Quality relationships: partnering in the construction supply chain

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Abstract *Subcontractors and suppliers are playing an increasingly important role in project construction – it is not uncommon for as much as 90 per cent of a project to be undertaken by subcontractors. The result of this increased involvement is that main contractors are now concentrating their efforts on managing subcontractors rather than employing direct labour. Outlines an approach to partnering developed by a European conglomerate which is being employed throughout the UK. Commences with an overview of recent studies into the UK construction industry concentrating on partnering, quality and lean production. The second part discusses the context of these points from a quality, general and construction project management perspective. A form of benchmarking is described and the actual partnering approach is detailed. Finally, the paper identifies the main points relating to quality as perceived by the project participants, as well as some of the overall advantages of adopting this approach to partnering.*

Introduction

Manufacturing commentators have recognised the positive impact closer working relationships with suppliers can have on product quality (Womack and Jones, 1996) whilst construction industry commentators advocate the use of partnering to improve relationships (Latham, 1994; Egan, 1998; CII, 1991). However, most work undertaken in construction partnering has been largely main contractor (MC)-client based, with little or no mention of adopting partnering with subcontractors (SC). Also, the exact nature and content of these closer partnering relationships has still to be clarified (Matthews, 1996). This paper addresses these points, and contributes to the body of subcontracting and partnering knowledge by detailing a partnering approach based on the MC-SC relationship. The reported partnering approach facilitated greater control over a pilot project through increased levels of co-operation and openness/transparency that facilitated the earlier anticipation of and minimisation of problems.

Both partnering and total quality management (TQM) have been in use for a considerable time now; an early example of partnering was the relationship between Bovis and Marks & Spencer which commenced in the late 1950s (Ministry of Public Works, 1962) and formed the basis for the Bovis A5 fee system. The developments in TQM are described in the section below. This paper draws together these techniques, and others identified below, and explores them in the context of an industry based research project which was

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primarily aimed at improving the procurement process by establishing high levels of trust and cooperation between MC and SCs through a partnering approach. The paper focuses particularly on how the partnering approach enabled the quality management process through the modification of the conventional MC-SC relationship; an area which has been cited in the past as an impediment to successful TQM (see, for example, Rowlinson and Walker, 1995)

The main contractor that initiated this study believed that in order to perform more productively it had to work more closely with its SCs and develop closer working relationships. The main contractor developed a research strategy with the aim of creating an environment on site where it can be clearly demonstrated that SCs perform more effectively in meeting customer needs, than they can when working on sites of other main contractors.

Subcontracting

The importance of subcontracting

In contrast to manufacturing repetitive "products", the construction industry's outputs vary greatly in kind and scale. Each product has its own design and a distinct process of production or erection – the product is, in general, a prototype. Unlike manufacturing, the construction process is not continuous and repetitious – and the steps involved are not always identifiable. Process segments, whether they be design or construction based, overlap and impinge on one another in a reciprocally dependent manner producing an outcome that is inherently uncertain. However, like the manufacturing industry, construction employs a vast number of suppliers, SCs and consultants.

According to Nobbs (1993) the contribution of SCs to the total construction process can account for as much as 90 per cent of the total value of a construction project. He suggested that the increased involvement of SCs in the shift away from the traditional craft-base has led to a greater reliance on increasingly sophisticated technological based products, which has led to main contractors concentrating their efforts on managing site operations rather than employing direct labour to undertake construction work. Jamieson *et al.* (1996) also attributed the increased use of SCs to the increased complexity of both the construction of buildings and the organisational relationships. The increase in complexity, the over-supply of specialist firms, and the declining construction output (maturity of the market) has cultivated an adversarial atmosphere which has had a negative effect on MC-SC relationships. As MCs have realised that the greatest potential for cost savings lies with SCs, the prevalence of unfair contract conditions, subcontract auctioning and other onerous practices has increased (Matthews *et al.*, 1996). Many SCs do not have the necessary expertise to undertake work satisfactorily and, as a consequence, are unable to give their clients the service they require and many of the undesirable traits common to the MC-SC relationship are also common to the SC-sub SC relationship.

Agapiou *et al.* (1998) concluded that builders' merchants are an important link within the construction supply chain and that partnering could help

improve the supply chain and reduce costs. However, Green (1999) argues that this integration of the supply chain can be abused and Atkin (1998) argues that it is the "value stream" which is most important and should be the focus of consideration.

The importance of improved MC-SC relationships

Hinze and Tracey (1994) put forward a series of recommendations to improve the SC-MC relationship and suggested that the relationship of SCs and general contractors is one that merits further study; this paper addresses a number of the issues raised, specifically focusing on the development of trust and harmonious, yet productive, relationships between MCs and SCs.

In 1994, Sir Michael Latham's review (Latham, 1994) provided, *inter alia*, the focus and motivation to explore improvements in MC-SC relationships for the benefit of the construction supply chain (value stream) and the industry as a whole; partnering was seen as one way to achieve these improvements and that partnering arrangements were beneficial to firms on the supply side as well as between supplier and client, citing the fact that some MCs had already developed long-term relationships with SCs. Latham (1994) maintained that this was a welcome development but warned that such arrangements should have the principal objective of improving performance and reducing costs for clients and they should not be "cosy" (for an extended critique, see Green, 1999). Latham (1994) concluded that the construction process existed to satisfy clients – "Good relationships based on mutual trust benefits clients".

Egan (1998) established "performance" targets for the UK construction industry that required reductions of 10 per cent in construction costs and construction time. He also proposed that defects in projects should be reduced by 20 per cent per year. In order to achieve these changes it was proposed that the construction industry developed long-term relationships through partnering in the supply chain. Egan also discussed the application of "Lean Production" to the construction industry as well as a "quality driven agenda", outlining the fundamental philosophy behind lean production and concluding that it could be applied to every business activity.

Partnering

Partnering has become an increasingly popular form of business relationship within construction over the last decade (Crane *et al.*, 1997). The adoption of partnering into the construction industries of the USA, Australia and the UK can be attributed to the fact that relationships in these industries were commonly lacking trust, respect and honesty between professionals, MCs and SCs. The consequence of this is that procurement of buildings is problematic, with litigation and unsatisfied clients being commonplace.

There are no fixed definitions used when defining partnering although common themes/elements prevail (Matthews, 1996). Essentially the relationship

is based on trust, dedication to common goals, and an understanding of each other's individual expectations and values. Crowley and Karim (1995) state that partnering can be defined in one of two ways:

(1) by its attributes such as trust, shared vision, and long-term commitment; and

(2) by its process, whereby partnering is seen as a verb and includes developing mission statements, agreeing goals and conducting partnering workshops.

Partnering is defined by CII (1991) as a long-term commitment between two or more organisations for the purpose of achieving specific business objectives by maximising the effectiveness of each participant's resources. This requires changing traditional relationships to develop a shared culture without regard to organisational boundaries.

However, notwithstanding these definitions, different types of partnering relationships have developed. Initially, "project partnering" and "strategic partnering" relationships were established. However, Kubal (1994) and The Reading Construction Forum (RCF, 1998) identified industry level partnering (macro level) or "third generation partnering". In discussing third generation partnering, RCF noted that this level of partnering would come about when the construction industry became collaborative, producing and marketing a range of services in which clients wanted to invest. RCF see the long-term collaborative nature of third generation partnering producing cost savings of 50 per cent or more, and time savings of 80 per cent.

Matthews' (1996) research identified that the benefits of partnering can be achieved in the following areas:

- contractual situation;
- communication and information flow;
- level of understanding;
- efficiency of resources;
- financial position; and
- quality.

He also noted that the following elements were commonly raised in the partnering literature:

- goals and objectives;
- trust;
- problem resolution;
- commitment;
- continuous evaluation;
- group working and teams;

- equity;
- shared risk;
- win-win philosophy; and
- collaboration/co-operation.

Quality and lean production

It is now necessary to put this discussion of partnering into the context of this paper and the following discussion centres around TQM and lean production philosophies. These concepts must, of course, be viewed in the context of the MC-SC relationship in the construction industry; a very different context to that in which these two philosophies originally developed.

Quality

Micklethwaite and Wooldridge (1996) noted that the concept of "quality" has gained increasing importance since the 1980s – although it has been employed since the Second World War. With the establishment of quality standards (the most notable being The International Standards Organisation's ISO 9000 series) and positive results and feedback from their implementation, quality has become a valuable and necessary pursuit for many companies (and even governments). Hamel and Pralahad (1994) argue that quality is no longer a competitive differentiator, but simply the price of market entry. Juran (1989) stated that although the need for quality has existed since the beginning of time, the ways and means of meeting this need for managing quality have changed dramatically.

Defining quality

One of the outcomes of the research on which this paper is based was the reinforcement of the view that "quality" means different things to different people within the construction process and this became a crucial issue in developing the partnering charter. Although the manufacturing term of quality is a widely discussed topic, no universal definition has been developed.

Hardie and Walsh (1994) identified 11 different definitions of quality, including that put forward by Crosby (1980) which stated that quality is "conformance to specification". This definition has been widely implemented throughout industry and academia as Crosby (1980) stipulates that if a product does not meet the specified standard defined according to customer demand and requirements, then it is defective, i.e. the customer will be dissatisfied with the product. Other notable definitions which were highlighted by Hardie and Walsh (1994) include "anything that can be improved" (Imai, 1986) and "fitness for purpose or use" (Juran, 1989).

Lean production

Great improvements in performance have been observed in manufacturing, particularly in the automobile industry in the past couple of decades. These improvements have not been a product of radical or sharp change of technology but the result of the application of a philosophy which leads to "lean

production" (Alarcon, 1997). This production philosophy is a generalization of such partial approaches as JIT, TQM, time-based competition, and concurrent engineering. Undoubtedly, more attention is now being paid in the construction industry to the lessons that can be learnt from manufacturing for improving its production processes.

Lean production gained popularity as a result of the landmark study by Womack *et al.* (1990) which investigated the Japanese automobile industry and ascribed its success in achieving a technological and competitive edge to the concept of lean production systems. The approach resulted in "greatly decreased cost and time with improved quality and customer service across the industry", (O'Brien, 1996). However, it was not until the early 1990s that the concept of lean construction was coined as a derivative of what Koskela (1994) described as the "new production philosophy" also commonly known as lean production.

In the construction industry, the overall diffusion of the philosophy is still rather limited and its applications incomplete. Quality assurance and TQM have been adopted by a growing number of organisations in construction, first in construction material and component manufacturing and later in design and construction, but this has often been driven by commercial imperative rather than as a business philosophy. Koskela (1993) commented that the diffusion of the lean production philosophy has been so slow in construction because of the following barriers to the implementation of these ideas in construction:

- cases and concepts commonly presented to teach about and diffuse the new approach have often been specific to certain types of manufacturing and this is not easy to internalise and generalise from the point of view of construction;
- relative lack of international competition in construction; and
- lagging response by academic institutions.

Koskela (1992) identified that the first task for academics "is to explain the new philosophy in the context of construction". He explains the overwhelming dominance of conversion thinking in construction and argues for replacing the conversion model with a flow/conversion model in order to reduce waste resulting from non-value adding activities. Koskela (1993) has indicated the extent of such waste in construction as depicted in Table I.

O'Brien (1996) argued that the construction industry needed to shift its focus to the underlying philosophy of lean production by recognising construction as a flow process in which construction should be seen as a hierarchical collection of value generating flows and achieve the goals of lean construction, hence the move to the term value chain, rather than simply supply chain, as it emphasises a holistic view based around the value concept. Ballard and Howell (1998) have proposed that lean revolution is essentially a conceptual revolution, at the heart of which are the flow and value models.

The characteristics which the construction industry possesses are "one-of-a-kind nature of projects, site production and temporary multiorganisation"

(Koskela, 1992). Because of this the construction industry is often seen as being different from manufacturing. Indeed, these characteristics may prevent the attainment of flows as efficient as those in manufacturing. However, the general principles of flow design and improvement apply for construction flows and in spite of these characteristics, construction flows can be improved to reduce waste and increase value in construction.

As it is not possible to change the circumstances of the construction industry to fit a theory that is useful in a more stable environment such as manufacturing, other approaches are necessary. Initiatives undertaken in several countries have been trying to alleviate related problems associated with construction's peculiarities. The one-of-a-kind feature of the construction industry can be reduced through standardisation, modular coordination and widened role of contractors and suppliers. Difficulties of site production are alleviated through increased prefabrication, temporal decoupling and through specialised or multi-functional teams. Finally, the number of liaisons between organisations is reduced through encouragement of longer-term strategic alliances and partnering.

Whilst partnering has been seen as a "programmatic band-aid" on the current construction management system, there is a need to develop the concept of partnering and start revising the current mind set and practice of partnering (Howell *et al.*, 1996). The ambiguous definitions of partnering illustrate, among other things, the extent to which the current practice is deficient. It is easy to identify at least half a dozen different perspectives on partnering, of which the application of lean production is one. The widespread use of partnering is evidence that the current rules provide an inadequate basis to manage complex, uncertain and quick projects and that it is time to re-conceive the construction process.

The findings made by Howell *et al.* (1996), based on a public sector hospital project and on a design and construct private sector factory project in the USA using the lean production principle, showed that there was a trend toward greater emphasis on production management through supply chain alliances. Alliances between members of supply chains are being formed explicitly for managing production. Waste is being reduced at downstream level by actions taken upstream and the gains shared. They also reported that there is a trend

Waste	Cost	Country
Quality costs (non-conformance)	12 per cent of total project costs	USA
External quality cost (during facility use)	4 per cent of total project costs	Sweden
Lack of constructibility	6-10 per cent of total project costs	USA
Poor materials management	10-12 per cent of total project costs	USA
Excess consumption of materials on site	10 per cent on average	Sweden
Working time used for non-value adding activities on site	Approx. 2/3 of total time	USA
Lack of safety	6 per cent of total project costs	USA

Source: Koskela (1992)

Table I.
Waste in construction: compilation of existing data

toward long-term partnerships where each party is responsible for the acts of others and performance of the larger entity. This change of emphasis has driven management thinkers to focus on the concept of the value stream, a holistic view of the supply chain from a long-term, collaborative perspective underpinned by a process and product model viewpoint.

These findings are very encouraging in that partnering is not conceived only as a comprehensive approach which addresses the total range of problems of construction processes, but as bringing new understanding, which is emerging under the umbrella of lean production, together with themes such as value management, concurrent engineering, planning, constructibility, process re-engineering and benchmarking. The construction industry is changing rapidly in terms of demands made by clients and it is important to respond to the increasing relevance of quality and flexibility in the construction process, both key issues to the concept of partnering in the realm of lean production.

Against the backdrop of current construction practice, lean thinking directs attention on how value is generated rather than how any one activity is managed. Where current construction management views a project as the combination of activities, lean production views the entire project in production system terms, as if the project was one large operation – the process model viewpoint. Thus, the implementation of lean thinking in construction should start at the beginning of a project, to ensure that the project is always in the value stream of the client. Specifying value by product to the client shapes all actions around client requirements and this is vital in the construction industry and is sadly lacking in the present practice (Atkin, 1998). Mapping the value stream which can be understood as a series of process flows enables options to surface and raises the possibility of maximising performance at the project level by eliminating non-value adding activities using the "pull-driven" process management technique as suggested by Howell and Ballard (1998) and Tommelein (1998).

The claim that partnering produces specifications of value and that it attends to the project system in terms of reducing waste and improving quality needs to be questioned in current practice. These usually partial and more incomplete than supposed implementations come short of the goal and the system focus made possible by lean production techniques. Howell and Ballard (1998) argued that current partnering practice does offer a plus side in that it establishes a base level of trust which allows people within the system to shift their attention to improving at the system level instead of simply defending their interests. There is therefore a need to cultivate trust in the project environment and at the same time have a reliably stable work flow for lean production to take place effectively. This paper reports how the partnering approach facilitated both continuous improvement and the overall achievement of customer requirements and indicates how benchmarking was used in this process.

Study methodology

This paper outlines a collaborative applied research project undertaken in the UK by a European main contractor (MC) and a leading UK university with the

aim of improving the performance of SCs by developing closer relationships within the value chain using an alternative partnering approach. The main contractor has an annual turnover in excess of US$12000 million (1999/2000) in the UK. The contractor undertakes traditional, design and build, and negotiated projects. The research is based on in excess of 130 interviews and 240 questionnaires undertaken over a two-year period. This research enabled the collaborating MC to identify not only industry best practice, but also areas in which it could improve its relationships with SCs. Subsequent to this, an 18-month site-based pilot study was undertaken adopting the alternative partnering approach.

In order to develop an alternative approach to project partnering a four-stage research plan was developed by employing a Delphi approach utilising the expertise and knowledge of a team of ten professionals drawn from the MC and academia. The professionals concluded that the research methodology enabled identification of the main areas that had negative and positive impacts on the MC-SC relationship. This approach elicited opinions on:

- *Stage 1*: assess the requirements of subcontractors from the MC's perspective.
- *Stage 2*: assess the requirements of main contractors: the SC's view.
- *Stage 3*: compare MC performance to that of its competitors.
- *Stage 4*: develop an alternative project partnering approach.

Within each of the above stages, questionnaires were used employing both open and closed ended questions (tick box). A total of 217 questionnaires and 59 interviews were completed in the first three stages of this research case study. Sample sizes for each stage were:

- *Stage 1*: 141 questionnaires and 11 interviews.
- *Stage 2*: 76 questionnaires and 31 interviews.
- *Stage 3*: 17 interviews.

The following examples of open-ended questions used in this research are based around two of the fundamentally important areas of price and quality:

> Do you consider main contractors place too much importance on price to the detriment of quality?
>
> Does the quality of the main contractors team have a significant effect on the time it takes you to undertake your subcontract?

Closed questions took the form of statements that were required to be marked in terms of importance from 1 (no importance) to 6 (most important) and open-ended questions were analysed by using a content analysis identification test (Matthews, 1996). All responses to questions were recorded using, where possible, a tape recorder. Answers to questions were then incorporated into a computer database. The database allowed answers to questions to be recorded in a systematic way that, in turn, facilitated the overall identification of those issues that were found to be most prevalent.

The names of SC organisations used within this research were obtained from MC procurement database. This database contained various details on over 1,000 organisations with which MC had had a working relationship in the past. SC organisations that were contacted and selected within Stages 2 and 3 of the research were chosen primarily on their trade/specialisation.

The benchmarking method

In order to identify how relationships with SCs could be improved, MC personnel decided to employ a form of benchmarking that would enable empirical data to be collected from industry in a quick and efficient manner. Benchmarking is the process by which companies compare their current practice against industry best practice. It is an external focus on internal activities, functions or operations in order to achieve continuous improvement. Karloff and Ostblom (1993) defined benchmarking as a method that identifies operations that need to be improved. The next step is to look for other organisations that perform equivalent operations with outstandingly good results and to make detailed measurements of how they do it. A process of improvement can then be initiated which aims at shifting the focus of the organisation and developing the skills of its leaders and members. The benchmarking process in the construction industry is a qualitative as well as a quantitative process – the research presented in this paper employs both of these processes. The advantage of such a "dual" approach is that not only is an organisation benchmarked so that it can be assessed in terms of performance but the process of data collection allows the identification of the variables which can improve performance. Hence, the benchmarking process is also a process of identification of strengths and weaknesses and this was facilitated through Delphi workshops.

Interim research findings

Using the methods of analysis previously identified and the Delphi workshops with MC personnel, research findings were made that would affect the final partnering approach. Examples of these conclusions include:

- use SCs earlier within the procurement process;
- provide more post-contract feedback to facilitate ongoing learning;
- move away from evaluating bids purely on price – look at quality, safety, past performance, etc.;
- improve and increase the level of dialogue to build better relationships; and
- promote team working, honesty and integrity.

Issues that relate specifically to quality include:

- Higher tender prices/quotations and low quality work had a detrimental impact on MC and SC relationships. Low quality was defined in the context of "low workmanship from labour", "not carrying out work to specification" and "promising one thing, but doing another."

- MCs in the UK construction industry place too much emphasis on price to the detriment of quality.
- When selecting MCs and SCs for tendering it was seen that certification to BS5750/ISO9001 were not important selection criteria. However, a company's reputation for quality workmanship was seen as important.
- Good quality site management had a very positive impact on the SC's ability to perform. However, good quality site management is not sufficient if the project is under resourced.

Selection of the partnering approach

The approach to partnering was developed using the knowledge gained during the questionnaire surveys and interviews as well as the knowledge gained from a literature review on partnering and subcontracting. The partnering approach developed was implemented on a design and build construction project. The generic project partnering approach was selected by the sponsoring MC as it satisfied more closely the following selection criteria:

- duration of the relationships;
- possible cost savings;
- initial set-up costs;
- degree of price competition;
- use of alternative SCs;
- the promotion of SC knowledge in the development of a better quality product;
- the amount of trust and honesty required; and
- the workload required to maintain the relationships.

Partnering approach to the MC-SC relationship

This approach to partnering is divided into four areas:

(1) procurement establishment;

(2) pre-selection and notification;

(3) selection and appointment; and

(4) construction.

As previously stated, this approach was employed in full and, although in this instance it was used on a design and build project, the approach could be used in its entirety, or in part, with other types of procurement systems.

Procurement establishment

Project team set-up

A project team is established at the commencement of the design development stage of the project and it was agreed between the client and the MC that the project team would include:

- an estimator;
- an architect or project design manager;
- a quality manager;
- a structural and/or services engineer; and
- a project and/or contracts manager.

The client team would consist of:

- a project manager;
- a quantity surveyor; and
- a structural and services engineering consultant(s).

All partnering SCs and suppliers would also be incorporated into the team.

Package and company identification

Packages were evaluated by the clients and the MC's project staff under the following headings:

- the design content of the package;
- complexity of construction;
- high subcontract value;
- long periods of construction; and
- early "added value".

The selection criteria for firms to undertake the packages included:

- past performance on similar types of project;
- ability to meet the quality requirements of the project;
- ability to resource the project to a sufficient level;
- positive working attitude; past safety performance;
- sound financial background;
- good "in-house" design resource (where applicable);
- proven ability of site and head office management; and
- willingness to forge long term relationships.

Pre-selection and notification

Subcontractor interview

This interview had three aims:

(1) to assess the firm's ability within the context of working attitude, pro-activeness, design capabilities, honesty, and current workload;

(2) to introduce the concept of partnering and the working relationship required; and

(3) if required, to hand over pricing and contractual information.

Tender clarification

This interview was used when the previous (subcontractor interview) acted only as a selection meeting. During this interview detailed discussions were held on financial matters as well as performance and quality. This can be seen in Figure 1.

Selection and appointment

Project day

A one-day project day was established with the aim of bringing all partnering parties together before the construction phase commenced. Within the project day, team exercises were carried out and the partnering charter, issue resolution and partnering evaluation procedures were developed and agreed upon. The project day was undertaken at a neutral location away from the regular meeting venues.

Partnering charter

A partnering charter was developed by the project team in two stages. The first stage required each partnering firm to identify their partnering objectives for the project. The partnering objectives were identified by a facilitator who developed a provisional charter – this charter was subsequently presented on the project day. The second stage required all partnering parties to agree on the content of the charter during the project day. Changes were recommended

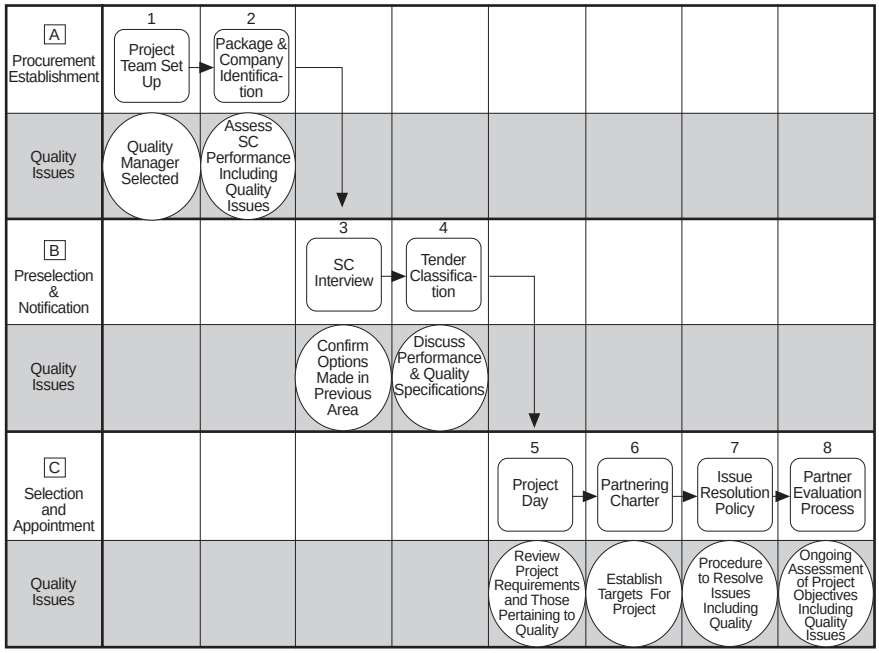

Figure 1.
Partnering procedure and quality issues

and made directly to the charter. Once all parties were in agreement the charter was printed and signed by all parties. The partnering charter contained no direct statement concerning quality but quality in the context of the project was defined as meeting the client's requirements to the agreed specification, at the right price at the right time; this was clear to all members of the project team. During the charter formulation process the project participants believed that a "generic quality" statement would dilute its (quality) impact.

Issue resolution procedure (IRP)

An IRP was developed by the project team with the assistance of a facilitator. The aim of the IRP was to resolve grievances at the lowest level of management. The following rules applied in managing the IRP:

- each level of resolution had a time 24-hour time period;
- any partnering party could raise an issue; and
- all problems were dealt with first at the lowest level (if no agreement could be found in the stipulated time period then the issue was moved to the next level);
- no jumping of levels was allowed; and
- ignoring problems or "no decision" is not acceptable.

Partnering evaluation

An evaluation process was developed that assessed the impact of partnering on the project. This process took the form of a monthly questionnaire and key stage forums. The questionnaires were analysed by a facilitator who depicted the results of the questionnaires on charts contained in the project site office. The forums gave project partners a "platform" on which to voice their opinions on the project. Also, "follow-up" workshops were used to:

- renew partnering commitment;
- build team synergy;
- review project performance;
- develop further action plans to improve the performance of work processes; and
- introduce any new project staff to the partnering philosophy.

Overall, the project participants interviewed believed that a great deal of emphasis was given to quality during both MC and SC selection – although it may not have been explicit within the partnering process. Both the client and the MC stated that only those contractors (main and subcontractors) were employed who had a proven history of producing a high quality end product. However, an interesting point made by the MC buyer was that contractors who

were not BS5750 (ISO9000 series) registered were used as it was believed that many small companies did not have the resources to implement such procedures. Also, only SCs with an excellent safety record were used.

Senior members from the client and MC organisation noted that the traditional way of procuring building in the UK compromised the level of quality over price. Many believed that the way forward was to seek overall "value for money". Typical comments received on to this point were:

> Traditionally whatever form of contract or choice of procurement route is selected quality is compromised because of price constraints.

> At the end of the day we knew that partnering was the logical way forward and we all wanted the possibility of working together in the future – rather than "short term" gains we all wanted "long-term" success.

> What partnering did on this project was to minimise the opportunity for conflicting interests to become a fundamental problem (or even a conflict). By identifying and agreeing project objectives partnering can develop a commitment to the "overall" project success.

Programming and planning on construction projects are critical to the overall success of the project. Frequently, operatives are working in confined spaces, usually in close proximity to other trades. This can lead to situations where conflicts arise over allocated space and time is wasted waiting for trades to complete their work. Also, couple this to purchasing lead in times on products such as steel structural frames, carpet, lifts and escalators – the propensity for conflict and chaos is high.

During the review sessions "waste" kept arising as a key point. Waste was seen to happen primarily in two areas: material and time. The project manager noted that on traditionally procured projects waste could not only be a safety hazard but also compromised the overall quality of the building. The project manager continued that although "material waste" was not an issue included in the partnering charter, it was a key point by which his site staff evaluated SCs. He noted:

> If we saw a subcontractor working in an area of the project surrounded by wasted material we would be asking serious questions about their levels of skill and ability to satisfy the project specification. Through the partnering selection process and the value engineering exercises we identified subcontractors who could perform – and at the end of the project there were no complaints from my site team about wasted material.

Formal mechanisms used to assess material wastage on site were daily site diaries kept by both the MC's and SCs' site staff. Also, weekly site meetings enabled staff to raise any issues. Wasting "time" was also seen as an issue frequently found on normally procured projects. The MC's and SCs' staff noted that wasted time usually occurred during the decision making process either at the design stage or during construction.

Conclusions

This research has identified a method by which the concepts of quality management systems and partnering can be effectively incorporated into the

construction process which has lean production as its objective. Partnering is concerned with managing the business and improving relationships. Partnering can bring about improvements in the design process, communication and buildability; thus it has the potential to improve the levels of productivity and quality attained on site. Such productivity improvements can also be attained in the design office when projects are procured through routes other than the traditional competitive tendering route. Hence, partnering is not a technique which establishes rules, regulations, documentation and procedures but is a proactive approach to the management of business relationships. As such partnering has great potential to provide an environment which facilitates improvements in quality, productivity and safety. By invoking partnering one brings about a change in attitudes and culture from the very start of the project. In so doing trust is engendered and working relationships are enhanced. This is the essence of the advantage which partnering brings to the construction industry and, when dovetailed with other techniques such as TQM, provides the necessary environment for a lean production philosophy to flourish.

The general consensus from the study was that in order to assess the impact of partnering on quality it would be necessary to have tangible measures or performance targets incorporated into the partnering charter. It was also noted that any "performance targets" should be achievable and based on research rather than a measure gratuitously imposed on the project team. Interviewees believed that a continuous target of improving 10 per cent each month would soon be unachievable. However, given the truism that "quality" means different things to different people partnering can facilitate the identification, through consensus of opinion, of quality targets and measures regardless of their nature. What this will then do is improve the chances of achieving these measures through "ownership" and commitment, hence the recommendation is that performance targets be negotiated on a project by project basis.

Follow-up interviews with over 30 project participants also elicited a general consensus that much better working relationships between and within teams having been generated in this study project. It was also found to be much easier to control time and cost performance levels and achieve higher quality levels given the close co-operation and openness/transparency that facilitated earlier anticipation and minimisation of potential problems. Having looked at some of the advantages that partnering brings to the construction project it is also useful to look at future developments. One of the key issues mentioned by many of the participants in this research was that waste minimisation was a key issue which should be addressed in partnering charters and is essential in quality management systems. In addition, taking the partnering concept to its limit, the objective of sustainable construction should also be included in the partnering charter.

Finally, as working relationships become closer, technology transfer will increase providing organisations with limited resources the opportunity to obtain expert skills from their partners in the quality management area.

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