



# A survey of supply chain collaboration and management in the UK construction industry

Akintola Akintoye\*, George McIntosh, Eamon Fitzgerald

*Department of Building and Surveying, Glasgow Caledonian University, Glasgow G4 0BA, UK*

Accepted 6 April 2000

## Abstract

The paper details the results of a questionnaire survey of supply chain collaboration and management in the top the UK construction industry contractors. The results indicate the formation of a significant number of partnerships/ collaborative agreements between contractors, suppliers and clients following the publication of the Latham (1994) and Egan (1997) reports. It appears that construction supply chain management (SCM) is still at its infancy but some awareness of the philosophy is evident. Contractors identified improved production planning and purchasing as key targets for the application of SCM in construction. Barriers to success included: workplace culture, lack of senior management commitment, inappropriate support structures and a lack of knowledge of SCM philosophy. Training and education at all levels in the industry are necessary to overcome these barriers. © 2000 Elsevier Science Ltd. All rights reserved.

*Keywords:* Supply chain; Construction industry; Supply chain management; Trust; Procurement; Partnering

## 1. Introduction

There is now a substantial literature which acknowledges that a major part of the formula for the successful reform of the UK construction industry is the greater involvement of contractors at an early stage in the decision to build. A growing emphasis on design and build in private and public sector contracts — the latter associated with an increased emphasis on the UK government's Public Private Partnership (PPP) — underpins this growing emphasis of the UK contractor's role and the promise held out of greater efficiencies in the supply chain. Two UK Government sponsored reports, Egan (1997) and Latham (1994), addressing barriers to efficiency, seek major reform in UK procurement methods and give the potential of supply chain management (SCM) particular relevance at this time.

In many other industries, firms have been quick to identify the potential benefits of efficient SCM. The Economist Intelligence Unit (1996), found that in Europe, 85% of retail stores are in the process of re-design their supply chains and 3% have completed the process. Of the

150 companies surveyed, 80% stated that their supply chain had become “significantly more important” due to the breakdown of pan-European trade barriers. The Economist study also predicted that global supply chains, already important, would increasingly replace both national and pan-European supply chains. The increasingly global nature of such supply chains will, in this view, call for continual re-design of supply chains in order to maintain competitive advantage.

Supply chain collaboration and management has been beneficially applied to several industries, notably in vehicle manufacture and the retail trade. The manufacturing industry has been at the forefront of developing SCM for many years (Landry, 1998). Within agriculture, SCM relationships are becoming more important as a result of dynamic consumer demand, global competition and the dismantling of official protection; a process termed: the “industrialisation of agriculture” (Boehlje, 1996). The retail industry has arguably been most successful in the implementation of SCM strategies. This follows from a climate of intense competition, high-volume low-value product lines with marginal cost savings benefiting price conscious customers and the competitive standing of their suppliers (Hollis, 1996).

This paper documents current opinions of SCM in the UK construction industry from the contractor's

\* Corresponding author. Tel.: +44-141-331-3626; Fax: +44-141-331-3696.

E-mail address: akin@gcal.ac.uk (A. Akintoye).

perspective. The paper — an empirical study of the UK construction industry — identifies and discusses the views of main contractors on supply chain collaboration and management, including current usage patterns, its future use and the importance currently attributed to its philosophy.

## 2. Overview of supply chain management

In recent times, the theory of purchasing and supply operations has been widely studied under a variety of labels and for a number of reasons. Each of these focuses on different operations within an organisation but SCM is the single most wide-ranging approach in its range of study in considering how firms utilise their suppliers' processes, technology, and capability to enhance competitive advantage (Houlihan, 1985; Cooper et al., 1993; DTI, 1995). Tan and Kannan (1998) consider how all strategic suppliers in the chain can integrate to act as a single entity and enhance overall performance in SCM.

One definition of SCM is offered by La Londe (1998) as: "the delivery of enhanced customer and economic value through synchronised management of the flow of physical goods and associated information from sourcing through consumption." Johnston (1995) offered: "The process of strategically managing the movement and storage of materials, parts and finished inventory from suppliers, through the firm and to customers." The various definitions which have been proposed, indicate that SCM prescribes organisational restructuring, extended to the achievement of a company-wide collaborative culture. For Rich and Hines (1997), it embraces a strong sense of integration of all activities controlling the timing and synchronisation of material flows.

The benefits of collaborative, rather than adversarial, working relationships within and beyond the organisation were identified by Ford (1980) while Lummus et al. (1998) suggests that SCM was growing in importance due to: increased market competition, the acceptance of a wider focus for evaluating organisational change and its full impact on company fortunes and the declining incidence of vertical integration as a result of which efficiency and innovation can no longer be solely an internal management function. Wider co-operation and consultation are regarded as a necessity in the new order. Christopher (1992) suggested that a customer service explosion, time compression, the globalisation of industry and organisational integration has given great importance to SCM. For him, a thorough business philosophy must replace logistics management. Burgess (1998), suggests that SCM offers competitive advantage in better lead times, customer service and supply chain synergy.

In terms of the SCM process, Waller (1997) stresses rigorous attention to quality, cost and lead or delivery

times based on teamwork, co-operation and effective coordination throughout the organisation. He argues that that the concept should be considered for all decisions and levels in the organisation and he associates success with the handling of a number of key management activities in the supply chain. For some writers, the absence of a unifying common methodology throughout the supply chain, in the departmental systems of the past, resulted in conflicting goals. The balkanisation of the supply process leaves many unresolved conflicts for SCM to address (Ganeshan and Harrison, 1997).

Realising competitive advantage from organisational alignment and SCM in relation to materials supply is for Stevens (1986), a form of backward integration; at first, it involves the focal enterprise forging alliances of distribution and manufacturing activities to deliver improvements for the final customer (internal integration). In the process, the manufacturing organisation obeys demands from distributors; purchasing is in turn re-structured and managed to achieve improved customer value for manufacturing; thereafter, the process addresses the suppliers to the organisation (external integration) typically involving supplier rationalisation and the introduction of supplier evaluation systems. For Stevens (1989), the evolutionary process develops through: the baseline organisation; the functionally integrated company; the internally integrated company; and finally, the externally integrated company.

With regards to SCM implementation, a study by Lambert et al. (1998), conveys the SCM implementation process as a more straightforward matter. In their view, senior management must address the process and they identify three closely inter related elements to aid the SCM task, namely: the supply chain network structure; the business processes; and the management components. For Bushnell (1999), implementing SCM requires a thorough understanding of the concept and its technology over a lengthy and diverse range of activities and organisations. He states: "There is nothing worse than trying to train for a technology when employees do not really understand or fear the concepts that it supports. And there is nothing worse than managers pursuing a concept when they do not understand the importance of, or the difficulties related to, the technology on which the concept depends."

## 3. Construction industry supply chain collaboration and management

The construction industry has been slower to employ the concept, which has been embraced elsewhere, perhaps because of the unique context in which SCM collaboration must be applied, i.e. an organisational structure consisting of individual elements in the nature of a conglomerate, termed "the temporary multiple

organisation” (Cherns and Bryant, 1983). For Cherns and Bryant (1983), the two most important aspects of the industry are customer specificity of the (“bespoke”) final product and the involvement of numerous value-adding organisations.

The construction industry product is in the nature of an investment service where the customer wields great influence on the final product in relation to its physical aspects (dimensions, application of materials, etc.) and the value of logistic parameters (delivery date, project duration, etc.). In some cases, the customer selects the manufacturer (contractor), the suppliers of specialist parts and the material suppliers (Kornelius and Wamelink, 1998). Longstanding, efficient supplier–contractor relationships are vulnerable to disruption in this context.

Vollman et al. (1997) hold that construction SCM is increasingly seen as a set of practices aimed at managing and co-ordinating the entire chain from raw material suppliers to end customers. Bontekoe (1989) developed a list of 10 bottlenecks that hamper the application of logistics in construction which may also have application for SCM. These include a need for extensive preparation for approval procedures, conflicts of interest between organisations within the project organisation and a need for co-operation with public utilities.

O’Brien (1999) noted that the existing manufacturing research in supply chain management, while useful, does not readily translate to a construction environment; given the transient nature of production in construction projects. He concluded that relatively little is known about construction supply-chain management. Nonetheless, it was recognised that SCM promises an engineering basis with which to design, plan, and manage construction projects in a collaborative manner. Although effective SCM is a key element in reducing construction costs (Atkin et al., 1995), Agapiou et al. (1998) noted that no studies have defined what SCM is within the construction process.

However, it is possible to apply a definition of the supply chain offered by Christopher (1992) as the “network of organisations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumers” to the description of construction SCM. In the context of the current work, Construction SCM may be regarded as the process of strategic management of information flow, activities, tasks and processes, involving various networks of organisations and linkages (upstream and downstream) involved in the delivery of quality construction products and services through the firms, and to the customer, in an efficient manner.

In terms of the foregoing, the upstream within construction SCM in relation to the position of a main contractor, consists of the activities and tasks leading to preparation of the production on site involving construc-

tion clients and design team. The downstream consists of activities and tasks in the delivery of construction product involving construction suppliers, subcontractors, and specialist contractors in relation to the main contractor. For Saad and Jones (1999) downstream is the weaker link and needs to be improved if the full potential of SCM for the industry and its clients, is to be realised.

Wong and Kanji (1998) believe that construction SCM, when adopted along with partnering and total quality management, can successfully address major problems of the industry and its clients. They visualise a wider and clearer view of project partnering and their view of the link to total quality management has been emphasised by Wong and Fung (1999). They conclude that SCM must be a vital part of the total quality objectives of a general contractor. They recommended that in managing the supply chain for total quality, the general contractor must develop an enabling structure and an efficient communication system for effective relationship management as part of project management.

Research on construction SCM is relatively scarce, although Egan (1997) advocated partnering to increase efficiency and productivity.

#### 4. Study methodology and sample coverage

##### 4.1. Questionnaire design

The questionnaire survey sought UK contractors’ opinions on supply chain collaboration and management. A two-page closed questionnaire, accompanied by a covering letter, was sent to the managing director of the sample firms. Because the research was considered exploratory, a questionnaire survey was chosen as an appropriate approach (Bailey et al., 1995).

The questionnaire was designed to replicate three previous studies by P.E. Consulting (1991, 1994, 1997) about collaboration in the retail supply chain: “Long Term Partnerships- or Just Living Together?” (1991); “Supply Chain Partnerships — Who Wins?” (1994); and “Efficient Consumer Response — Supply Chain Management for the New Millennium” (1997). The present questionnaire explored the upstream and downstream supply chain identified by Jones and Saad (1999).

The questionnaire was divided into seven sections exploring supply chain relationships. Contractors were asked their opinion on the efficiency of tendering, the value of clients and suppliers, and their opinion of partnerships. They were also asked how important they felt supply chain collaboration and management was for the industry. The final section of the questionnaire looked at success factors in supply chain collaboration and management using a five point Likert scale with ‘5’ indicating “high Extent” or “most important” and “1” indicating “least extent” or “least important”.

#### 4.2. Sample design

The questionnaire was sent to 100 the largest contractors (by value of projects) in the United Kingdom listed in the July/ August 1998 issue of Construction Manager, the official magazine of the Chartered Institute of Building (CIOB, 1998). In response to the initial 100 questionnaires issued, 22 replies were received after a six-week period. From the list of 78 contractors that had not replied, a random selection of 50 contractors was made and a reminder sent with a two-week deadline for a response. Overall, 40 positive replies were received - a 40% response rate. The survey cannot be considered biased following Moser and Kalton (1971), who hold that the results of a postal survey are biased if the return rate is lower than the range 30–40%.

For the analysis, respondents were split into three groups (large, very large and mega large) based on their annual turnover, to determine whether their responses varied with size. Watts (1980) points out that the size of a company can be measured in terms of number of employees, net assets (capital employed), value added (net output) and turnover. Table 1 shows the grouping of the firms, the number in each group, the mean turnover, and the standard deviation for each.

Fifty per cent of the respondents were directors in their respective organisations followed by 30% who held a managerial position. Five per cent were chief executives and another 5% chairman. Researchers made up 2.5% of respondents and 7.5% gave no designation.

### 5. Data analysis and results

Data analyses were undertaken using the statistical package for social sciences (SPSS) and dealt mainly with the ranking of the variables based on mean values and frequency distributions. Analysis of variance (ANOVA) was undertaken to test the null hypothesis that mean values of the dependent variables are equal for all groups. This enabled researchers to clarify whether or not the opinions of the separate contractor groups were the same on the various issues dealt with in the study.

Tables 1–9 present the results of the analysis. Tables 4–9 show “*F* statistics” (based on *F*-ratio or value) which tests the null hypothesis that all groups have the same mean. “*F* significant” indicates the probability of rejecting the null hypothesis i.e. that there is no difference between the mean values of the groups. Lower probability value indicates that the null hypothesis can be rejected, suggesting that there is a difference of opinion between groups. A probability value (sig.) below 0.05 suggests a high degree of difference of opinion between groups in relation to that factor. For example, in Table 4, in relation to the production planning function, the *F* ratio is 0.303 and the observed significance level is 0.740,

Table 1  
Frequency distribution for the responding contractors

Group	Turnover (£ m)	Frequency	%	Mean (£ m)	Std Dev.
Large	Less than 100	14	35	44.36	21.17
Very large	100–250	15	37.5	169.33	43.13
Mega large	Greater than 250	11	27.5	802.64	518.93
	Total	40	100	299.75	413.7

Table 2  
Length of partnership agreement with suppliers and clients

Length of agreement (Years)	Suppliers		Clients	
	Frequency	(%)	Frequency	(%)
No agreement	14	35	6	15
1–2	10	25	15	37.5
3–5	12	30	11	27.5
6–10	4	10	5	12.5
Over 10			3	7.5
Total	40	100	40	100

Table 3  
Importance of supply chain collaboration and management to contractors

Importance	Frequency	(%)
Not important	1	2.5
Limited importance	3	7.5
Important	17	42.5
Critical	19	47.5
Total	40	100

indicating that the null hypothesis cannot be rejected in favour of its alternative. This suggests a consensus between the groups (large, very large and mega large contractors) in relation to the proposition that the production function is an important internal organisation function for SCM.

### 6. Contractors' relationships with suppliers and clients

The first set of questions asked the contractors whether they had any partnership agreements with any of their suppliers and clients; twenty-six (65%) have some form of collaboration/partnership agreement with one or more of their suppliers. Of these 26 contractors, 14 of them held a contractual agreement. Fifty-five per cent of the agreements between suppliers and contractors were made in the last 5 years while 10% of the agreements were of 6–10 yr standing.

Table 4  
Internal organisation functions important to supply chain management

Function	Overall	Turnover (£ millions)			F stat.	Sig.
		Less than 100	100–250	Greater than 250		
Production planning	4.38	4.29	4.53	4.27	0.303	0.740
Purchasing	4.00	4.07	4.07	3.81	0.224	0.801
Transport	2.87	2.93	2.73	3.00	0.216	0.806
Storage	2.83	2.93	2.87	2.64	0.222	0.802
Inventory	2.80	2.71	2.80	2.91	0.070	0.933

Table 5  
Factors in supply chain relationship with supplier

Function	Overall	Turnover (£ millions)			F stat.	Sig.
		Less than 100	100–250	Greater than 250		
Better quality service	4.63	4.71	4.67	4.45	0.655	0.525
Cost benefits	4.55	4.50	4.67	4.45	0.543	0.585
Simplifying the construction process	4.23	4.21	4.33	4.09	0.171	0.843
Simplifying the ordering process	3.48	4.00	3.13	3.27	0.810	0.073

Table 6  
Factors in supply chain relationship with client

Function	Overall	Turnover (£ millions)			F stat.	Sig.
		Less than 100	100–250	Greater than 250		
Cost benefits	4.55	4.71	4.47	4.45	0.367	0.695
Simplifying the construction process	4.15	4.29	4.13	4.00	0.232	0.794
Simplifying the tendering process	4.03	4.00	4.07	4.00	0.021	0.979
Simplifying the design stage	3.98	3.93	3.93	4.09	0.115	0.892
Creating standardisation of processes	3.73	3.64	3.80	3.73	0.880	0.916

Table 7  
Principal objectives in developing construction supply chain collaboration

Principal objectives	Overall	Turnover (£ millions)			F. Stat.	Sig.
		Less than 100	100–250	Greater than 250		
Benefits to the client	4.53	4.57	4.53	4.45	0.089	0.915
Improved customer service	4.50	4.64	4.47	4.36	0.536	0.589
Reducing bureaucracy/ paperwor	4.50	3.93	4.80	3.45	0.946	0.397
Increased profitability	4.48	4.50	4.53	4.36	0.263	0.770
Cost reductions within organisation	4.38	4.50	4.53	4.00	2.060	0.142
Increased market competitiveness	4.35	4.14	4.67	4.18	1.970	0.154
Benefits to the supplier	4.03	3.71	4.13	4.27	1.645	0.207
Improved quality assurance	3.93	4.00	3.93	3.81	0.133	0.876
Overall supply chain reduction	3.70	3.64	4.00	3.36	1.760	0.186

Table 2 shows that a vast majority of the contractors (85%) have an agreement with one or more clients — 65% having formed their agreement within the last

5 yr. Of the 36 that had an agreement, 25 (69%) of those were contractual with only 11 (31%) being based on trust rather than formal contracts.

Table 8  
Key factors in effective construction supply chain relationships

Function	Overall	Turnover (£ millions)			F stat.	Sig.
		Less than 100	100–250	Greater than 250		
Trust	4.48	4.50	4.47	4.45	0.010	0.990
Reliability of supply	4.30	4.57	4.13	4.18	1.300	0.285
Top management support	4.28	4.00	4.47	4.36	2.198	0.125
Mutual interest	4.00	3.79	4.27	3.91	1.034	0.365
Free flow of information	3.68	3.57	3.93	3.45	0.798	0.458
Joint business planning	3.48	3.57	3.20	3.72	1.816	0.177
Closer links between demand/ supply	3.40	3.57	3.60	2.91	2.121	0.134
Integrated information systems	3.23	3.29	3.47	2.81	1.578	0.220
Manpower development	3.15	3.43	3.27	2.64	4.102	0.025
More frequent meetings	2.83	2.86	2.53	3.18	1.838	0.173

Table 9  
Major barriers to construction supply chain relationships

Function	Overall	Turn (£ millions)			F stat.	Sig.
		Less than 100	100–250	Greater than 250		
Lack of top management commitment	4.03	3.86	4.40	3.73	1.921	0.161
Poor understanding of the concept	3.98	3.86	4.13	3.91	0.258	0.774
Inappropriate organisation structure to support system	3.90	3.57	3.93	4.27	1.851	0.171
Low commitment of partners	3.85	4.00	3.80	3.73	0.169	0.850
Strategic benefits unclear	3.48	3.36	3.53	3.55	0.122	0.886
Lack of appropriate information technology	3.13	3.36	3.07	2.91	1.280	0.290

The majority of the contractors formed an agreement with their suppliers and clients within the past 5 years i.e. in the years following the publication of the Latham Report (1994). Latham had recommended that separate parties in construction should work together in order to produce better work, higher productivity and a higher level of efficiency.

The fact that contractors have more collaboration/partnership agreements with their clients, than with their suppliers, supports the findings of Jones and Saad (1999) who concluded that contractors prefer to look upstream rather downstream in the supply chain. This position is further supported by the question in which the contractors were asked whether they value collaboration/partnerships with clients more than that of suppliers. Twenty-seven (67.5%) of respondents said that they did, with 13 (32.5%) viewing suppliers as more or equal in importance to clients.

Contractors were asked if they considered tendering to be the most efficient way of gaining work and only 3 (7.5%) regarded it to be so; they hoped it could be eliminated through the growth of partnering in construction procurement. The majority of the contractors (87.7%) would, in the long run and in line with the

Latham and Egan reports, prefer to have partnerships with a set amount of clients.

## 7. The importance of SCM to construction contractors

Companies were asked to provide their opinion on how important supply chain collaboration and management is to their business (Table 3). Forty-eight % felt that SCM is of critical importance; another 42.5% rated it important. Only four (10%) feel that it has either limited or of no importance. The clear majority (90%) regarded SCM as, at least, important to their organisation; this suggests that the industry appreciates the management challenge.

## 8. Construction functions important to efficient supply chain management

SCM seeks to bring together activities that traditionally were split between departments of the parent organisation (PE Consulting, 1997). Table 4 shows contractors' internal functions that are important for

consideration in SCM. The most important ones identified by contractors were production planning (mean value = 4.38) followed by purchasing function (mean value = 4.00). The other three functions (transport, storage and inventory) have relatively similar values.

These results contrast with those recorded in the PE Consulting (1997) study which revealed transport, followed by warehousing and inventory, as the areas most often controlled or significantly influenced by an integrated supply chain management functions in grocery and non-grocery retailer sector; production planning was of more concern to grocery and non-grocery suppliers than retailers. The results from the construction contractor is similar to that of suppliers in the PE Consulting study in which production planning function followed by purchasing function are most important for SCM.

The contractors' ranking of production planning perhaps stems from its contribution to the other identified functions in procurement (purchasing, inventory, etc.). The ANOVA analysis shows that none of the functions has any significant variance in relation to the size groupings of the contractors.

### 9. Factors considered when forming a supply chain relationship

Tables 5 and 6 show what a contractor might consider when forming a supply chain relationship with a supplier and a client, respectively. The most important one for contractors, is the quality of service, closely followed by cost benefits to be derived from a supplier and the extent to which the relationship will lead to simplification of the construction process. An overall rating of 3.48 for the simplification of the ordering process was lower than the rating of 4.23 for the simplification of the construction process at the 0.05 level of significance ( $t$  value = 3.66,  $p = 0.001$ ). With the exception of simplification of the ordering process ( $F$  stat = 2.810,  $p = 0.073$ ), there is no significant difference of opinion on each of the factors based on the size groupings of the contractors.

The significant difference of opinion on the simplification of the ordering process shows that for large contractors, the simplification of the ordering process is more important than for their very-large and mega-large counterparts. This result is not unexpected given that most very large contractors have better resources with a dedicated purchasing department for an efficient and quick ordering of supplies.

Table 6 shows that the most important factor that a contractor considers, when forming a supply chain relationship with a client, is the cost benefits to be derived from such relationships, followed by the simplification of the processes of construction, tendering and design. Contractors expect the simplification of various processes involved in construction to be a major attraction of

supply chain relationship with construction clients, given the high mean value for the processes as shown in the table. Kornelius and Wamelink (1998) suggest that, because of the massive amounts of documents involved in a construction project, the necessary co-ordination is amenable to SCM. ANOVA results show that the opinion of the three groups of contractors did not differ on each of the factors at the 5% level of significance.

### 10. Principal objectives in developing supply chain collaboration

Table 7 shows the principal objectives of contractors in developing supply chain relationships with either clients or suppliers. The table shows that all the nine factors listed are important to contractors with the most important objective being the benefits it provides to the client followed by improved customer services; the least important factor is overall supply chain reduction. For contractors, the direct benefits of supply chain collaboration lie in reduced bureaucracy, increased profitability, cost reduction and increased market competitiveness — these being ranked third, fourth and fifth, respectively. However, there is no statistical difference at the 5% significance level between the first and sixth principal objectives; it suggests that these are of equal standing in the eyes of respondents. The objective: direct benefit to the supplier, was ranked in seventh order of importance. The principal objective in developing SCM is to bring benefits to the customer and these results suggest that less attention is given to developing benefits for suppliers. The significance attached to of reduction of paperwork and bureaucracy, echoes the findings of Kornelius and Wamelink (1998). Contrary to the significant importance placed on “overall supply chain cost reduction” by PE Consulting (1997), this objective is the least rated by the construction contractors; perhaps this is because — in contrast to retailers — main contractors feel less in control of their market. However, as in the PE Consulting study, contractors did not rate improved quality assurance as one of the principal objectives of supply chain collaboration.

### 11. Key success factors in SCM development

Table 8 shows the key factors considered by contractors in forming supply chain collaboration. The coefficient of Cronbach Alpha reliability (indicating the reliability of the five-point Likert scale — see Norusis, (1992)) is 0.8264 and confirms that the result is reliable, at the 5% significance level.

The most important factor identified by the contractors is trust followed by reliability of supply, top management support and mutual interest. These four are

among the top five factors identified by PE Consulting (1997) in terms of importance for the development of effective SCM for grocery and non-grocery retailers and suppliers. The contractors' rating of "free flow of information", was lower than for "mutual interest" at a 5% significance level. It suggests that the four top factors (trust, reliability of supply, top management support and mutual interest) are held to be significantly higher in importance than the lower six, for construction SCM.

The three least important key factors were identified as integrated information systems, manpower development and more frequent meetings. The latter two also rank amongst the three least important factors for SCM development, in the earlier study by PE Consulting (1997). The low status accorded to "integrated information systems" may be a reflection of the current state of ITC systems within the construction industry i.e. its relative underdevelopment in comparison with other industries (Akintoye and McKellar, 1997).

Schultz and Unruh (1996) concluded that the construction industry is unwilling to trust or share and the present survey shows that contractors feel it is indeed important to do so in order to achieve successful SCM. Perhaps this signals a major cultural shift for the UK construction industry. With the exception of manpower development, the ANOVA analysis shows that the opinions of contractors did not differ on each of the factors (5% significance level). The rating given to "manpower development" suggests that mega-large companies are more confident in manpower development than large firms; it probably explains why they have not rated this factor as important for an effective supply chain relationship.

## 12. Barriers to implementing construction supply chain relationships

Table 9 shows a range of factors that may make it difficult to implement an efficient, and successful, supply chain collaboration. The Cronbach Alpha test indicates that the 5-point Likert test of the factors is reliable (5% significance level).

The biggest barrier to implementing a successful supply chain partnership was a lack of top management commitment, followed by the poor understanding of the concept, an inappropriate organisation structure to cope with the concept and low commitment from partners. The least important factor was lack of appropriate information technology followed by the strategic benefits being unclear. The fact that all the barrier factors exceed a mean value of 3.00 suggests that they are all important in the implementation of effective construction supply chain management, however the top four barriers are more significant than the last two barrier factors at the 5% significance level. ANOVA tests did not show any

significant difference of opinion on each of the barrier factors by the contractors' groupings.

The three most important barriers to implementing construction an SCM strategy are related to the culture of the industry in dealing with the leadership, structure and mentality of its organisations. It suggests that an effective construction SCM calls for education and for a re-orientation of the industry. Given that a majority of respondents occupy senior positions (Directors/Chief Executive = 60% of respondents) and are responsible for policy making, it is surprising that lack of top management support is identified as the most important barrier to implementing construction supply chain collaboration and management.

## 13. General comments by respondents

Respondents were asked to provide comments on supply chain collaboration and management within the industry and how this can be improved. Eleven respondents (27.5%) completed this section of the questionnaire.

In the comments supplied by respondents, in relation to SCM, the following broad themes emerge: SCM seen as a means of waste reduction, resistance to change in the industry, debate on the practical applications of the principle, the tentative nature of interest in the approach and the importance of client support.

Comments supplied in the main referred to supply chain relations with clients, tendering and competitive bidding, as follows:

- Purchasing Manager from a company with £75 million turnover: "supply chain mapping will greatly assist in eliminating waste from the supply chain."
- Divisional Director from a company with £30 million turnover: "the industry is, and always has been, dominated by competitive tendering and it is difficult to change people's attitudes."
- Commercial Director from a company with turnover of £180 million: "supply chain management is an academic theory that does not apply in practice in commercial contractor/supplier chains."
- Development Manager from a company with £100 million turnover: "the emphasis is moving from client/main contractor relationship to the first tier suppliers and gradually the supply chain. We are now beginning to formalise long-term relationships in a structured procedure."
- Supply-Chain Manager from a company with turnover of £125 million: "more commitment from Government bodies and other clients to put increasing importance on factors other than price when determining best value."

- Chairman from a company with turnover of £300 million: “with tendering we know the commencement date of a project with some accuracy. This is the only reason we still tender a proportion of our work.”
- Managing Director of a company with turnover of £200 million: “the concept must be customer driven without being driven by a culture of competitive tendering.”
- Building Director of a company with turnover of £75 million: “topical subject! Good to see you are at the forefront of industry change, hope you succeed in your research!”
- Senior Estimator from a company with turnover of £627 million: “to make the industry more aware, and to be able to show the actual benefits, to all members of the supply chain.”
- Regional Manager from a company with turnover of £200 million: “the entire process is driven by lowest price philosophy. Partnering tends to mean the stronger party taking maximum benefits from the weaker! Until this changes we will not improve!”
- Purchasing Manager of a company with turnover of £18 million: “the contractor sometimes makes large profits on an element of work and, under partnering, the client expects full reimbursement. However, they are unwilling to assist with losses incurred when the contractor takes a risk and loses. A better appreciation of the true spirit of partnering is still required before it can be effective.”

The tone of the comments suggests that only one respondent was against the principles involved in construction supply chain collaboration and management. The number of respondents and the content of their comments does suggest that there is little knowledge of what is involved in the SCM process. Implicitly, respondents acknowledge that with changes in client attitudes (particularly in tendering), changes in the industry culture and with relevant training and education, the industry's businesses can benefit from SCM.

#### 14. Conclusions

Supply chain collaboration and management has been used in many industries to gain competitive advantage. From the retail industry to the automotive and the agricultural industries, the philosophy has examples of successful applications. Japanese car manufacturers have enjoyed the benefits of a close relationship with suppliers, enabling a close two-way flow of information and benefits. Following this success, The Supply Chain Council developed a supply chain operations reference model in order for different industries to apply the philosophy and improve their own strategy.

The construction industry has been relatively slow to adopt SCM as a management strategy (Table 2) in part

to be due to the well documented unique nature of the construction process and bespoke product with various stakeholders and a variety of objectives. The contractors' opinions were surveyed because of their pivotal role in the construction supply chain, previously referred to. It was regarded as a timely exercise in view of the interest and energy devoted to the debate on new forms of UK procurement, which emphasises the virtues of partnering, long-term and non-adversarial relationships as the key to substantial productivity gains for the UK industry.

The study reveals that contractors are more oriented towards clients rather than their suppliers in the supply chain. They have more arrangements with clients than with suppliers and a higher proportion of the relationships with clients are contractual. Owing to the aggressive business mentality of the industry and the non-trusting climate, contractors have tendencies to pay more attention to clients who provide their workload. The study suggests that contractors, regard suppliers on a par with employees and sub-contractors, i.e. as suppliers of a service they have the opportunity to dispense with largely as they please.

The study also shows that there is a high correlation between the timing of publication of the Latham Report (1994) and the Egan Report (1997) with the increased number of partnership arrangements in the construction firm's supply chain, both upstream and downstream. There has been an increase in the number of collaborative relationships following publication of these reports, but their influence cannot be quantified with any degree of precision. Open tendering was increasingly being regarded as out-dated; the vast majority of contractors preferred to build partnerships with the client.

Supply chain collaboration and management is an important element of construction with nearly all of the respondents rating it as being important or critical for future success. Although improved quality assurance is not a key objective for SCM development, contractors do seek a better quality of service from suppliers.

The problems in implementing successful supply chain collaboration and management within the UK construction industry are at present associated with an inappropriate traditional culture and the unique features of the organisational structure. Trust — a major requirement for successful implementation — is only now being actively cultivated by the industry. The lack of senior management commitment, the lack of appropriate support structures and the widespread ignorance of supply chain philosophy, must all be addressed if construction is to emulate other industries. Appropriate training and education, at all levels of the industry, is required to overcome these barriers.

The objective of SCM is to create the most value, not solely for any one company but for the whole supply chain network. It would appear, based on the study that

this message has not sunk in within the construction industry, despite the recommendations of Egan Report. Successful SCM requires a change from managing individual functions to integrating activities into essential supply chain processes (Lambert and Copper, 2000). Current research suggests that this level of integration is still lacking in the construction process. The construction industry need to address research agenda that will enable it to develop SCM suitable for the activities of the industry at the interface with its customers and product end users. For example, Lambert and Cooper, based on a case study approach involving members of the Global Supply Chain Forum, identified the key supply chain processes as including: customer relationship management, customer service management, demand management, order fulfilment, manufacturing flow management, procurement, product development and commercialisation, and return. The group interviewed by Lambert and Cooper has no construction industry participation. It is of interest to see how these key supply chain processes will be applied in construction; and this is the subject of a current post graduate research project at Glasgow Caledonian University, involving major construction industry players.

## References

- Agapiou, A., Flanagan, R., Norman, G., Notman, D., 1998. The change role of builders merchants in the construction supply chain. *Construction Management and Economics* 16, 351–361.
- Akitoye, A., McKellar, T. D., 1997. Electronic data interchange in the UK construction industry. The Royal Institution of Chartered Surveyors Research Paper Series 2 (4).
- Atkin, B., Flanagan, R., Marsh, A., Agapiou, A., 1995. Improving Value for Money in construction: Guidance for Chartered Surveyors and their Clients. Royal Institution of Chartered Surveyors, London.
- Bailey, V., Bemrose, G., Goddard, S., Joslyn, E., Mackness, J., 1995. Essential Research Skill. Collins Educational, London, pp. 60–62.
- Boehlje, M., 1996. Industrialisation of agriculture: what are the implications? Choices. Canada-United States Joint Commission on Grains, Final Report, Vol. 1.
- Brugess, R., 1998. Avoiding supply chain management failure: lessons from business process re-engineering. *International Journal of Logistics Management* 9, 15–23.
- Bushnell, R., 1999. Managing your supply chain. *Modern Materials Handling* 54 (1), 43.
- Cherns, A., Bryant, D., 1983. Studying the clients role in construction management. *Construction Management and Economics* 2, 177.
- Christopher, M., 1992. *Logistics and Supply Chain Management*. Pitman, London.
- CIOB, 1998. Top 100 Contractors. *Construction Manager*. 16–17
- Cooper, M.C., Ellram, L.M., 1993. Characteristics of supply chain management and the implications for purchasing and logistics, Strategy. *The International Journal for Logistics Management* 4 (2), 13–24.
- DTI, 1995. *Logistics and Supply Chain Management*. Department of Trade and Industry, HMSO, London.
- Economist Intelligence Unit, 1996. Supply chain management is a key competitive weapon in Europe. *International Journal of Retail and Distribution* 24 (4), 26–30.
- Egan Report, 1997. *Rethinking Construction*. HMSO, London.
- Ganeshan, R., Harrison, T.P., 1997. *Introduction to Supply Chain Management*. Department of Management. Science and Information Systems, Penn State University. US.
- Hollis, J., 1996. Supply chain re-engineering: The experience of little-woods chain stores. *Supply Chain Management* 1 (1), 5–10.
- Houlihan, J.B., 1985. International supply chain management. *International Journal of Physical Distribution and Materials Management* 15 (1), 22–38.
- Johnston, P., 1995. Supply chain management: the past, the present and the future. *Manufacturing Engineer* 213–217.
- Kornelius, L., Wamelink, J.W.F., 1998. The virtual corporation: learning from construction. *Supply Chain Management* 3 (4), 193–202.
- Lambert, D.M., Cooper, M.C., Pagh, J.D., 1998. Supply chain management: implementation issues and research opportunities. *International Journal of Logistics Management* 9 (2), 1–19.
- La Londe, B., 1998. *Supply Chain Management: An Opportunity for Competitive Advantage*. Department of Transport and Logistics, The Ohio State University.
- Landry, J., 1998. Supply chain management. *Harvard Business Review*, 24
- Latham Report, 1994. *Constructing the Team*. HMSO, London.
- Lummus, Vokurka, and Alber, 1998. Strategic supply chain planning. *Production and Inventory Management Journal* 39 (3), 49–58.
- Moser, C.A., Kalton, G., 1971. *Survey Methods in Social Investigation*, 2nd Edition. Dartmouth.
- Norusis, M.J., 1992. *SPSS for Windows, Professional Statistics Releaser*. SPSS Inc., Chicago.
- O'Brien, W.J., 1999. Construction supply chain management: a vision for advanced co-ordination, costing and control. Proceedings, Berkeley-Stanford CE & M Workshop: Defining a Research Agenda for AEC Process/Product Development in 2000 and Beyond, Ed. Tommelein, I D and Fischer M A, 26 to 28 August 1999, [www.ce.berkeley.edu/~tommelein/CEMworkshop.htm](http://www.ce.berkeley.edu/~tommelein/CEMworkshop.htm)
- PE Consulting, 1991. Long Term Partnerships – or Just Living Together? Institute of Logistics, London.
- PE Consulting, 1994. Supply Chain Partnerships- Who Wins? Institute of Logistics, London.
- PE Consulting, 1997. Efficient Consumer Response — Supply Chain Management for the New Millennium? Institute of Logistics, London.
- Rich, N., Hines, P., 1997. Supply-chain management and time-based competition: the role of the supplier association. *International Journal of Physical Distribution and Logistics* 27 (3–4), 210.
- Saad, M., Jones, M., 1999. The role of main contractors in developing customer focus up and down construction's supply chain. Proceedings, Perspectives on Purchasing and Supply for the Millennium, 8th International Annual Conference of the International Purchasing and Supply Education and Research, Dublin, March 29–31.
- Schultz, H.J., Unruh, V.P., 1996. *Successful Partnering — Fundamentals for Project Owners and Contractors*. Wiley, New York.
- Stevens, G., 1986. Integrating the supply chain. *International Journal Management of Physical Distribution and Materials Management* 15, 16–26.
- Tan, K.C., Kannan, V.R., 1998. Supply chain management: supplier performance and firm performance. *International Journal of Purchasing and Materials Management* 34 (3), 2–9.
- Vollman, T., Cordon, C., Raabe, H., 1997. *Supply chain Management' Mastering Management*. Pitman, London.
- Watts, H.D., 1980. *The Large Industrial Enterprise*. Croom Helm, London.
- Wong, A., Fung, P., 1999. Total quality management in the construction industry in Hong Kong: a supply chain management perspective. *Total Quality Management* 10 (2), 199–208.
- Wong, A., Kanji, G.K., 1998. Quality culture in construction industry. *Total Quality Management* 9 (4,5), 133–140.