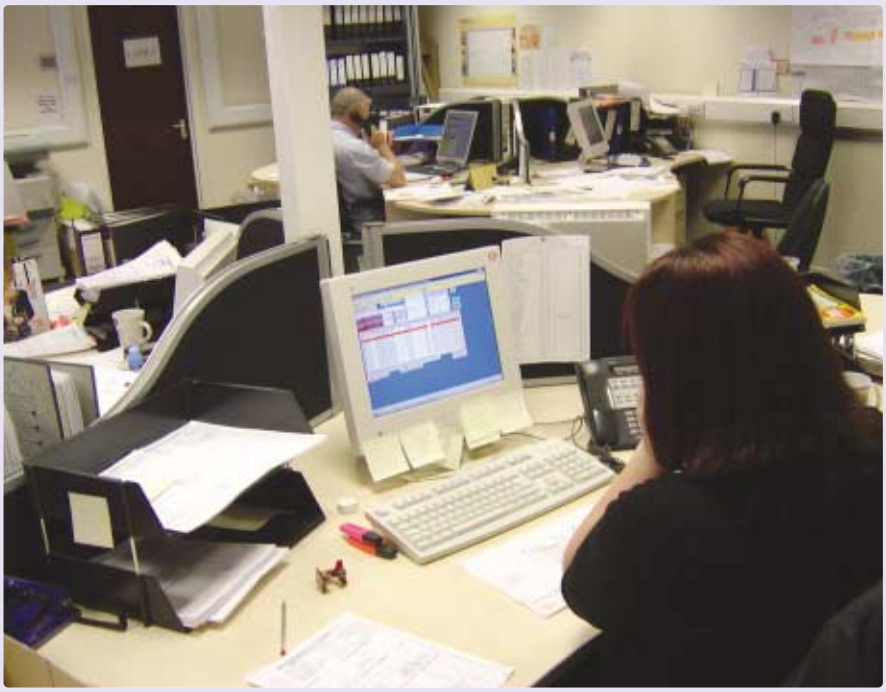

Figure 1 Courtesy of Express Reinforcements Ltd

Reinforcement data

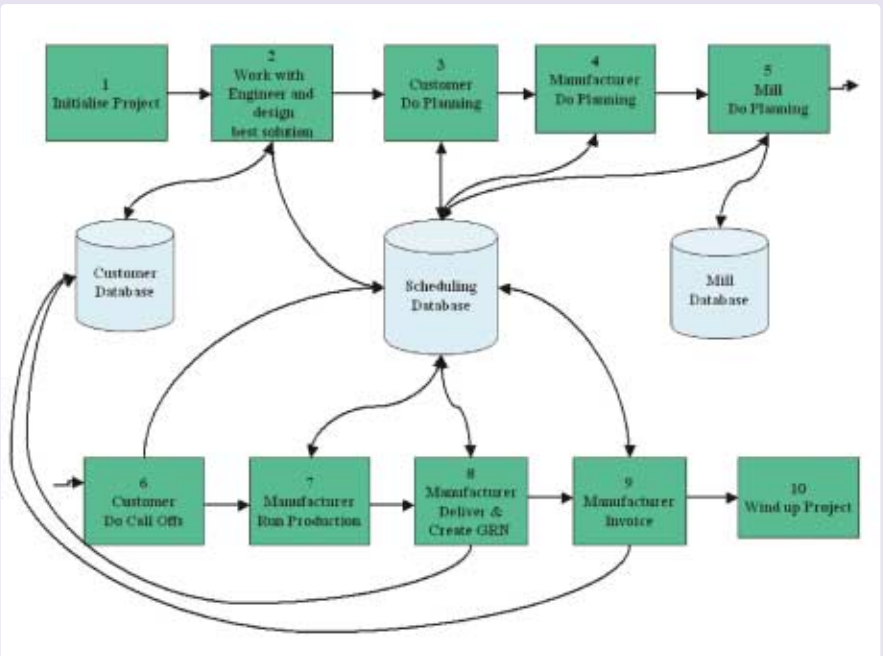

Figure 2 Courtesy of Express O'Rourke JV Ltd

3.1.2 Reinforcement processing

A significant challenge for the project team was the procurement and movement of 150,000 tonnes of reinforcing steel from the producing mills, through processing and on to site. As all steel was required to be delivered to the factory by rail, dedicated railhead facilities were established, as was a purpose built reinforcement fabrication factory at Colnbrook, approximately 2 kilometres away from the construction site.

There was extensive use of bar coding to ensure effective stock control and product traceability. The build up of material information begins in the steel mill, where bar codes on bundle labels provide full production and consignment details. This information is posted to the T5JV database, enabling accurate stock control at the railhead and factory. In the factory, the use of similarly bar coded labels for both production and dispatch to site make it possible to track the full path of each as it moves through the factory.

The single T5JV database of information has enabled the generation of various user interfaces to facilitate site planning, package call-offs, production planning as well as raw material planning. By involving the full supply chain in the process, full traceability from hot metal to site was ensured, i.e. from material test certificate, through each individual bar mark to the relevant call-off and associated invoice. The various parties throughout the supply chain use this information to ensure that no data is out of sequence and that the cost of duplication can be saved throughout the full supply chain process.

An overview of the process is shown in Figure 2

3.1.3 Quality Assurance

The technology of making use of bar code scanners to follow the process of raw material receipts through to delivery to site has various advantages. These advantages far outweigh the initial investment costs. From the time of steel making onwards, all production information is built into the bar codes of the identification labels used. These bar codes are scanned as required and the data is sent electronically to the steelmill database. Upon receipt at the reinforcement fabrication factory the bundle labels are scanned and the delivery data, including cast information, updates the stock records. Throughout all processing stages in the factory the production labels are scanned to maintain product traceability and provide factory performance indicators, including operator, machine and delivery data. This technology enables the database to be updated with regards to all events in the procurement cycle with 'real-time' information. Not only is traceability in place but management of the factory is more effective as the status of production can be monitored and 'real-time' productivity reports to not only the produced material but also manpower and machines can be obtained. Furthermore errors in deliveries are minimized and early warning signals trigger faster responses to various problems or queries.

Use of bar coded product labels

Figure 3 Courtesy of Express O'Rourke JV Ltd

3.1.4 Computer aided manufacturing

Computer aided manufacturing in the reinforcement processing industry has come a long way over recent years. Traditionally the downloading of information to the manufacturing equipment was seen as automation. The latest software and technology, in this case called ARMA+, turns the factory into a homogeneous manageable unit, making optimum use of the various resources available. These process control systems have the flexibility to run the production unit as a fully optimized, lean manufacturing solution. Again, all parties in the business process have access to the information via the single T5JV project database that enables early action to be taken on external procedures and decisions.

Optimization has progressed from the saving of raw material and now focuses on the whole business, managing all business processes from pre-manufacturing through to installation on site ensuring the

Computer aided manufacturing

Figure 4 Courtesy of Express O'Rourke JV Ltd

optimum use of design, planning, manpower, machines, raw material, deliveries and installation. This approach not only streamlines the reinforcing process but has a positive knock-on effect on the whole construction process.

3.2 Wembley Stadium, London

Traditional construction project teams consist of a number of independent firms that each have their own information technology systems designed for their own business processes but cannot easily communicate with external firms. Constructive Technologies have developed a fully integrated electronic solution for reinforcement management under the 'Steelpac' brand name that facilitates effective electronic information exchange between firms. Pivotal to the whole process is the Steelpac SITE tool that gives the contractor control of his reinforcement requirements, featuring procurement and change management tools. Steelpac SITE standardizes the file formats to facilitate electronic exchange of information between all parties in the construction project using two file formats, .SDI (Steelpac data interchange) and .SOI (Steelpac order interchange).

Reinforcement detailing for the 18,000 tonne Wembley Stadium project was carried out in the UK and South Africa using several different detailing packages including Caddett, Cads RC and Prokon, all of which are able to produce reinforcement schedules in the SteelPac SDI format. Schedules were then issued through SteelPac RC to be fully validated and to ensure any errors are identified at the design stage. The reinforcement schedules are then issued to the construction team from the concrete frame contractor, using Steelpac SITE. By using these electronic schedules reinforcing bar schedules to BS 8666 or BS 4466 are automatically validated and any errors identified. There are also specific instructions for steel fixers, along with efficient and effective bar schedule revisions.

When the contractor places his steel order from Steelpac SITE, a SteelPac Order Interchange (SOI), file is generated and sent to the reinforcement fabricator, which in this case was BRC at Newport. The SOI file is then imported directly into the fabricators production system saving time and avoiding the risk of transcription errors and allowing the execution of the order to

Reinforcing schedule generated using SteelPac

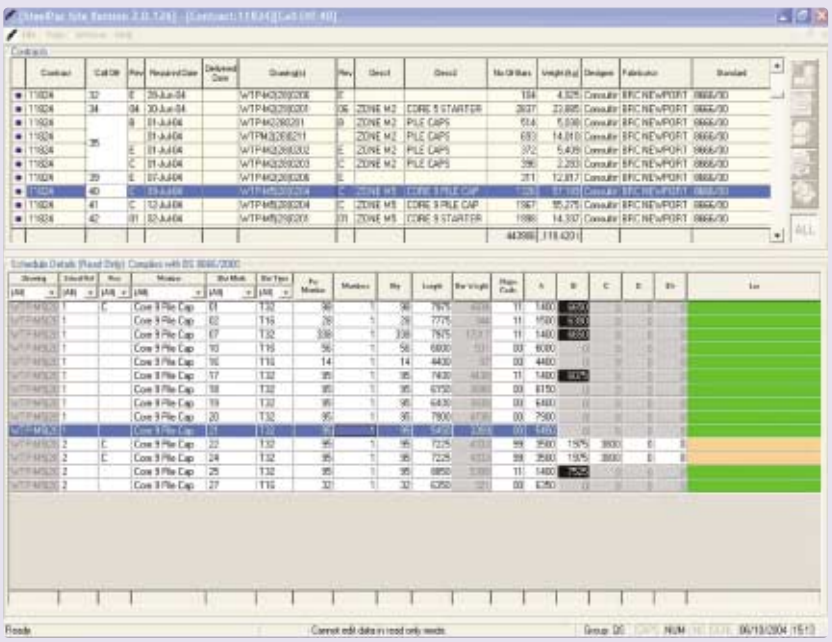

Figure 5 Courtesy of Constructive Technologies Ltd

commence immediately resulting in shorter lead times and efficient scheduling of deliveries. The reinforcement fabricator achieves improved schedule input time, fewer errors, and avoidance of delays between the receipt of reinforcing bar schedule and delivery of material to site. The program also provides improved analysis of cutting and bending requirements, production planning, execution and delivery. In addition, it enables an effective solution for the receipt of shape code 99's, producing a fully dimensioned drawing on the production labels.

The system is fully networked across all firms involved in the construction project allowing all relevant personnel, project management, engineers and quantity surveyors 24-hour access to 'real-time' data.

Figure 5 shows reinforcing schedule generated using SteelPac

3.3 Dubai airport, Dubai

One of the largest reinforcement projects in the world at the moment is the new airport terminal in Dubai where an estimated 430,000 tonnes of steel reinforcement will be fixed. Detailing is being undertaken across the world in countries such as India, Pakistan, Malaysia, Australia , UK and Lebanon. Drawings and Bar Schedules are issued from the detailing teams to the contractor, Al Naboodah Laing O'Rourke, via the web-based ASITE collaboration tool. The detailing teams are using various Steelpac compatible brands of RC detailing software for the creation, validation and issuing of schedules. Steelpac SITE is then being used by six construction teams from Al Naboodah Laing O'Rourke to receive and manage the schedules and order the steel reinforcement bar. The orders are received seamlessly into the various production systems being used by the local reinforcement suppliers, including Al Naboodah Laing O'Rourke's own factory. The compatibility of Steelpac with all of the production systems of the local reinforcement suppliers ensures that the contractor has flexibility on sourcing the reinforcement required.

Reinforcement processes using SteelPac

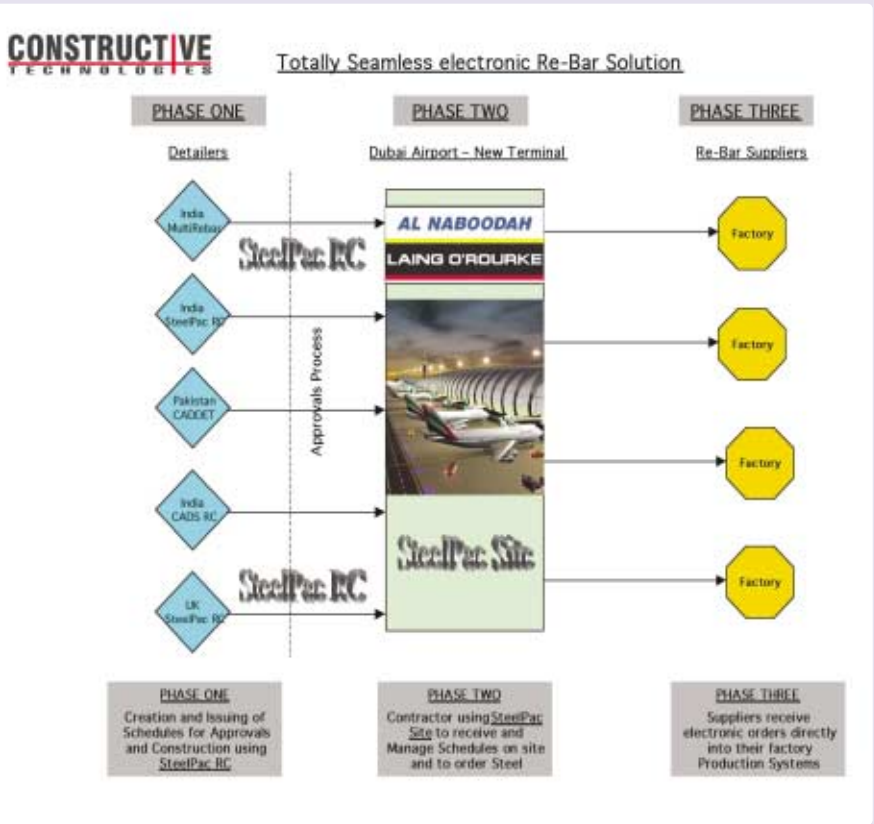

Figure 6 Courtesy of Constructive Technologies Ltd

Figure 6 shows the reinforcement processes using SteelPac.

4.0 CARES product test data depository

CARES, reinforcement producers, reinforcement fabricators and a software development firm have developed a secure website to allow the electronic exchange of product test data between the reinforcement producer and fabricator. It will result in the reduction of paper 'Test Certificates' traditionally sent by the steel producer to reinforcement fabricator, although it will enable these to be provided to the construction client if required.

The secure website receives an electronic copy of the product test data, normally documented on a paper 'Test Certificate,' for each cast of steel when it is dispatched from the steel producer's works. The product test data is stored on the CARES reinforcing steel product test database and accessed via a secure website, i.e. each user has a username and password allocated by CARES, to permit access only to data relevant to them.

A successful trial between a steel producer and reinforcement fabricator commenced in October and it is envisaged the system will be made available to all CARES approved firms from the second quarter of 2005. Initial feedback indicates there has been a significant reduction in the volume of documents forwarded from the reinforcing steel producer to the purchaser and a reduction in the time spent validating, storing and retrieving product test data.

The system will be operated and maintained by CARES and provide benefits to the purchasers of reinforcing steels supplied by CARES approved companies.

5.0 CARES list of approved manufacturers

The scope of each approved firm is given on the CARES website, www.ukcares.com. In addition the product marking, often referred to as the bar mark, is shown for each producer of reinforcing steel products covered by their CARES certificate of approval. Before choosing a CARES approved supplier it is important to ensure the scope of certification covers the products or services required by the purchaser. It is only the approved scope that is supported by assessment and continued audit. Firms may have an approved scope that covers a number of categories and the complete scope of approval is detailed on the firm's certificate of approval that may be obtained from the firm or from the CARES office. The CARES certificate number is displayed in this list and on certificates of approval and, where appropriate, on product labels attached to products supplied by an approved firm. CARES certificates of approval are updated as required and reissued annually.

Should there are any doubts concerning the scope of approval of a firm then the CARES List of Approved Firms should be consulted, www.ukcares.com, or alternatively the CARES office can be contacted for verification, contact details are given below.

6.0 Future developments

New developments in communication technology, including 3-D modeling and wireless technologies, may soon allow open ended, permanent information to be stored on site for future measurement and bench marking. Although wireless technology in terms of 'on-product-memory' is available it is still relatively expensive and it may be some time before it can be used in the reinforcement supply chain. However as a solution to have meaningful sources of data available on site for the use of various disciplines it opens exciting avenues at a relatively low cost. The current generation of available systems are already being used in the macro management of post construction in other parts of the world. More visionary firms are needed to develop these products into useable tools for the future.

7.0 References:

1. CONSTRUCT. A guide to contractor detailing of reinforcement in concrete. **Crowthorne, BCA, 1997. Ref. CSG/001**
2. Improving rebar information and supply (IRIS) by **A. Kalian, T. Thorpe and S. Austin**. Available from the Concrete Centre.
3. **Herman van Rensberg**, Systems Manager, Express Reinforcements Ltd.
4. **Andrew Woolnough**, Managing Director, Constructive Technologies Ltd.
5. **Colin Banks**, Technical Director, Laing O'Rourke plc.

UK CARES
Pembroke House, 21 Pembroke Road, Sevenoaks, Kent TN13 1XR
Phone: +44(0)1732 450000 Fax: +44(0)1732 455917
E-mail: general@ukcares.com
URL: www.ukcares.com

This guide is available in pdf format. If you wish to receive a pdf copy and receive future updates, please send an e-mail to the address above