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Obstacles to implementing total quality management in the UK construction industry

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Since at least the Tavistock studies, the need to improve communication and coordination in the construction process has been stressed. This paper reports from a study of 25 construction projects where QA and a number of procedures were in use which might have been expected to bring such improvement. The finding was, however, that coordination was poor. The purpose of the paper is to consider how this finding is to be explained. With reference to the markets/hierarchy theoretical framework, it is proposed that the use of this and other similar frameworks in fact obscures the empirical reality which they are intended to explain. It is accepted that the meta-language which such frameworks supply may enable researchers and those practitioners who choose to use this language to share their interests and concerns. However, the relationship between the abstract and global concepts which feature in such talk and the reality to which they refer needs closer enquiry. This paper proposes that our knowledge of the impact of QA has been compromised by the lack of such attention. The paper then inspects the global proposition that QA has been a step in the right direction towards TQM. With the aim of giving this proposition a stronger empirical referent, six key principles of TQM are used as a benchmark against which to assess the significance of the empirical data drawn from the study. It is proposed that greater attention to such data is necessary to provide a sounder basis for establishing what needs to be done to stimulate change.

Keywords: TQM, lean construction, continuous improvement, concurrent engineering, process re-engineering, markets-hierarchies, contractual controls, subcontracting, D&B, CAD

Introduction

A frequent observation by respondents, in the study on which this paper is based, was that there was poor, little or inadequate coordination/communication within the entire construction process. These respondents were people variously involved on projects where QA systems were in place and where a number of procedures were in operation, which seemed, on the face of it, likely to remedy some of the coordination problems to which the industry is usually subject. In talking about what they saw as the reasons for the difficulties they had to manage and about their dissatisfaction with the quality of the work they produced, the QA systems and the procedures in question were frankly appraised and found wanting. An objective assessment of the poor quality of some of their work, reported in Shammas-Toma *et al.* (1996) suggests that their dissatisfaction was well founded. The purpose of this paper is to enquire into the ways in which their difficulties and dissatisfactions may be addressed and perhaps alleviated through the use of TQM. More generally, it is to put the case that as researchers we should listen more carefully to what practitioners have to say rather than too quickly reformulating what they tell us in the terms with which we try to understand their industry.

Our respondents' critical observations concurred with the conclusions of the pioneering Tavistock studies of the building industry (Higgin and Jessop, 1965, Crichton, 1966). These studies highlighted coordination/communication failures as a key feature of the contracting system where the struggle between technical interdependence and organizational indepen-

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dence was not adequately resolved. Others (Bessant, 1991: p.184) have gone on to liken the condition to a relay race where each successive party to the project passes on the baton and with it unresolved problems. Such problems, it is noted, become the occasion for acrimony and dispute and have led to what is commonly described as a culture of conflict. To find ways of increasing coordination between concept, design and implementation, replacing the culture of conflict with one of cooperation, has therefore been identified as a priority if increased efficiency, cost-effectiveness and client satisfaction are to be achieved.

However, while the Tavistock studies pointed to the importance of, what they called, the informal and adaptive systems, that is, all those unremarkable processes which enable the construction process to function at all (and often despite the formal provisions), we will argue that attempts to theorize what these processes might consist of have had the effect of rendering them invisible. We will suggest that the ways of modelling the lived reality of work relationships by attempting to identify its objective features, have not attended carefully enough to the ways in which coordination and communication processes are in fact achieved. We will try to show that efforts to explain these processes are usually compromised by the fact that sight is lost of the primary data or the empirical phenomena which constitute them – the meaningful action of people – that is, what they do, what they think they are doing in the light of what they think is going on. We will suggest that the principles of TQM have much to offer in overcoming the problems of coordination. However, if it is to deliver these potential benefits we must review the ways in which we seek to understand the dynamics of the change it entails. We suggest, for example, that we know far too little about the relative failure of QA to meet the high expectations that were held of it. In our view, its history and what we may learn from it, are clouded by the very tools that were used to interpret whatever happened to it.

We deliberately began this paper with reference to the primary data – what people told us and what they taught us to see as relevant to the issue at hand. Throughout the paper we will emphasize the need to preserve this primary focus and say why we think it so frequently gets lost. We will try to do this by giving a critical account of the markets/hierarchy framework which has been used to explore the distinctive coordination problems of construction (Eccles, 1981; Winch, 1987; O'Brien *et al.*, 1995). We will argue that such explanatory frameworks direct attention away from this meaningful action, away from precisely that which needs to be understood.

Thus, the structure of the paper is as follows. The markets/hierarchies framework is discussed. This particular framework has been chosen because it addresses the key question of coordination which is a central consideration in all the various philosophies and techniques like Total Quality Management, Continuous Improvement, Lean Construction, Concurrent Engineering, etc., referred to henceforth collectively as TQM. What they have in common is an emphasis on process and harnessing disparate contributions to the delivery of quality in products and services.

Assuming that TQM offers methods of improving practice, we will then ask what stands in the way of implementing them. We propose that a much closer understanding of what happens 'on the ground' is necessary and that much discussion of QA and TQM is conducted in such a way as to prevent this. Key principles of TQM are then described to act as a kind of benchmark against which current practices, as revealed by the study, will be assessed. The study (of reinforced concrete construction) is described and findings presented. First, evidence is given of poor coordination. Second, the practice of using one subcontractor for the entire concrete frame, the use of Design and Build (D&B) contracts, and the use of CAD are considered. The argument is offered that while these measures could improve coordination, the rationales for introducing them and the spirit in which they are implemented undermine their coordinative potential. Finally, the challenges facing any efforts at more effective coordination are considered.

Coordination – markets and hierarchies

The markets and hierarchies framework has been used to conceptualize the different ways in which coordinated action is achieved. What we will be asking in this section is: what empirical phenomena do these concepts refer to? In common sense terms, the answer is clear enough. Hierarchy refers to the conventionally conceived formal organization or firm. People are directly employed, exchanging their labour power and their willingness to submit themselves to the authority of their employers for payment and for the satisfactions that stable working relationships may bring. Here, coordination can be effected on the basis of unified authority. In contrast to this arrangement, coordination can also be achieved by independent individuals, or firms, entering into exchange relationships through the market as and when it suits them. The suitability of markets or hierarchies as forms of coordination can, in principle, be calculated in terms of transaction costs (Williamson, 1981).

As noted, in common sense terms this is clear enough, however, Eccles (1981) was one of the first to point out that the two concepts mask all kinds of

differences that empirically occur in any given 'market' or 'hierarchy' such that the distinction becomes less than clear. Thus, with respect to construction, he shows that a loose association of contractors and subcontractors who tend to work together, and which, in terms of the distinction, is a market, in many respects more closely resembles a hierarchy. He calls this a quasi-firm. Taking up this point, a third category has been identified, that of the network. While it may be said that the three categories more closely fit empirically occurring phenomena there is still the tendency towards economic reductionism and reification. Thus, commentators on the framework (Powell, 1991), have warned against thinking of forms of coordinated action as falling on a single continuum–hierarchy at one end, markets at the other with networks somewhere in between. To do so, they point out, is to ignore the multi-faceted nature of all exchange relationships. In particular, it ignores the quality of relationships that exist between people and provides no way in which the nature of these relationships may be better understood.

We do not, of course, object to classificatory distinction *per se* but insist, following Blumer (1969: p.21) that classificatory concepts must refer to empirical phenomena which 'are available for study, observation and analysis'. 'Loose' concepts which are said to 'sensitize' or 'illuminate' the real world may have their uses but, then, their usefulness must be judged against the purposes for which they are intended. Here, too, are empirical questions. How are such categorization devices used, by whom, for what purposes and so on? As noted above, the concepts 'market', 'hierarchy' and 'network' have the effect of foreclosing consideration of the multi-faceted character of the phenomena to which they refer.

Thus, we submit that in the pursuit of formal models to explain cooperative action, theorists have looked beyond or through actual behaviour seeing in it instances of more general constructs. In doing so the empirical nature of the phenomenon under study is rendered invisible. The point is well made by Anderson *et al.* (1989) in their discussion of the economic construct 'entrepreneurialism'. '[. . .] preoccupation with the function or place of entrepreneurialism in the system of economic activities and the conflation of that activity with a specific kind of economic rationality tends to lead away from the examination of what entrepreneurs actually do. Instead, there is a tendency to opt for global summaries of the outcomes of their activities and idealized versions of the nature of their decision making.' (p.1). With regard to the markets/hierarchies framework, two subsequent commentators on it, Butler and Carney (1983), illustrate this globalizing tendency.

While Williamson recognizes the complexity of what transactions actually entail he cuts through all that it *might* entail by referring to the importance of the 'atmosphere' in which transactions take place. Butler and Carney (1983) are less than happy with this 'catchall' but nonetheless confirm their essential alignment with what they take to be Williamson's purposes and try to develop a conceptual framework which can be *used* (presumably by managers) to judge the relative merits of a 'hierarchy' or 'market' solution – do we make it ourselves or do we buy it in? What Butler and Carney (1983) are keenly aware of is that such decisions are immensely complex and that the phenomenon 'market' is not as simple as it appears. They therefore try to get closer to this complexity and elaborate on the role played by 'trust', 'routines' and 'mutual adjustment'. They then illustrate what they mean by these concepts by describing three cases. The question that we raise is: what use is being made of these abstracting concepts? It will be noted that the authors are required to illustrate what they mean by them thereby evoking all kinds of tacit knowledge in an uncontrollable way. So, while such concepts are presented as having a 'free-standing' status (such that they can even be added and subtracted, Butler and Carney (1983) Figure 1, p.215) and as referring unproblematically to some empirical phenomenon, they cannot in fact have such a status. Their meaning is embedded in a wealth of taken-for-granted understanding about particular circumstances; the meaning is indexical (Garfinkel, 1984: p.4). Thus, despite their commendable effort to get closer to the empirical reality of markets, it is still being filtered through the conceptual mesh which they provide. They are not actually looking at the reality but at a version of it construed in terms of the conceptual framework.

Of course, everybody uses the abstractions which language provides to understand and communicate perception. What we are drawing attention to is the presumed purposes of such abstractions. Two such purposes are usually confused. The first purpose, and the markets/hierarchies framework is an example, is to provide a higher order set of generalizations with which specific instances can be characterized. The second is similar but crucially different and that is to provide 'thinking tools' (Checkland and Scholes, 1990) for practitioners. The first, as part of the scientific endeavour, is to reveal the imminent truth of phenomena which can be objectively validated against empirical manifestations. The test of whether the second purpose is achieved is that the tools are used by practitioners. In other words, both may be subjected to empirical test. With respect to the first, we have just argued that markets and hierarchies refer to a vast range of conduct. The answer to Coas' (1937)

original question which gave rise to the market/hierarchy distinction; 'why are there hierarchies?' is not to be found in the economically rational decisions which are presumed to be made (Anderson *et al.*, 1989) in the calculation of transaction costs. Rather, it is to be found in the multiplicity of reasons to be found in a multiplicity of circumstances giving rise to a multiplicity of organizational forms. In short, the concepts 'market' and 'hierarchy' do not have clear empirical referents and defy empirical testing.

The temptation to ignore this empirical complexity and seek generalizations is to respond to the second purpose, noted above, which is to provide ways of cutting through the complexity, to provide conceptual tools which sensitize practitioners/managers, to illuminate the issues they face, to provide them with guides for action. To contrast markets and hierarchies makes commonsense and may be useful as such. The empirical questions are then: are they used in this way? Do they illuminate? Does globalizing phenomena in this rough and ready way help managers to negotiate the problems they face?

Markets or hierarchies as a practical issue

We repeat, these are empirical questions. We therefore now consider the debates in construction about the practical choices to which the markets/hierarchy distinction refers. We suggest that these debates are conducted in terms which, as Morgan (1986) notes, are often supplied by academic theorists, but which carry a wealth of tacit meanings which are not made explicit. In passing, we observe that while academics have an obligation to make them explicit, consistent with their claim to be in the business of pursuing a scientific enterprise, it is for practitioners to judge whether the terms serve their purpose.

One debate, amongst those advocating unified control through hierarchy, is about who should have that control, client, consultant or contractor. Thus, Lombard (1975) and Breakwell (1985), for example, argue that it should be the contractor who is responsible for quality control. In contrast, Issak (1982) sees it as the responsibility of the design professional and not the contractor. In turn, this view has been criticized. Hauser (1979), Fraszek (1979), Hammarlund and Josephon (1991), Burati *et al.* (1991, 1992), question the effectiveness of the traditional professional system of inspection and approval. In their study, Bubshait and Al-Musaid (1992) concluded that clients' involvement in the construction phase is essential to project quality though they share Lombard's view that the contractor's role is vital and look for a much closer liaison between the clients and contractors. Willenbrock and Shepard (1980) conclude that the contractor or designer should maintain a quality control group, whose duty should be limited only to quality control, and who must be insulated from cost and schedule pressures. Finally, there are those who argue that the choice of quality control programme and who should initiate it must depend on the particular characteristics of the project (Hester, 1979).

The brief reference to these studies is intended merely to point out their indexical nature; the mass of situated knowledge, values and interests that they subsume. Here, they are in effect talking about the ethos in which or the quality of relationships through which a project should be coordinated. However, they do not discuss how these matters are to be addressed; how to achieve a better understanding of how relationships are constituted. Rather, there is the tendency, in reaching for a solution, to short-circuit the substance of the problem. They are fully aware, one supposes, of what actually goes on and that the necessary preconditions for hierarchical coordination are absent. What we draw attention to, then, is both a deeply-rooted bureaucratic mode of thinking, which, we take it, expresses their values and interests, and a tendency to debate in terms of global and undifferentiated concepts. Here, it seems to be so deeply rooted that it ignores not only the non-existence of the particular conditions required of a bureaucracy (legitimated basis for unified control), but all the other features – the complex of accomplishments acquired by people and exhibited in any kind of social order. In other words, discussion is conducted at a purely abstract and ideological level. Exactly how what is being discussed relates to empirical reality is *ad hoc* and undisclosed. In a different context but having extreme relevance for what is being said here, Fisher and Ury (1990) note that negotiations frequently founder or result in unwise outcomes because people are blinded by global concepts and will argue fruitlessly on the basis of them without ever enquiring into what they actually mean.

The same problem is evident in the other standard debate which concerns the important fact that in construction coordination is not achieved through hierarchy but through market relations. The issue here is construed in terms of the formal governance of these relations, that is, the contract. While we do not underestimate the importance of formal contracts, we are commenting on the fact that little is known about what part they play in the day-to-day running of projects (Rooke and Seymour, 1995). As noted earlier, the Tavistock studies pointed the way in this matter, observing that coordination was achieved by virtue of what were called the *informal* and *adaptive* systems, that is, people are relied upon to get the work done in spite of the formal provisions of contract. By virtue of good-

will and the willingness to work collaboratively, projects were carried out with little reference to the formal system. In short, social order and coordination is a day-to-day accomplishment of members. We have little systematic knowledge of how this relates to the various formal systems – contractual, technical, directive and so on – since attention is directed almost exclusively at the latter. The direction signalled by the Tavistock studies has not been followed. We still know little, for example, about all the social and intersubjective considerations that underlie the use of any form of contract. A contract, is, as it were, just the tip of an iceberg; it is interpreted and enacted on the basis of a multitude of tacit assumptions and understandings, not to say feelings (Durkheim, 1933, Clegg, 1992).

In summary, in addressing the coordination of construction, we suggest that commentators have attended too little to the subtle and multi-faceted character of coordination, whether within (hierarchy) or between (market) organizations and the people that compose them. In this we see a confusion of purposes: i) to develop abstract conceptual models which accurately capture the reality they represent and ii) to provide conceptual tools which can be used. Both results may be subjected to empirical test but rarely are. Thus, there have been two tendencies in addressing the coordination problems of a construction project. Firstly, it is treated as if it were a hierarchy or should be managed as one, or, secondly, it is treated as an economic coalition with almost exclusive attention given to the forms of contract which govern the relationships between parties – detailing of rights and obligations, the allocation of risks and responsibilities. While, of course, a construction project is carried out by economic coalitions that need to be governed by contracts, it is far more than that. To an extent, the obsessive attention to the formal mechanics of contractual and procurement systems is now being supplemented by attention to all those social and cultural factors, referred to above, within which they are enacted. In part, this has been prompted by the recognition that Japanese projects are effectively run with less attention to the formal terms of a contract than to the spirit of it. However, the challenge in this awareness that 'other cultures do it differently' is to look carefully at the fine-grained texture of how relationships are conducted in any given culture and not reach out to the grossly oversimplifying and globalizing conceptual schemes provided, for example, by Hofstede (1991), in order to understand them.

QA and TQM

In this section we suggest that commentaries on QA and TQM in construction are not sufficiently empirically based. QA and TQM are sets of practices and principles which are intended, amongst other things, to facilitate coordination. As a matter of history, QA in the shape of BS 5750 was one of the initiatives of the early 1980's to improve construction performance. Pressure was exerted by clients and Government on construction firms to adopt QA as a means of better coordinating the delivery chain. By closely documenting procedures, errors would be reduced and participants could proceed with greater confidence and fewer outstanding problems needed to be solved. As with our critique of markets/hierarchies, what actually happened during this period is clouded rather than clarified by the bulk of the commentaries on it. Barrett's paper (1991) is fairly typical. In it we see the conflation of the two quite separate purposes outlined above: i) an empirical account of what the paper purports to be about – the use being made of QA; and, ii) to provide a usable digest; an expert evaluation of the 'pros' and 'cons' of QA to help managers decide policy and strategy. In seeking to achieve the second purpose, which is perfectly legitimate, any number of unspecified assumptions are made about the connection between the global concepts ('cognitive dissonance', 'regression') that are used and what they refer to; about the interests and aims of those he is addressing, and so on. It is, in a sense, part of a dialogue with members of the academic community, assumed to share a grounding of common knowledge and concerns, and such members of industry who are prepared to enter into the dialogue. What the paper is not, we suggest, though it is offered as such, is a genuinely empirical account which provides evidence to answer the question which the paper poses: has QA been a step in the right direction? Others, too, have posed this question (Burati *et al.*, 1991, 1992; Tyler and Frost, 1991; Kline and Coleman, 1992) tending to conclude that it has been but that a more radical approach to improving the total process – such as is to be found in TQM – is now required. However, though we respect the right of these commentators to make such evaluations, we think it would be useful to have firmer empirical referents for them.

Whether or not QA has been a step in the right direction is the question which we now address. We will do so by asking how practitioners in the industry see it. We offer this as an alternative basis from which to see what might be necessary to bring about the fundamental changes in attitudes and culture that are said to be required to implement TQM. By gauging what we observed and were told against six key features of TQM, we believe the study to reveal that, though there are many who are desirous of committing themselves to the radical change which TQM is said to require, a number of current developments which are

also seen as 'steps in the right direction' are nothing of the kind and are rather symptoms of existing attitudes.

Six key features of TQM

The principles of TQM as described, for example, by Oakland (1993) derive from the simple idea that the processes necessary for the production of given goods and services should be determined by the functional requirements of the ultimate customer. In turn, contributors to the process are coordinated by directly communicating their requirements to the other contributors on whom they are dependent in a series of customer-supplier relationships. The power with which to obtain compliance (and therefore coordination) and the sanctions available in the event of non-compliance are seen as secondary issues. They may result from hierarchy (internal suppliers and customers), networks (partnerships, quasi-firms, etc.) or market relationships (both external). In common with Chandler's famous dictum 'strategy before structure' (Chandler, 1962), a priority is assumed, namely, process comes before ways in which people are recruited to the process.

A number of principles may be adduced from the basic concern with process.

1. Customer/supplier relationships: at each 'link' within the delivery chain, it is the responsibility of the customer-supplier to signal his/her requirements and ensure that the requirements placed upon him/her are met.
2. Prevention rather than detection of defects: the emphasis is on identifying the origin of defects and continually improving the capacity to prevent them from occurring.
3. Leadership: total commitment of top management to the principles of TQM.
4. Change in organizational culture: attitudes and expectations about ways of working must change in line with the philosophy of TQM.
5. Emphasis on team work: problem-solving requires cross-boundary communication and cooperation.
6. The use of statistical tools: methods for measuring improvement must be developed.

The study

The purpose of the study, some findings of which are now reported, was to record the quality achieved in a sample of concrete structures and to relate these findings to the circumstances in which the work was carried out. Twenty-five sites were investigated, varying in type of structure, size, contract, and located throughout the UK. A sample of structural elements on each site was selected; a quality feature was measured and its achievement was compared to the specifications and standards. The construction processes which had resulted in the measured quality of the samples were monitored through their various stages. The purpose was to establish the reasons for the levels of quality that were achieved. Informal interviews were conducted with operatives, foremen, engineers and managers during the course of the work about what they were doing, why they were doing it and so on. The period of investigation for each site was, on average, one month.

The measurement techniques used to determine the achievement of quality, descriptions of the methods employed to investigate the causes of the non-achievement of quality standards and full details of the findings are reported elsewhere (Shammas-Toma *et al.*, (1996); Seymour *et al.* (1997)). However, a major finding was that the quality achieved generally fell below the required standards, despite the fact that all contractors involved in the study had quality control procedures in operation and all but two of them were certificated to the BS 5750 Standard.

In reporting the study, as now follows, our concern is to suggest that the issues raised are to be addressed at the level at which they are raised. We do not presume to suggest that they are in any way statistically representative, for this is not the point. What is presented is an attempt to report the issues in the terms actually used by *our* informants and to give a sense of the way they were experienced. There may be other informants who would have told a different story. As discussed at length by, for example, Popper (1959), this will always be the case. We try not to preempt allowing practitioners to speak for themselves by translating them into theoretical categories for the reasons already discussed. We organize the materials we present in natural language terms such 'coordination' and 'control'. We give no special theoretical status to such terms. In the final section we will suggest that the kind of understanding that the approach we adopt provides is a sound basis for actioning change and has no need, if indeed this were possible, for some kind of statistical validation. Where we use phrases like 'some people said' and 'there was a general consensus', the reader must take it on trust that we are not lying, a commitment that must be made about the origin of statistical data. Finally, we note that the methods we used were constrained by all the standard restrictions of research: time, cost, and so on. However, these constraints prevented us from enquiring more deeply

into the circumstances in which the things we report were said and observed. A larger sample would have brought us no closer to the situations in which the meaning of what we report is to be found.

Poor coordination

There was a general consensus amongst respondents that projects are dominated by uncertainty and unpredictability; problems are tackled as and when they arise. The following quote by a Resident Engineer (RE) is fairly typical:

> Designers come with variations and design changes and that is disruptive to the contractor. We [REs] also tend to work on crisis management, we do not deal with problems until they arise. This is disruptive to the contractor, but we do not have time to do anything else. The problems we deal with have been caused by inadequacies of the design or development of the design and we do not have time to check all the bars that have been scheduled, et cetera. We have just found that we have included enough reinforcement to do the piles, they missed half the bars.

It was recognized by many participants that communication and coordination have to be improved between the parties to the project, so as to enable them to solve the problems arising from what they saw as the endemic uncertainties of work on site. However, while some participants viewed the achievement of quality as a function of relationships, others viewed it as a matter of strict adherence to calculated and specified requirements.

It was also recognized that, in temporary coalitions of differentiated economic interest, there was no unified control and that attempts to achieve coordination through contractual formalization and regulation was also failing. This was particularly noted within two sets of relationships, that between the RE and the operative and that between the designers and contractors.

Findings suggest that contractual procedures constricted communication between the RE and the subcontractors. The client's representative was not allowed, contractually, to advise the operatives during construction when the realities of the situation emphasized the need for technical guidance to the operatives from the RE. In many cases, informal procedures were used, such as an RE communicating with operatives to overcome a problem on site as it arose without resorting to the formal method of filing a non-conformance report. However, informal procedures could be interpreted as a breach of contract and it was suspected that contractors' personnel might exploit this to gain financial advantage. The following comments highlight this point:

> I [RE] do not know how skilled the steel fixers are in reading intricate drawings. We [REs] try to help them along to make them understand how to put it together. However, there is always the problem of talking to subcontractors. I had a situation where I was accused of telling a steel fixer what to do, and I was accused of causing it in the first place. The operatives needed some help or guidance on some stir ups which I thought I was giving. At the end of the day I was accused of causing the delay, so it is a difficult balance. It is a delicate tight rope that we are walking on. On one hand you are accused by the client for not having done your duty, not having pointed them out at sensible times and practical times for the contractor. Yet the contractor should only come to us when he thinks he has got it right not when we find forty faults wrong with it. Two things he might have missed, bar cleaning, or cover blocks, not the fact that he has missed whole bars out or the shutters are not as good as they should be.

> We [REs] never tell them [operatives] how to do it. We either approve it or not approve it. We never tell them because if anything happens then it would be the REs fault.

Another argument, which was also suggested by a few participants, might be inferred from the above comment. That is, instructions to operatives should flow from one source, namely, the contractor. The receipt of instructions from two sources may result in confusion. However, the gain in efficiency from enabling an RE who is more fully aware of the design requirements would seem to be obvious to them. It may be concluded that contractual procedures are needed to provide communication channels between the RE and operatives.

As to the relationship between the designer and contractor, many participants, including many designers, suggested that buildability of a design is not sufficiently considered. The design is passed from designer to contractor who is, then, expected to build it according to specified dimensions, shapes, strength requirements, etc., regardless of the problems that the design specifications may pose during construction. It was frequently suggested that the design would benefit from the contractor's early involvement and that there should be more interaction and collaboration at the design/construction interface. Thus:

> We [contractors] are getting all steel details that don't work. I am a strong advocate that the men who build things in concrete are the people who actually do the reinforcement detailing. Contractors should take over the responsibility of detailing. If we detail it ourselves then it makes it easy to understand.

> It is better if the contractor is given the detailing responsibility. Poor detailing can account for 15 to 20% of reinforcement which in turn is about 25% of the contract.

> That happened on a fast track project. A contractor was brought in to finalize design process. The contractor had an input on design and the building went so quickly.

These comments suggest the need for contractors' reinforcement detailing. The contractors' stated reason is improved buildability. Another, inferred, reason might be that it would give contractors some control during the design phase of the project, such control being a reason for D&B contracts. However, it was frequently suggested, sometimes by designers themselves, that designers realized their limitations in producing buildable reinforced concrete designs and the negative impact that impractical designs can have on structural quality. Therefore, they inserted clauses in the specifications to relieve the designer from the contractual liability of impractical design and detailing by placing such liability with the contractors. Such clauses, for example, are:

> The reinforcement shall be cut and bent within the tolerances given in BS4466 but it shall not relieve the contractor of the responsibility of the correct fit of the reinforcement and achievement of the required cover.

> The contractor shall check bar schedules, make any corrections necessary and submit revised schedules to the engineer for approval [. . .] The contractor shall be fully responsible for the correctness of the schedules.

These clauses, which were perceived as sources of conflict between designers and contractors, are evidence that contractors do, in fact, hold responsibility for reinforcement designed by others. It seemed logical, therefore, to allow the contractor to detail the reinforcement in the expectation of improved buildability. The findings also suggested that the absence of 'coordinative' procedures within conventional contracts added to the divide between design and construction. For example, there is no contractual procedure allowing for coordination between the contractor and consultant on buildability matters. The following statement is by a site agent:

> We [contractor] are here to work to the drawings and we will continue to work to the drawings until we are told otherwise, regardless of whether they are right or wrong or indifferent or could be better, because we are paid to work to drawings. I do not communicate my thoughts on the drawings to anybody. If I think there is something wrong I do not tell anybody. I am not required to do so contractually. The relationship is very adversarial in conventional contracts.

The above comment may also suggest that within the present climate contractors are not encouraged to cooperate but, on the contrary, to exploit design errors through claims and extra work to the detriment of quality and cost. The stultifying effects of contractual procedures which protect against error rather than promote coordination is well summarized by a steel fixer:

> I [steel fixer] go to the site engineer and tell him what is wrong and then the site engineer goes to the client. The contractor actually posts the letter to them although their site offices are near each other. This delays the job.

The reasons given for contractual controls being included in the contract, despite the fact that they did not serve their purpose, were in terms of the need to survive in the fierce economic climate. The consequence of operating in this climate is an overwhelming emphasis on profit optimization which, in turn, is seen to result in adversarial relationships and lack of mutual trust. It was suggested by some participants that many clients' procurement policies are based on low tender price without sufficient consideration given to the qualification or quality records of the bidders.

The following comments, by contractors and clients support the above argument:

> The contractor on most jobs these days is going out looking for money from day one to make up for his low tender figure. He is not going to change anything without the approval of the Engineer, to make sure that he is going to get paid for that. We [client] are looking for quality and we expect the contractor to have a system of approval. If the contractor's work is not checked at certain responsible levels we get to this non-clean business of who is responsible for it if something goes wrong in there. Similarly, if something is required to be changed then the contractor either gets paid because he knows that the Engineer has made the change or we turn to him and say, 'well we told you to put it right and you did not do it'.

> I [steel fixer] know how to rectify the situation and what is wrong but I cannot change it. It is all money. They design it wrong so the contractor puts in claims. There is no point in changing it because they [contractor] want the money. Claims are very important. This delays the job, but delay is money as well. 4T16mm bars 4m long were missing. The steel fixer can pay it from his pocket, nothing went on until someone had to pay for it. Cost should be one part of a whole equation, others are quality, innovation, the future. In reality, cost is what matters.

> I [client] do not think the tender period affects the contractor, I try to cut it down and they say it is too short: I say, well, he only rings the suppliers in the last two weeks anyway. He has a habit of doing that. At the end of the day, they want the job. They [contractors] will say that we get the job and make claims afterwards for millions of pounds. This is the mentality of how the job is run these days. Quantity surveyors are running these jobs which is another problem. They are

> very money conscious. They say if he [contractor] does not claim then it is not worth taking the job. They either try to stop the job or cut corners or whatever. So they try to get the job and then running it financially not quality (*sic*). Some contractors are there on the claims from day one. Some claim on other jobs to make up for the loss of one job which make the rest suffer. Other contractors employ someone for this purpose. It takes a lot of time to settle claims, takes up the RE's resources.
>
> We [client] usually award the contract to the lowest bidder. We do look for any peculiarities in the rates, but normally you get satisfactory answers at that stage. It is an ever continuing battle with the contractors. What we do not want is a contractor who says, 'O.K. this is changed here, you have not told me what to do, I am not moving until you do'. At the end of the day it should be a joint exercise between our and their expertise to produce a quality job with the minimal money but in reality it is not.
>
> We [contractor] are breaking even in this project. We cannot afford to spend on quality. It is the recession.

This concern with short-term financial viability seems to be assumed as prevalent throughout the industry and now includes the design sector as well as the construction sector. There is a tendency amongst clients to use the competitive tender system with consultants, as the following comment, by a client, suggests:

> Consultants are on competitive bases now which is a real struggle. It comes down to writing a good brief. As soon as we [client] are party to the brief, we are on additional works because we pay them on a tonnage basis not a lump-sum. It is the name of the game, at the end of the day if they have any reason to claim money then they will. I tell the consultants your fees are tiny compared to the cost of the job so I want the best job not the cheapest that you managed to pick off the shelf. It is getting that relationship. We approach different consultants and change our list all the time.

In summary, the view seems to be that external constraints of the competitive market that the industry is subjected to, and which fall outside its control, are detrimental to the achievement of satisfactory quality standards. As an example of the effect that these constraints can have on the achievement of cover, the reasons for the problem of congestion of reinforcement, encountered on the sites investigated, were explained by contractors:

> In one instance we had two decks standing against each other, an old one and a new one. The new one is 1 metre thick with heavy reinforcement and links sticking out and the other is 2 feet thick with no reinforcement compared to ours. The difference was dramatic. A lot of these problems come down to the clients wanting cheaper, faster products. Even their appointment of consultants. Ten years ago consultants were awarded on merit now they are competing all the time. We [contractor] try and get drawings clarified or detailed but consultants do not want to know. They are on price. They are no different to contractors.
>
> This design is well over the top. They get paid a percentage of the value of the design, so if they over designed it, they get paid more. This slab area, the amount of steel in there is incredible. If we [contractor] had to design it, we would not put half the amount of steel that is in there. We can use 16mm bars instead of 25mm and we will get the same strength etc.

Methods to improve coordination?

We suggest that the foregoing accounts indicate that current working arrangements militate against effective coordination. A number of management practices, which have grown in recent years, like D&B, the use of one subcontractor and Computer-aided design (CAD), would seem likely, on the face of it, to improve coordination. Thus, one might conclude that people have realized the negative impact of contractual practices on the quality achieved and have moved to improve the situation. The evidence we now present does not bear this out. It suggests that these practices have, in fact, created further fragmentation and have been driven by firms seeking to allay contractual risk and only taking on those elements of the contract where profits can be made.

The use of one subcontractor

Subcontracting was seen as generally intensifying the problem of effective coordination. In the following a contractor is talking about the relationship between subcontractors:

> With reinforcement you have a set of steel fixers who come and do the steel and a set of joiners who come in and put the forms around. The joiners, when they stick up their forms, they do know where the T40mm rebar is. The joiners do not give a toss about steel fixing so they just clip off the bits of rebar and throw them away and stick their bolts through. When we [contractor] come to inspect the base we find that the rebar is not right. There are problems that have arisen through steel fixing or subsequent handling of the steel after the steel fixers have left. We get a steel fixer who is only interested in fixing the steel and a formfixer who is only interested in putting the shutters up alone, and they both have their respective eyes on how much productivity they have to knock out between them in each shift so they have no respect for each other's work. They are in conflict.

Employing one subcontractor for the whole concrete construction process might seem to address these difficulties. However, the data suggest that the trend has made matters worse because the concrete subcontractor, in turn, subcontracts work. This means longer chains of command, and more obstacles in communication because the contractor is further detached from the operatives. This leads, it was suggested by some contractors, to more elaborate management control procedures directed at operatives:

> We [contractor] may appear to have less worries because we employ one subcontractor to do the whole job, but ultimately as main contractor, we retain the responsibility at the end of the day. So employing one subcontractor makes us one step way from operatives because we do not have hands-on control on them. The subcontractor we have employed is using subcontractors because it is cheaper. We cannot foresee doing the job for the same figure so we have to wonder where he is cutting corners. In many ways, we need to employ more supervision to satisfy ourselves that the quality required is achieved.

> Subcontracting does not help at all. If we [contractor] employ our own people we get better control over them. The other way, we have financial control on subcontractors. If they make a mistake they have to pay for it. If we subcontract the work to one subcontractor, there is longer communication channels to go through to get them to do the work. If, however, we employ our own people then we can say to them directly that we want things sorted.

> We [contractors] do check most of the subcontractors' work. The problem is when the subcontractors subcontract part of their work to others and they leave the site, so we end up supervising their subcontractors and end up having a contract with them.

The reasons for employing one subcontractor was explained by many contractors in terms of financial advantage and contractual risks. The following comment is by a contractor:

> Mainly, we choose the subcontractor based on price. I [site agent] have got three or four prices in. I look at the two lowest. It is usually the cheapest price that gets it. There has to be good reasons for not choosing the cheapest price for obvious reasons. We usually employ one subcontractor for the concrete structure because it is cheaper for us than to employ different subcontractors for each section of the work.

> The subcontractor is liable for the defects encountered on site. He will have to pay for rectifying them not us.

The use of D&B contracts

Many REs, consultants and even some contractors were sceptical about the use of D&B contracts and some claimed that they had worked on D&B contracts where quality was suffering and the contractor was cutting corners:

> Looking at Design and Build, they seem to me [RE] to produce as many problems as they solve. It sounds ideal to have one contractor to design and build it and do the whole package. I do not think this way you can produce a good quality job, I think conventional contracts give you a better quality job. This sort of contract does not involve much in the way of supervision apart from the contractor's supervision and that is where it slightly falls down. In addition, there is the situation where because it is design and build any alteration in the course of the contract can be expensive and tend to be ignored if they possibly can.

> There are reservations on design and build of what the client is actually getting. It seems odd that there are massive savings of money and nothing suffers. The work does not suffer. So we need to ask ourselves where are these savings coming from, are they coming from design or some other aspects? Time will tell.

It was suggested that a reason for the ineffectiveness of D&B contracts in improving coordination is that the contractor usually subcontracts the design work to consultants. In doing so, first, the client, by choosing a D&B contract, has merely shifted the control of the project from the consultant to the contractor; second, the emphasis on competitive tendering carries through to design. A consequence is that the reinforcement drawings may not be ready until the consultant is certain that he has won the tender. This, in turn, means that the contractor will, ultimately, have less preconstruction time to examine the drawings and the reinforcement schedules for buildability. That there is no improvement in coordination is suggested in the following:

> Most design and build jobs are done by contractors who subcontract a consultant to design it. It is a similar system to conventional contracts. The contractor usually chairs the meeting but that does not mean improved quality.

> In conventional contracts, 50% of the cases you get the drawings and the reinforcement schedules. In a D&B job, when you submit your bid, in 100% of the cases the drawings will not be done. We [consultant] do not have it because of the actual cost of producing the drawings. If we have not got the job it is a waste of cash and time then. The contractor will have less time then to check the drawings.

Finally, as might be expected, the reason for using D&B contracts seems to be more financially than

quality orientated as these comments, made by contractors, clients, and consultants, suggest:

> At the end, D&B is going to save people money. The money that is paid by a client is far cheaper in a D&B than in a conventional contract.
>
> D&B contracts appear to achieve their goals quicker. The quality may suffer on these contracts because they [contractor] might build the things wrongly. They can cut corners to achieve their cost and time target and no one would know about it.
>
> I [contractor] do not think D&B has an effect on quality. They might be cheaper and cut back on reinforcement.
>
> Design and build, the likes of this contract is a lump-sum contract. The client wants to know how much he spends. They do not want to pay a penny more. They [contractors] can bid lower and end up with a lower final cost to the client. Therefore, financially it is cheaper for the client but the specifications have to be very tight because the client has to tell them exactly what he wants them to do.

The use of CAD

A development amongst design practices that seems to have coordinative advantages, is the use of sophisticated computer packages to produce designs and drawings. The following comments, made by designers, suggest their use is on the increase:

> Our schedule has been manual up to now. We are now embarking on AutoCAD and computer drafting systems. We have not used it to a great extent on detailing concrete structures but we envisage to use it in the future.
>
> We are aiming for automatic drafting and detailing. The software packages have been developed to be as user friendly as possible.

However, the use of CAD was criticized by many contractors and steel suppliers because the logic on which it is based did not allow for the practicalities of construction and bar bending. It results in complex designs, where, for example, different sizes of bar are used for the same slab in order to reduce the tonnage of steel used. The buildability of design, which is usually acquired through site experience, is not built into the computer programmes.

> We [steel supplier] prefer to produce reinforcement details manually. The main reason is that the computers are far too logical. They do not take into account the site conditions. They do not make allowances for little quirks of making them easier to construct. The way the computer works is through straight yes or no binary system. We [steel supplier] used to find some strange shapes, layouts, lengths which come from the use of CAD. The industry is taking the wrong step in using CAD systems. We found a problem in the program. Now, it is too easy with computers to press a button and put a few details like span and loading. It is very dangerous. No one has the feel for the amount of information that is coming off. The amount of steel that comes in. It could be wildly over or under, it has taken the learning out of it.
>
> CAD do not have that practical feel for the design. The designer cannot detail by the book. It just does not work like that. They have to feel and breathe like the man on site.
>
> There is a need to have young designers working on site to learn the practical aspects of design. CAD cannot do everything itself. It needs the input of the engineer. The engineer should be aware of what details to use. The CAD system is just a tool to make sure it's user transparent to the drawings.

Another argument can be inferred from the above comments. That is, given an engineer with sufficient site experience, then CAD may prove useful from an engineering perspective. However, some comments suggested that CAD further detaches the design stage from the construction stage by reducing the frequency of interaction between them and, ultimately, negatively influencing engineers' buildability experience:

> I [site engineer] worked in a design office and spent a whole year with designers who have never been on site and they used to ask me: 'will this one do?' At least, then, the design office was geared towards asking anyone who had been on site if the design would work. There was some interaction. This does not go on now with the use of computers.

Consultants offered an explanation for using CAD. Its principal virtue, as far as the users of it were concerned, was that it made possible the optimum quantity of steel reinforcement employed – thereby reducing cost.

> The designs have changed over the years in that there is a need to produce much more cost effective designs. In the past there was not so much pressure and competition to any big extent. That is why we rely more heavily on computers, to reduce design cost and speed up the design process.

How to achieve coordination

All these developments are taking place within firms that have QA in operation. We take this as evidence that these firms are not evolving their practices in the direction intended by QA and are moving in the opposite direction to that intended by TQM. Thus, with reference to the six points of TQM principle stated at the outset:

1. Clients appeared to adopt a very narrow view of the relationship with designers and contractors. They selected on price and expected their interests to be protected through contractual provisions.
2. The TQM emphasis on prevention rather than detection of defects was notably absent. This issue is examined more fully in Shammas-Toma *et al.* (1996) and Seymour *et al.* (1997) (forthcoming). In brief, all defects revealed through checking were treated as sporadic rather than systemic and therefore mechanisms were not developed to remedy systemic problems. Enabling the workforce through training to control quality and identify sources of problems, consistent with TQM, was not apparent.
3. There was no evidence so suggest that top management are committed to quality. On the contrary, the data suggest that cost and profitability were the forces driving the policies enacted on the projects studied.
4. The culture, far from being devoted to quality improvement, was dominated by short-term financial considerations, reflected in uncooperative and suspicious relationships.
5. With regard to team work, the findings on culture (in 4 above) are equally relevant. Relationships were frequently antagonistic with accusations, recriminations and blame common.
6. Finally, measurable quality criteria against which improvements could be monitored were absent. This crucial issue is fully discussed in Seymour *et al.* (forthcoming).

Overcoming the obstacles

In presenting the findings of this study we do not wish them to be read as yet another depressing confirmation that the industry is not working. While we believe the above to be an accurate assessment of how far the practices observed fall short of what TQM is intended to achieve, we note, again, in common with Higgin and Jessop some 30 years ago (Higgin & Jessop, 1965), that there is much goodwill, desire to collaborate and produce good work. However, we also note that, first, much of that is being squandered and, second, that more research should be devoted to the unremarkable, taken for granted features of collaboration.

Thus, on the evidence of our study, we query the view that QA has been a step in the right direction. It would seem that the way QA has been interpreted and implemented in construction can be seen as a step in the wrong direction and reveals features of the industry that now challenge the implementation of TQM programmes. However, the more fundamental point that we have tried to make is that policy evaluations of this kind must be kept separate from empirical accounts of what is happening. We may make as an empirical observation that to the extent that BS 5750 was adopted, it was on the basis that there was nothing revolutionary about it and that well-run firms could readily comply with the procedures required in order to qualify for certification. We may similarly observe that, in contrast, TQM, following the pronouncements of gurus like Deming, demands nothing short of a revolutionary culture change. It is an empirical question as to whether the ultimate intentions of BS 5750 may have been misunderstood but the net effect seems to have been at best superficial and at worst damaging. With its quite proper attention to the documentation of procedures, it seems to have diverted attention from the even more important process of improving the procedures themselves. Documenting existing procedures, though acknowledged by some to have had some benefits in improved efficiency, was a marketing necessity and was mainly to be commended on the basis that it served to protect a firm from the predations and illegitimate claims of other parties to a project. In other words, it has done little to promote collaboration and trust as a basis for better coordination and has done little to resolve the struggle between the technical interdependence and organizational independence noted by the Tavistock studies.

Our conclusions about what needs to be done so that the promise of TQM may be fulfilled largely coincide with the advice which is emerging from the US (see for example, the special issue of the *Journal of Management in Engineering*, **9**(4), (1993) devoted to TQM). However, to emphasize the distinctive contribution that this paper has tried to make we will attempt to position it with reference to the purpose of the papers in that issue.

Their concern is to advise on good practice – what to do and what not to. The authors of these papers select from their experience and research to illustrate and reinforce their recommendations. However, in doing so, in most cases, they confuse the two purposes which, we have argued, it is crucial to observe: the provision of empirical findings and the provision of findings, methods, tools and so on for the use of managers. One of the papers (Federle and Chase, 1993) is interesting for the unusual form it takes and distinctive in that the second purpose is explicit. The paper simply reports a colloquium involving practitioners and academics. As such, it is a very informative account of a particular group of managers on a particular occasion sharing their interests and concerns in the terms they use for these purposes. The paper records their priorities, definitions of their problems, proposed remedies and so on. The paper, in other words, provides empirical,

ethnographic data *about* these people in the same way that this paper has provided data about the concerns, etc., of the people that we talked to. We have argued that much of the putatively empirical work on QA and TQM must be recognized as commentators talking to each other using abstract concepts with which to share their perceptions and concerns. More attention should be given to how they do it and its relation to the phenomena that they observe and learn about and try to influence.

The recommendations we now make endorse most of the recommendations in the issue of the *Journal of Management in Engineering* referred to above. However, we emphasize those matters which bear on our themes of coordination and the way we researched it. Thus, we emphasize the need, starting with clients, to unlearn the habits of competitive tendering, to take a holistic view of the process which is at odds with the current situation where a set of fixed and finite requirements is expected to be passed from party to party in the delivery chain. This latter conception does not match the reality of meeting client needs and focuses attention more on issues of contractual liability, thereby undermining the possibility of coordination and teamwork.

We also stress the need to accept the inevitable variability in client requirements, the starting point for one variant of TQM known as Lean Construction. Ballard, one of its proponents, argues the need to recognize the distinctive nature of variation in construction:

> In manufacturing, variation is to be eliminated because the standards against which variation is measured are themselves invariant. In construction conceived as a product development process, we are producing those standards. Variation cannot be eliminated, but variation can be managed. (Ballard, 1994)

It is managed by allowing site managers the flexibility to stabilize the 'upstream' conditions in which packages of work are carried out. Such packages are not begun until they are fully planned, resourced and realistic targets set for their performance. Present contractual arrangements do not generally facilitate such flexibility, nor the need for mutual adjustment between the contributors to the process. Contractual forms which aim to encourage flexibility and reciprocity, to reward forward planning and the avoidance of dispute, such as The Engineering and Construction Contract (formerly, NEC), are therefore to be welcomed. The ECC's provisions for giving contractors design responsibility without the need for a full D&B contract, for example, would assist in resolving a particular coordination problem, which was revealed by this study. Reinforcement detailing, which results in buildability problems, could be improved by making the contractors responsible for them.

While not discounting the influence that contracts may have on improving coordination and recognizing that to look for a solution in them does not preclude attending to other matters, we nonetheless draw attention to two issues.

First, we believe that new forms of contract, however, well suited they may be in principle, can lead to confusion, ambiguity and conflict as conventional roles are redefined and redistributed. As Langford *et al.* (1992) note, this is precisely what has happened in the new forms of procurement that have developed in recent years, as evidenced in the rise in disputes and litigation. They conclude that effective teamwork will be achieved only 'if members are bound together by mutually set, internalized goals rather than by contractual arrangements alone' (Langford *et al.*, 1992: p.71). In other words, as we have emphasized throughout this paper, people's attitude to each other in work relationships are more important than the provisions that formally bind them and need to be more closely researched.

Second, attention to contract may signal the existence of a mindset that impedes looking carefully at the work processes themselves. We invoke here, again, a variant of the dictum 'Strategy before structure', thus, 'Process before contract'. As Koskela (1992) seminally noted, construction thinking is dominated by the attention to *conversion* activities and not to *flow* activities. This is to say that not enough attention is given to the way particular items of work or work packages are coordinated, or, as he called this activity, the management of flows. In the same way, the concern with contract may serve to focus too heavily on the contractual responsibility to deliver a package of work which, in turn, would impede flexibility, coordination and the effective management of flows.

Integral to the management of flows is the crucial need to understand the nature of variation, to diagnose errors correctly and to authorize people to act on the diagnoses. To do so requires the use of simple statistical tools like tally charts, pareto diagrams and so on. The use of such tools within the philosophy of empowerment has been the foundation for the holistic problem-solving approach which is characteristic of successful TQM. The CIOB study (1995) group provides a clear account of such practices within a more general account of Research and Development in the Japanese construction industry. The key features of the process are:

> "Participatory – everybody feels part of the process, however small their individual contribution may be; Fundamental – it aims to achieve deep-seated and continuous transformation; Incremental – improvement is brought about gradually by small step-changes; Continuous – it consists of a permanent search for improvement; Holistic – improvement is achieved by

> looking at the whole system, not parts of it in isolation; Reflective – it means learning from what you already do well and from what others can do even better." (CIOB, 1995: p.28)

They recognize the distinctive cultural and institutional context of the Japanese model but propose that it can be adapted to the UK context. It seems to us eminently possible to set in motion incremental improvements, using methods for establishing quality and performance benchmarks and measuring improvements against them. Given the lack of senior management commitment, as revealed by the study, the use of such measures makes it possible rapidly to demonstrate the value of incremental change both in quality and cash savings. Such demonstrations may act as points of leverage for those who look for genuine improvements to convince senior management of its benefits. This attaches great importance to the role of quality and middle level managers. We do not underestimate the difficulties of the task they face. They have to persuade both senior management and those at the operational level of the need for changes which emphasize teamwork, collaboration and openness. This is in the context of a culture formed in an atmosphere of mistrust, suspicion and fear of exploitation, all occasioned by the essential vulnerability of an industry chronically subject to economic uncertainty.

While the spirit in which all such methods and strategies are adopted is continually stressed in the literature as crucial, equally crucial is another matter rarely commented on. It concerns the principle of empowerment and a 'bottom-up' approach. While these may be formally endorsed, they become meaningless unless the point, well stated by Argyris *et al.* (1985), is observed. This is that conceptual frameworks are not value-free. They presume to reconstitute the meanings and lives of the people to whom they refer. They are, as Argyris *et al.* put it, 'generated in conditions of unilateral control' (Argyris *et al.* 1985: p.42). Researchers therefore constantly risk subordinating the purposes and interests and riding roughshod over the values of those they research. Through their conceptual frameworks, they risk isolating fragments of social reality, decontextualizing them and then recontextualizing and, in so doing, creating a different kind of world. Constant reference to the concerns and interests of the researched in the terms they use to express them is a way of helping to ensure that talk of bottom-up and empowerment is not just empty rhetoric.

Conclusions

In this paper we have considered some obstacles to implementing TQM. We have focused on the issue of coordination – a key requirement of it. We have suggested that there exist in the industry two powerful ways of conceptualizing the coordination problem and that both pay too little attention to the conditions for any kind of social order, that is, the learned dispositions and attitudes of people. We see this as reflecting a much more fundamental problem which concerns expectations about what constitute theory and method. We have tried to show that much of what passes as theory is not empirically grounded and therefore does not address the base source of all our data – what people do and their reasons for doing it. The methodology used on the sites studied was designed to achieve these data and on the basis of them we conclude that the QA systems in use were ineffective and that the major characteristics of TQM practice were absent. We have considered three features of current practice and provided evidence that there is a coordination problem with regard to the way *in situ* structural concrete is produced and that this is reflected in a significant degree of inadequate quality. We would also hazard that similar problems are to be found in other aspects of the construction process.

We have made no attempt to measure the size of the problem or dimensionalize its constituents. We make no apology for this and suggest that on the evidence given, a sufficient case is made that there is both a quality and coordination problem. We further suggest that the remedies for tackling them lie with practitioners. The CIOB Report on how programmes of Continuous Improvement may be implemented is a timely challenge to the construction research community as to how they can participate in the process. We have argued that a requirement of the research community is not to confuse the two roles both of which they may legitimately play. The first is that of the empirical scientist whose purpose is to 'yield verifiable knowledge of human group life' (Blumer, 1969: p.21), the second is that of the participant who seeks to be of direct use. As empirical scientists of construction management, the empirical base on which are erected all the commentaries that we offer is the concerns, interests, intentions and so on of all those who participate in construction as clients, architects, engineers, managers, etc. Our primary access to this empirical base is through talking to them. Certainly, we can observe them, read what they write, inspect the technologies and information systems that they use but in doing so our first concern is to find out what it all means to *them*. To the extent that we can be said to be *part* of construction – supplying information, helping to develop technologies, offering advice and so on, it is stressed that our status *viz-a-viz* the industry is strictly equivalent to theirs. This dual role that we play as both observers and participants must be kept

constantly in view since confusion of it results in many needless and fruitless wrangles. The importance of this reminder is that our primary data are, as noted above, the concerns of the participants and they must be taken at face value without prejudice. Insofar as we consider ourselves as scientific observers we must recognize that at any given moment we risk compromising our access to our data by asserting the perspective which we bring as just one amongst many other participants and then reconstituting their lives by imposing our theoretical frameworks on them.

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