BENCHMARKING THE USE OF IT TO SUPPORT SUPPLIER MANAGEMENT IN CONSTRUCTION

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SUMMARY*: This paper follows an element of the research programme of the Construct-IT Centre of Excellence, a UK-based organisation responsible for promoting the strategic awareness of IT within construction enterprises. Funding has been granted from the Department of the Environment to benchmark the use of IT within ten mission-critical business processes. Supplier Management is the first benchmark with ten construction contractors interviewed between July and November 1995. The results show that the internal exploitation of IT within the contractor is more advanced than between the separate legal entities of contractor and supplier. Hard copy transfer dominates information transmission with few companies experimenting with technologies such as Electronic Data Interchange (EDI). Of the two measures used, use of IT to support a process and importance to the process, the importance of using of IT is recognised, but does not translate into use. Summaries of the comments made at interviews are provided to give the reader background to the companies' attitudes towards IT in this process area. Reference is made to comparisons with a shipbuilder and automotive parts supplier as out-of-industry examples of companies performing a similar process to assess how other industries use IT within a similar process.*

KEYWORDS*: IT, Strategy, Supplier, Management, Relationship, Benchmark*

1. INTRODUCTION

The use of IT to support supplier management provides a useful case study of how performance improvement might be possible within construction. A study of ten major UK construction companies provides the basis for comparing construction industry performance with that in the automotive components and shipbuilding industries. Quantitative results are presented, together with lessons that might be learned from practice and procedures in these other two industries. Recommendations for research and development initiatives to improve the effective use of IT are included.

2. STRATEGIC USE OF IT

The use of IT as a strategic weapon has been described by Earl (Earl, 1989), and Porter and Millar (Porter and Millar, 1985). Betts (Betts, 1992) develops the concept, applying a five level framework of (1) national construction industry, (2) professional institution, (3) construction enterprise, (4) construction project and (5) construction product. Issues surrounding the use of electronic communications affect all five levels in different ways and it would seem from the work that the strategic and technological co-ordination of all five levels is essential for the successful use of IT for a national industry, a factor that rose to prominence from the work of Porter (Porter, 1991). This examined the determinants of the competitive advantage of national industries.

Unisys (Unisys, 1996) show from a multi-national, cross-sector study that construction does not lag other sectors in its implementation of IT systems, but it does lag other sectors in the impact of IT to the business. 78.9% of respondents felt that IT does not allow profit generation, against an average of 54.5% for senior managers within other industries answering the same question. Respondents from the construction sector outranked other sectors when citing an inadequate organisation of information management systems when asked why they did not have direct access to the information needed to do their job. Inappropriate IT architecture was seen as the prime disadvantage with current management information systems, in common with other sectors. A lack of external links was cited by 13% of construction professionals while the same disadvantage attained no response from the other sectors. Betts (Betts, 1992) articulates the overall problem facing construction, reflected by the Unisys study:

> *'The opportunity for a big-bang in construction exists. Our problem is not the lack of technology but more a lack of awareness of how to exploit it.'*

3. SUPPLIER MANAGEMENT AND IT

The commercial issue of using IT to manage suppliers has been well addressed in other industries. Hammer and Champy (Hammer and Champy, 1993) describe how The Ford Motor Company has dispensed with invoices and rationalised its supplier and inventory management processes utilising the leverage of IT. Paperless processing is the focus of the US financial markets for a continuing drive to reduce the time between a financial trade and its resultant settlement (Rothnie, 1995).

The term 'holonics' is used by McHugh et al. (McHugh et al., 1995) to describe a group of companies who collaborate as a "virtual organisation" in taking advantage of a particular business opportunity. The analogy to the construction project is clear. It would seem that the construction sector has been pioneering in the development of what is currently called a "virtual organisation" to satisfy a customer need, although the sector's use of IT to co-ordinate the disparate companies has lagged significantly behind other sectors.

The technological trajectory of the construction industry has little choice other than to adopt electronic trade and supply chain management if it is to remain competitive in a global market or against other industries. Supplier and sub-contractor (hereafter supplier) management in the UK construction industry is a process of particular importance to construction contractors due the value of supplier input to a completed construction project. Suppliers commonly contribute 75-80% of the value of a construction contract (Atkin et al., 1995) making their effective management and co-ordination essential to cost, quality and time objectives during the construction process. Improved ways of managing the supply chain are therefore essential to overcome the problems that have plagued the construction industry, i.e. late completion, exceeded budgets and poor quality (Ball, 1988).

Improvements to the supply chain have been achieved in many industries through partnering arrangements with a few selected suppliers (Gomes-Casseres, 1994), lean production methods (Womack et al, 1991) and information technology (Hammer and Champy, 1993). There is a wealth of information that can be readily drawn upon providing a plethora of examples of diverse industries. IT as an enabler of process change is the focus of the work of the Construct-IT Centre of Excellence for the UK construction industry and the basis of the research, which this paper documents.

Improving supply chain management in the UK construction industry is a key foundation of *'Construct-IT: Bridging the Gap'* (HMSO, 1995). Particular recommendations were the utilisation of an electronic

communications infrastructure, shared project planning information direct from project planning packages and electronic processing of orders and payments within supply chain relationship frameworks. The supply chain relationship frameworks will be the essential element to enable parties to a construction contract to trade electronically. Suppliers will be engaged by contractors on a regular basis and strong working relationships will develop with time. This form of work has found success in other industries, particularly automotive manufacturing (Womack et al, 1991).

In focusing upon the construction sector, Grilo *et al.* (Grilo et al., 1996) found that the main reason for the lack of electronic trading relationships is the unwillingness of either party to invest in a technological infrastructure that is characterised by the inherent risk of managing a supply relationship within an unclear legal framework. The litigious nature of the UK construction market provides a strong barrier to electronic trading. Analysis of Porter's five forces model in construction also highlights the relative lack of power of construction organisations in a trading relationship (Betts et al., 1991). The trading power of large buyers has been a method by which other industries have forced electronic trading on to suppliers (Atkin et al., 1995).

Despite the inherent difficulties of trading electronically within the context of the UK construction industry there are examples of contractors forming partnering relationships that rely on electronic trading. Tarmac Construction is reducing their supply base to partner with fewer key suppliers in a bid to reduce administrative costs of managing a large supply base (Nunn, 1995). Single monthly invoices from builders merchants who will have the opportunity to be sole suppliers will be supported by an IT infrastructure. Reduced costs to Tarmac and a bigger business opportunity to the supplier will be the competitive reward offered under a new method of trading. The research findings in section 6 of this paper will show that this is a common objective for major contractors in the UK, although Jamieson et al. (Jamieson et al., 1996) have found that few suppliers have the IT infrastructure to manage this relationship and do not view this as important to their competitive future. The outlook for the supply base of the UK construction industry is that those with the strategic vision and technical know-how may be the competitive winners as the sector develops its use of electronic trading.

Initiatives such as Construction Industry Trading Electronically (CITE) (Kavanagh, 1995) and the Construct-IT Centre of Excellence are vigorously promoting the use of IT in the UK construction industry. The following section looks at best practice benchmarking as a method of improving the use of IT in construction by raising the awareness of the use and potential of IT.

4. BENCHMARKING BEST PRACTICE

Benchmarking methodologies are primarily a tool for organisational continuous improvement. As competitors provide challenge within marketplaces, they also provide insight into how operating costs can be reduced and efficiency increased. Benchmarking through objective competitor analysis allows companies to measure products or services against competitors and best-in-class companies in other industries. Leibried and McNair (Leibfried and McNair, 1994) define benchmarking as *'an external focus on internal activities, functions or operations in order to achieve continuous improvement.'*

As a tool to manage change, benchmarking recognises the futility of maintaining a competitive edge in a dynamic marketplace. A reliance upon the replication of internal best practice forces companies into myopic management practices that fail to recognise a panoptic competitive environment. One of the responses to competitive threats has been to study internal and external practices of efficient companies with a view to learning and implementing superior processes that will contribute to a strategic competitive advantage (Leibfried and McNair, 1994). Benchmarking is the response that has a well-developed management toolkit for identifying the processes that will migrate between companies and for providing a methodology for enacting the implementation of the improved process.

Before embarking upon benchmarking some limitations need to be considered. Successful strategic management relies upon component processes to be sufficiently coherent to support the aims of the company (Davenport and Short, 1990). Processes have to be designed with care to ensure that the chosen combination support the strategic vision: contradictions should be rectified before they are operational. Without caution, benchmarking could lead to a mix and match approach to improvement with the potential consequence of being strategically *'stuck in the middle'* (Porter, 1985). Care should also be exercised to choose an analogous process to benchmark. Leibfried

and McNair (Leibfried and McNair, 1994) advocate process mapping and the development of an activity grid to define the salient features and the economic or regulatory constraints of the process for benchmarking.

Lewis and Naim (Lewis and Naim, 1995) identify four types of benchmarking; internal, competitive, parallel industry and best practice. The research that forms the basis of this paper uses all except internal benchmarking. Internal benchmarking is often a first step for many companies in learning a benchmarking methodology. The comparison is between different operating divisions or regions of the company where data are often readily accessible.

Competitive benchmarking occurs between firms within the same industry sector who sell an identical or similar good or service. This form of benchmarking is often the most difficult as it relies upon competing firms to share details of how processes are performed with each other. In this case ten major construction contractors, all of whom could be considered as competitors to each other, took part in the research. It is the opinion of the research team that their independence from all of the participating firms was a key factor in the willingness of the firms to be interviewed about their supplier management processes.

Parallel industry benchmarking occurs between companies from different sectors who undertake a similar process of production or service. This type of benchmarking is considered easier than the previous example as issues of access and willingness to participate in a comparative study will not be as problematic between companies who are not in direct competition.

Best practice benchmarking considers the merits of a comparison from a particular market leader who is known to have an exemplary process that is similar to the process under study. While all of the operations of the process may not be totally transferable between firms due to different industry structures, there will often be important lessons that can be learnt. Best practice benchmarking is called *innovation* benchmarking by Davenport and Short (Davenport and Short, 1990) as the target processes are often born out of innovative thinking and bold managerial implementation. Hammer and Stanton (Hammer and Stanton, 1995) conversely argue that benchmarking stifles innovation and should be used with caution.

5. METHODOLOGY

A research team that mixed academic and industrial knowledge was created. The most important task of this team was to develop a questionnaire to provide a common basis for comparison between the ten contractors willing to be benchmarked. A scoring method was devised that was based on a five point Likert scale for the use of IT and a three-point scale of the importance of the particular technological solution to the business. The questionnaire was designed around a generic model of purchasing and supply and piloted on three companies.

The questionnaire contained over 60 questions covering six areas of supplier management: strategy; communication; project requirements; selection; enquiries, quotations and orders; and contract management. Not all questions were for scoring purposes as it was considered important to elicit qualitative information about company operation and procedures.

Interviews were conducted in the offices of the recipient companies and were concluded to the satisfaction of the research team. Apart from answers to pre-determined questions, interviewees were encouraged to input additional commentary wherever they felt this would add something to the quality of the answers. It was common to interview personnel simultaneously. These were drawn from a mix of purchasing, IT and management functions within the companies. All companies, irrespective of size, were able to respond to all six sections.

While the benchmarking results for the construction contractors are important, it is essential to place the contractors scores in the context of a best practice out-of-industry example. This has the effect of positioning the contractors amongst themselves and relative to a considered world-class example. A difficulty arises with the choice of a best practice example that has to be credible to be acceptable. Table 1 was drawn up and considered by the research team.

(+) implies a characteristic which is shared in some way with the construction industry; conversely, (-) implies something that is inconsistent with the construction industry.

Overall, shipbuilding appears to offer the most appropriate example as a parallel industry for this process. Turbine manufacture, aircraft manufacture and railway rolling stock were also considered as credible comparisons. Ultimately, the search for a best practice comparison led the research team to benchmark an automotive components company. It was considered that supply relationships and IT infrastructure were sufficiently well developed in the automotive components industry to provide an out-of-sector example that used IT in an exemplary manner.

TABLE 1: Non-construction cases compared

Car manufacture	
(+)	Supply chain very efficient and supported by IT
(+)	Close relationships between suppliers and assembler
(-)	Highly repetitive process producing long runs of similar products
(-)	Epitome of single point responsibility
(-)	Sell the end-product
Turbine manufacture	
(+)	Made to order
(+)	Major capital item
(+)	Contracted to build the end-product
(-)	Single point of responsibility for design and manufacture of the product
(-)	Supplied as near complete to site, rather than assembled insitu
Aircraft manufacture	
(+)	Major capital item increasingly customised
(+)	Components often sourced from around the world
(+)	Considerable use of IT in all stages, not just the supply chain
(-)	Too much of a high tech image for construction audience
(-)	Selling the end product
Shipbuilding	
(+)	Major capital item, sometimes unique
(+)	Uses range of materials having much in common with construction
(+)	Some examples (cruise ships) are little more than floating buildings
(+)	Contracted to build the end product
(-)	Difficulty of acceptance by construction audience
Railway rolling stock manufacture - Channel Tunnel trains	
(+)	Major capital items
(+)	involved major innovations and procured against tight budgets
(+)	Contracted to build the end-product
(-)	Short runs of similar, if not identical, rolling stock
(-)	Probable lack of useful IT references/case studies
Retailing	
(+)	Very close relationship between supplier and retailer
(+)	Efficient ordering and payments system
(-)	Has little in common with the nature of an assembly process
(-)	Long runs (sometimes limited editions of low unit cost
(-)	Sell the end product

6. TEN CONSTRUCTION COMPANIES COMPARED

The following section shows the results of the benchmarking of ten construction companies, the parallel industry benchmark and the best practice benchmark. In all graphs, the ten construction companies are denoted by ◆, the average of the construction companies is denoted by □, the parallel industry by ○, and the best practice by Δ. Where all ten contractors are not visible in the figures that follow, it is because two or more overlay each other.

6.1 Overall performance

Brief description

Assessment of the overall positions of all ten construction companies relative to one another, parallel industry and best practice.

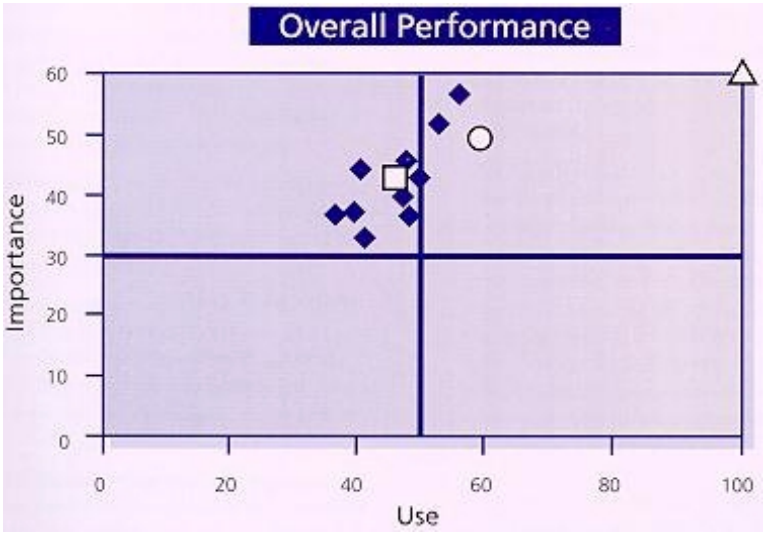


FIG 1: Overall Performance of IT Across All Measured Areas

Interpretation

The graph shows three clusters of construction companies. The overall positioning of the companies would indicate that the majority are committed in principle to the use of IT, though have some way to go before they could be regarded as best practice. Importance in the use of IT attracts a higher score than of current use. The parallel industry is placed ahead overall in its use of IT, though not significantly so. This suggests that the gap between construction companies and shipbuilding is not wide. When compared to best practice, the construction companies and the shipbuilder fared badly.

Analysis of the present and future use of IT

Supplier management is a key process to the construction companies and a desire to develop supporting technologies is important. Most of the construction companies saw future developments in the use IT to trade with suppliers. EDI, procurement systems and BACS were viewed as key technologies linking into integrated systems. Specific barriers to the increased use of IT in supplier management are the cultural problems associated with the take-up of IT within a traditionally conservative industry and a lack of commitment at board level.

The parallel industry's IT systems are essential to the company. If its systems were to fail the company would be brought to a standstill within two days. An integrated system has been created to eliminate as much paper as possible which supports design, bills of materials, planning, scheduling, ordering, delivery, production, commissioning and payments. The company's main weakness is its CAD system, which needs replacing.

The best practice company is also totally reliant on IT, emphasising a strong cultural value system. A dedicated training centre is provided to all employees to develop IT skills and everyone relies on IT for their daily routine. Sophisticated backup and power systems have been installed to guard against system failure. Like the parallel industry example, the 'best practitioner' would cease to trade within 24-48 hours of a total systems failure, but still, EDI is the primary technology for managing suppliers. The company is committed to achieving zero transaction costs.

6.2 Strategy for supplier management

Brief description

Extent to which companies have recognised the need for, and apply, a strategy for dealing with suppliers, including the use of IT in this relationship.

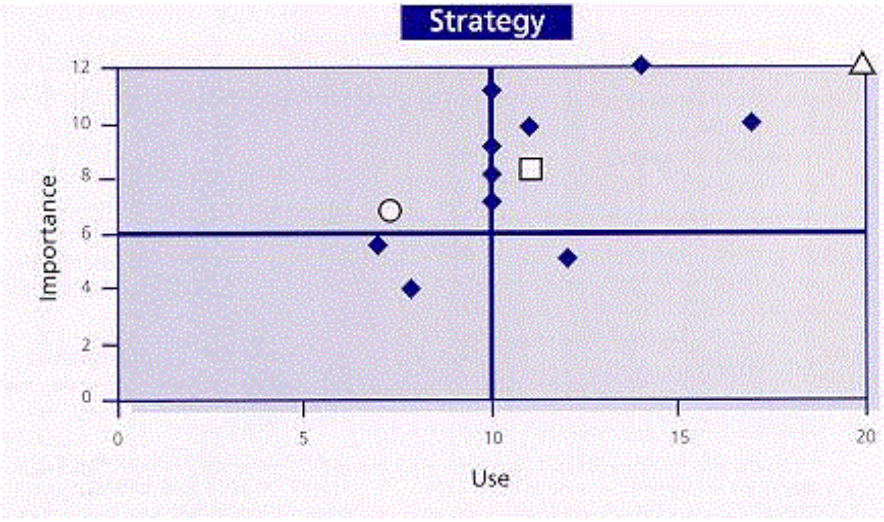


FIG 2: Need for IT Strategy for Dealing with Suppliers

Interpretation

The majority of construction companies appear to recognise the need for an IT strategy, though they do not necessarily see the need for a specific statement. There are one or possibly two exceptions in that they have developed formal strategies. The gap between them and the best practice company is small enough to be bridged in the near future. The parallel industry company appears oddly placed, since its more advanced use of IT is inconsistent with a strategy that appears informal and unsupported by a business case. This may be because IT is so fundamental to business strategy and has long passed the point of having to be accepted as a key factor in supplier management.

Analysis of the companies' strategy for supplier management

In the majority of the construction companies, development of operational policies is dominant over the development of strategies to deal with suppliers. This can be partly attributed to confusion between the dichotomy of strategic and operational policies. When strategies are apparent they focus on partnering arrangements and trading electronically using EDI technology. The majority of the companies had a quality assurance system in place that had procedures for managing suppliers. Few had incorporated IT procedures for managing suppliers into the quality assurance system. Partnering arrangements are seen as the next significant future development for strategically managing supply relationships by a few interviewees. One interviewee showed concern at his company's lack of a strategy and moreover a lack of interest at board level.

The shipbuilder's position in this section is rather curious as its use of IT is essential to operations, but strategically of low use and importance. Conversely, the automotive components company rates its strategic management as essential. Over half of the company's suppliers are working within a partnership framework that provides for detailed metrics of performance with clear targets. When these are reached, new metrics are devised to motivate both sides of the framework to continue to look for further cost savings.

6.3 Communication

Brief description of issues

Extent to which companies attach importance, and apply IT, to the communication of information generally between themselves and their suppliers.

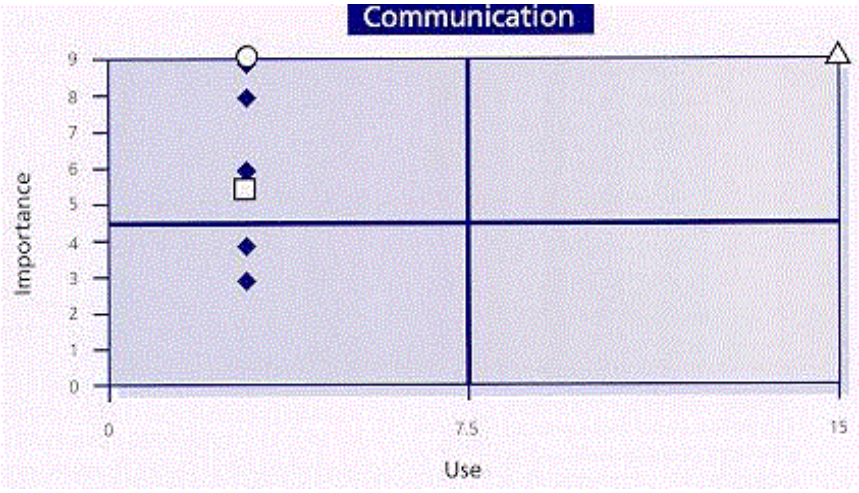


FIG 3: Communication Using IT

Interpretation

All construction companies exhibit a low level of commitment to the use of IT in communication between themselves and their suppliers. The degree of importance attached by the companies to the need for IT varies markedly. The shipbuilder is generally no further advanced in its communication of information with suppliers, although recognises how important IT is in this connection. The gap between the companies and *best practice IT* is significant and suggests that serious, immediate attention should be directed to this process.

Analysis of the companies' use of IT to support communication with suppliers

Most communication is by means of hard copy although some of the companies attach high importance to information but are not doing it. Indeed, interviewees talked enthusiastically about using EDI and discussed current pilot projects. The isolated instances of electronic transfer of information are mostly limited to floppy disks and sporadic email. Most companies cited the telephone and fax as key technologies for maintaining effective communication between themselves and their suppliers.

The shipbuilder mirrors the contractors by communication through hard copy, telephone and fax while stressing the important need to use more advanced methods. Security of transfer of information over the Internet is seen as a barrier to use. Conversely, the automotive components company and supplier use EDI exclusively. The company does not stipulate that suppliers use EDI if a better, lower cost alternative is available. This business arrangement, interestingly, allows the supplier flexibility in changing the method of communication if they can prove the worth of an alternative. The company uses the Odette (Organisation for Data Exchange by TeleTransmission in Europe) standard to support most activities. IT systems are open to the supplier to locate the information it requires to fulfil the partnership arrangement. Suppliers are responsible for managing the company's inventory. Here, the traditional boundaries of organisational responsibilities are shifting to a significant degree.

6.4 Requirements

Brief description of issues

Extent to which companies attach importance, and apply IT, to the exchange of information between themselves and their suppliers in respect of project- or contract-specific requirements.

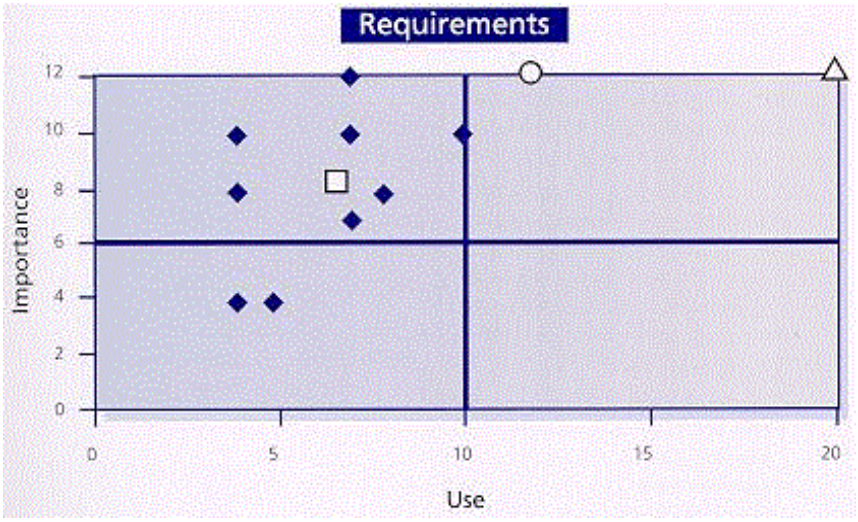


FIG 4: Project Specific Information Exchange

Interpretation

All construction companies, to a greater or lesser extent, provide little IT support for project- or contract-specific information and several consider it to be of a low order of importance. The shipbuilder not only recognises the importance of IT to the exchange of information between itself and suppliers on a shipping order, it also uses IT to support the process. Even so, the gap between these companies and *best practice IT* is great and indicates that much has to be done to improve this process.

Analysis of the companies' use of IT to support requirements with suppliers

As a corollary to communication, hard copy, telephone and fax dominate the exchange of project-specific requirements with suppliers. A dominant theme from the companies was the concern of the legality of electronic information in an industry that is litigious in nature. This appears to be a significant barrier as contractors do not want electronic transfer of information to be the Achilles' heel of a contractual claim. Whether this concern is justified in the light of the best practice example must be open to question. A second dominant barrier is the lack of bargaining power within the wider contractual arrangement. As a significant amount of power resides outside the domain of the contractor they feel unable to influence the communication protocols of a project to include electronic transfer of project specific requirements. Within the graphical grouping there is a wide disparity between the best placed and worst placed contractor. From the responses given it would seem that some contractors are able to use varying amounts of IT to support project-specific requirements, dependant upon the size and nature of the project.

The shipbuilder maintains a provision for exchange by floppy disk or modem where the supplier has a specified design responsibility. The ability of suppliers to make changes to the design is limited due to the precise requirements stipulated in ship design and construction. The automotive components company maintains close working relationships with its supply base to extract knowledge and information in partnership in order to develop solutions jointly for their customers. Working with an existing supplier to develop a new component is preferable to searching for a new company.

6.5 Selection of Suppliers

Brief description of issues

Extent to which companies attach importance, and apply IT, to the selection of suppliers and the maintenance of information on them.

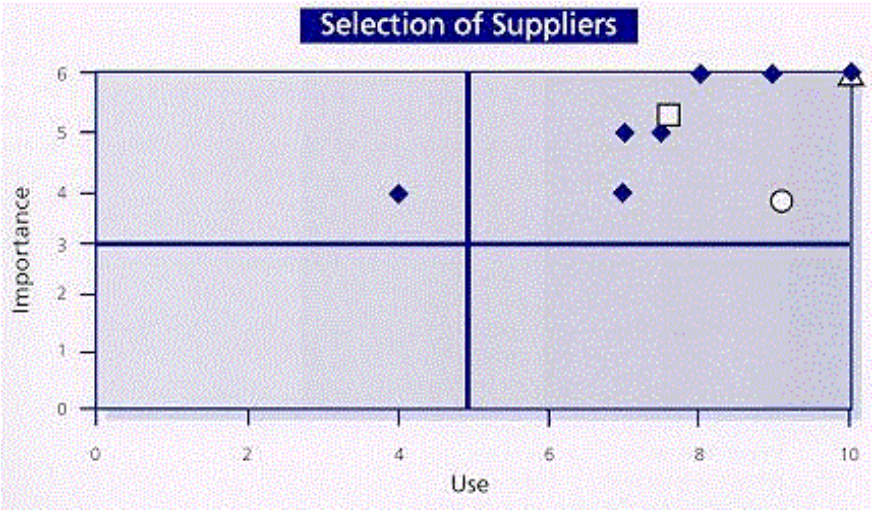


FIG 5: Selection of Suppliers

Interpretation

With one exception, all construction companies show a strong commitment to both the importance and use of IT in this aspect of supplier management. For the shipbuilder, both importance and use of IT is more evident than in its construction counterpart. Generally, the gap to be bridged between the companies and *best practice IT* is not so great as in other processes.

Analysis of the companies' use of IT to support selection of suppliers

All contractors display an extensive use of database technology to manage large supply bases. As all the contractors were operating at a national level the databases usually numbered thousands of suppliers. Information stored on the databases included ratings of suppliers' performances on contacts as well as suppliers' capabilities. Limited feedback, if any, was given to the suppliers regarding their performance.

The shipbuilder has the benefit of a comparatively small supply base as it works in one location. Control over supplies to a fixed location has meant that database structure and the information contained within it are sophisticated. There is also the ability to track the progress of orders at any stage of the contract. Although an advanced IT system is deployed to manage suppliers, it is a rare occurrence to select a new supplier. When selection of a new supplier occurs lengthy procedures are followed to ensure that a profitable working arrangement will be operational between the companies. Commitment to IT and culture are essential factors in determining a possible supplier's compatibility with the company.

6.6 Enquiries, Quotations & Orders

Brief description of issues

Extent to which companies attach importance, and apply IT, to the processing of enquiries, quotations and orders.

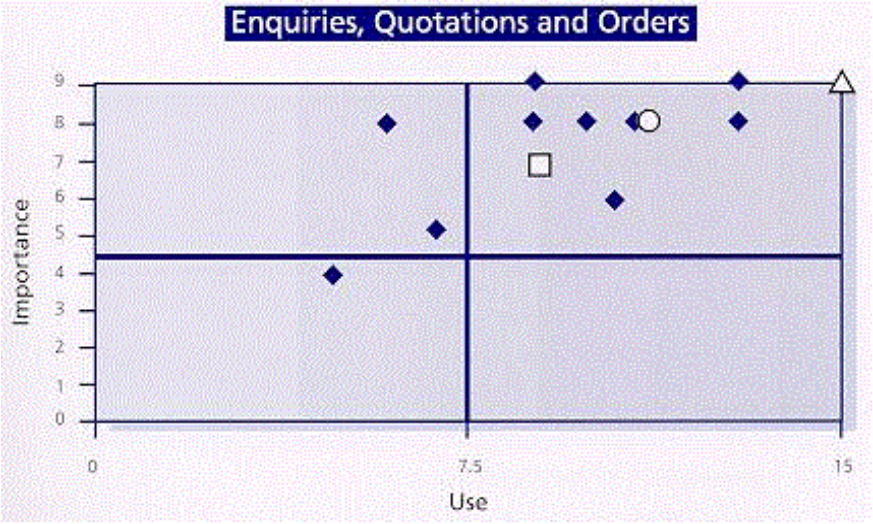


FIG 6: Enquiries, Quotations and Orders

Interpretation

Overall, construction companies exhibit a strong commitment to IT. This is seen as important by many of them and backed-up in practice. A small minority has yet to be convinced about the application of IT in this area. The shipbuilder recognises the importance of IT in this connection and this translates into a high level of use in practice. In some cases, the gap between the company and *best practice IT* is modest, although a few companies have a considerable distance to travel.

Analysis of the companies' use of IT to support selection of suppliers

Spreadsheet and database applications form the prime applications in this process area. IT use is advanced in the production of documentation and in the analysis of information returned from suppliers. Transmission of information is dominated by hard copy in both directions. A few companies used dedicated estimating systems for the production and analysis of information with isolated examples of disks being used to transmit information.

6.7 Contract Management

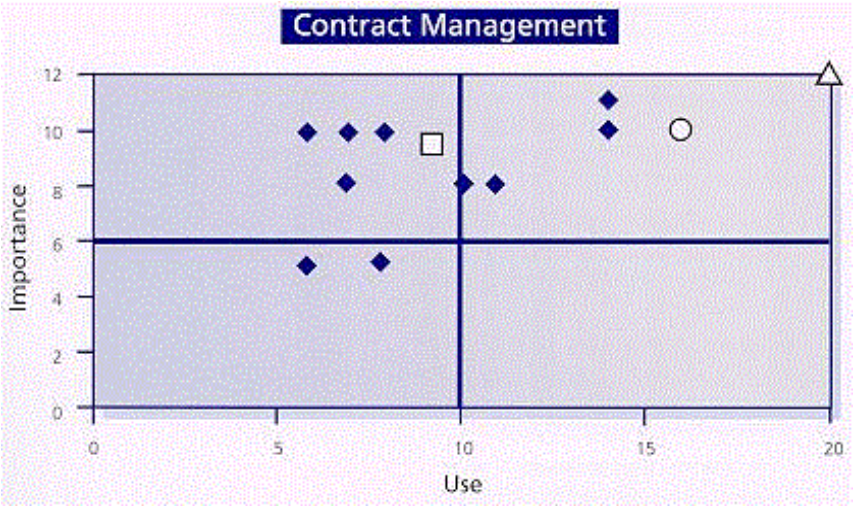


FIG 7: Contract Management

Brief description of issues

Extent to which companies attach importance, and apply IT, to the management of supply contracts, including methods of payment.

Interpretation

Generally, the construction companies show moderate commitment to the use of IT, with two possible exceptions. This is in contrast to the shipbuilder, where IT is regarded as important and used to a significant extent. The gap between the present and *best practice IT* for the majority of construction companies is considerable and demands serious attention.

Analysis of the companies' use of IT to support contract management

The litigious nature of the UK construction industry is a prime factor in the influence of IT to aid this process area. Concerns of allowing suppliers too much information prevail to quell the amount of information suppliers have in a claim situation. The common attitude was to provide suppliers with the minimum amount of information required to execute their contractual obligations. Two exceptions express a strong commitment to improve links with suppliers that entails closer working relationships in the form of sharing information electronically.

7. ANALYSIS OF THE RESULTS

The UK construction industry appears to be a long way from the technological utopia of electronic trading to support the competitive advantage of the whole industry. The research findings that follow document an industry that uses IT in support of supply chain management at a basic level of development.

When the quadrants of the graph are analysed, the following classifications appear:

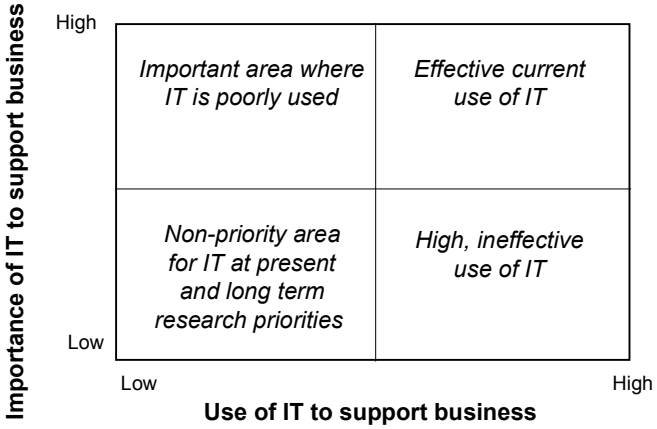


FIG 8: Classification of Research Results

The *effective current use of IT* places a company with only a relatively small gap to bridge before reaching best practice use of IT and shows companies who are harnessing currently available technology effectively to support business needs. The *high, ineffective use of IT* positions companies who have extensive use of IT to support a particular process area, but do not view the technology as important to address business objectives. The non-priority area for IT at present and long term research priorities shows IT deployment to be undesired at present by companies, but with implications for the research community, as technological solutions may yet have been

developed and are in need of development. The *important area where IT is poorly used* highlights immediate gaps in the companies' use of IT that are identified as one of remedy.

Imposing the average of all the process areas onto the same figure shows the following results:

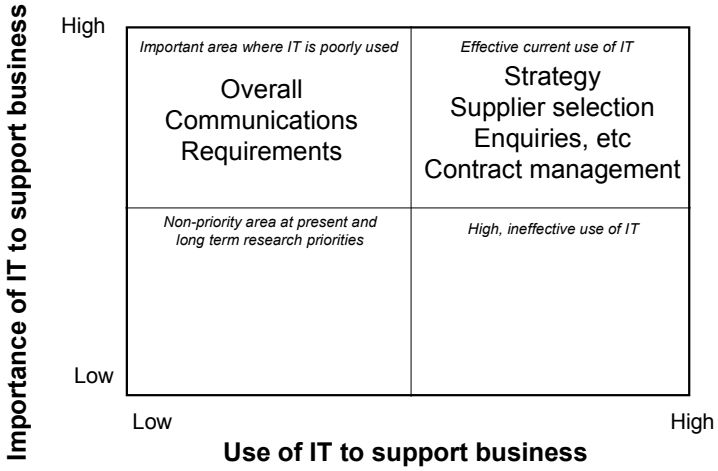


FIG 9: Development Priorities in Supplier Management

Figure 9 therefore shows the development priorities for supplier management. The position of overall performance would suggest that supplier management should be an area of research priority. Similarly, general communications and the communication of project specific requirements are short-term research priorities. Likewise, supplier selection, enquiries, quotations and orders and, contract management can be regarded as current system development priorities.

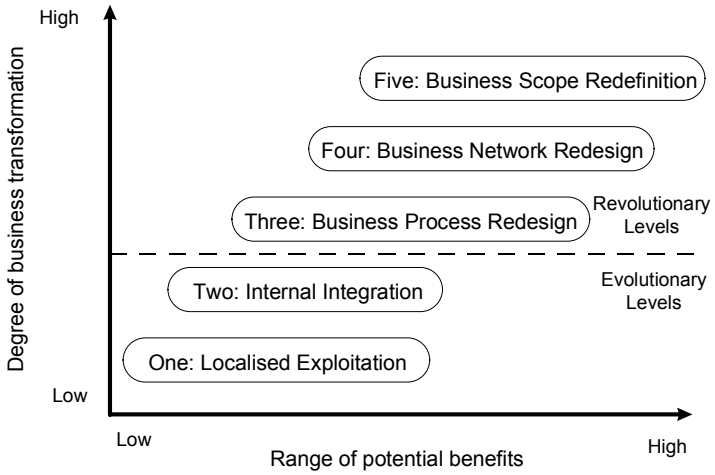
Figure 10 shows Venkatraman's (Venkatraman, 1991) five levels of IT-induced exploitation. The use of construction companies' deployment of IT in support of supply chain management can only be seen to fall within localised exploitation. Venkatraman describes localised exploitation as:

'…the exploitation of IT within business functions such as manufacturing or marketing or even isolated business activities within the functions.'

Conversely, the next step of IT-induced reconfiguration, that is internal integration, is described as:

'…the deployment of a common IT platform serves to integrate the organisation's business processes, potentially enhancing efficiency and effectiveness.'

Further revolutionary levels are yet to be touched, although the interview process revealed that some companies are considering and piloting methods of harnessing IT to enable radical change in the forms of business process redesign, business network redesign and business scope redefinition.



Five levels of IT-induced reconfiguration
Source: Venkatraman (1991)

FIG 10: Five Levels of IT-induced Reconfiguration

Clark (Clark, 1997) shows from a case study of a large UK construction company that internal integration of systems is a business issue of some seriousness. The use of integrated project databases for all project participants to access central information repositories is a central objective of construction IT research in the UK and would seem the most likely technological trajectory of the immediate future (HMSO, 1996).

8. CONCLUSIONS

The construction industry still has a significant gap to bridge to reach best practice in its use of IT to support supplier management. Fundamental changes are required in technology, information management, culture and procurement forms to allow an advanced use of IT to support electronic communication and trading at all levels. The technological infrastructure to manage the transition is readily available and waits to be harnessed. The inevitability of electronic trading faces the construction industry as a strategic weapon to the competitive advantage of the industry, a competitive advantage that is essential to maintain, not only in the marketplace for construction services, but against other industries. The choice for investment decisions of the future may be the choice between highways or information super-highways.

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