Success of Supplier Alliances for Capital Projects

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Abstract: Energy sector capital projects typically cost hundreds of millions and even billions of dollars. Managing the engineered equipment is important not only because of their high dollar value but also because the long manufacturing lead times often drive the overall project schedules. In recent years, several supplier alliances have been successfully implemented on such projects leading to initial price savings in the range from 6 to 10%. This paper presents the result of a study to assess the opportunities and barriers with such partnerships. Interviewed company executives perceived that time savings and quality improvements, mostly due to the suppliers' specialized expertise, are of much greater value than a lower bid price. Most surprisingly, very few companies use metrics to measure performance, thus leaving them in the dark on the question of how well an alliance worked or why it failed. The relevance of the presented work is in the amount of actual field data that has been generated and processed.

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Introduction and Background

The building of large-scale capital projects in the energy market sector is typically accomplished by engineer, procurement, construction (EPC) contractors that can provide a full range of services. In 2002, the global construction market was approximately $3.5 trillion (FMI Management Consultants 2002). In the United States, the construction industry contributed $480 billion to the gross domestic product in 2001 (Bureau of Economic Analysis 2002). Because of the size of this market segment, The Construction Industry Institute (CII) investigated the traditional relationships between the owner, EPC contractor, and supplier to study an alternative method to procure major equipment items for capital projects. Highlighting the differences between procuring major and minor equipment, the study group suggested the acronym PepC where the capital "P" stands for procurement of major equipment items that should occur before engineering. They noted that capital "P" procurement should not be confused with the early purchasing of major equipment but a method to integrate suppliers into the project design so that their expertise could be incorporated into the project.

Using computer simulations of the EPC process and four capital projects with PEpC style characteristics they found that PEpC could produce savings in excess of 10–15% in time and of 4–8% savings in cost. Other suggested benefits from the PEpC process include: (1) improved quality of the detail design; (2) improved system and facility performance; (3) earlier deployment of new technologies; (4) improved utilization of supplier core competencies; (5) reduction or elimination of redundant work processes; and (6) diminished need for owners or contractors to maintain noncore competencies.

The key premise of using PepC is that major equipment items would be evaluated based on more comprehensive, total value criteria that also considers the suppliers' expertise and the value-added solutions that they can bring to the project, not just lowest price. The collaboration between contractors and suppliers of a building project offers many opportunities to drastically improve productivity and cut resource waste. A contractor–supplier coalition has as its basic goal the creation of value by cutting the wasteful elements of operation for the participating coalition partners by optimizing the use of the combined resources.

In a comparative field test Salim and Bernold (1994) showed that, through upstream planning, the rebar could be bundled and shipped according to the way the rebar is placed. If the rebar is staged according to such a plan, as indicated in Fig. 1, ineffective time spent on rehandling and searching can be eliminated. The result of the study showed that placement-oriented delivery and staging improved crew level productivity in the placement of the rebar for floor beams by 30% compared to the traditional method. The key to the productivity gain in laying the bars, however, was a supplier who was willing to collaborate with the subcontractor in shipping the steel in a way that matched how the crew was progressing. Why should the rebar supplier be interested in participating in such a collaboration? Proposing a cross-company collaboration does not seem to make economic sense in an industry that embraces the antagonistic lowest-bid contracting approach. As with the rebar, however, value can only be "harvested" through the synergistic use of the expanded know-how pool generated when companies work together for the period of a project.

Von Hippel (1989) invoked the classical prisoner-dilemma game to model the empirical phenomenon of free know-how ex-

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Fig. 1. Rebar being staged according to sequence of placement

change between firms when he writes: "When required know-how is not available in-house, an engineer typically cannot find what he needs in publications either: much is very specialized and not published anywhere. He must either develop it himself or learn what he needs to know by talking to other specialists. Since in-house development can be time consuming and expensive, there can be a high incentive to seek the needed information from professional colleagues. And often, logically enough, engineers in firms which make similar products or use similar processes are the people most likely to have the needed information." It is apparent that this "know-how scrounging" from friends is not realistic for large capital projects. Thus, the key question remains. Is the contractor better off using his own engineering/management department to write low-bid oriented specifications or would it be a "better buy" to collaborate with the suppliers? This paper presents the results of an empirical study that included owners, EPC contractors, and suppliers to assess how the different constituents in the energy sector answer this very question.

From Procurement to Supply Chain Management

Recognizing the importance of managing the flow of resources the area of materials management in construction received increased attention in the 1980s and early 1990s (Stuckhart and Bell 1986; Thomas et al. 1989; Bernold 1990; Bernold and Treseler 1991; Bernold and Salim 1993). After realizing significant cost savings, it was thought that more improvements are possible by reaching further upstream the supply chain and by further integrating suppliers with the construction processes that relied on their material.

Synergistic Collaboration

Many authors, such as Lamming, suggested a strategic nurturing of suppliers as: "… allied business partners to enable lean production" (Lamming 1996). However, simply linking suppliers to customers to eliminate wasted time in the supply chain was not considered a sufficient reason to start collaborating. Supply chain management (SCM), which has received much attention from the industry and researchers, further advanced the holistic view of what is traditionally viewed as simple procurement. Christopher provided an early definition stating that SCM represented: "a network of organizations is structured through upstream and downstream linkages among the processes and activities that add value along the supply chains" (Christopher 1992). Many definitions have since been proposed all emphasizing several key features: (1) collaboration between multiple organizations/firms to achieve synergistic gains; (2) integration of design, implementation, and management; (3) bringing together people/know-how and technological resources from all participants; (4) opening communications; and (5) coordinating management of all materials, information, and financial needs. Thus, suppliers no longer work separately on individual parts. Instead, they need to work in interorganizational teams on the development of entire systems.

Alliances to Avoid Legal Nightmare

How does one create a legal contract that covers collaborating single firms that do not end up in court? Spelling the responsibilities of each member for every circumstance for such a network organization, which will thrive on finding new ways of handling things, would not only be costly but counterproductive. Gomes-Casseres (1996) argued that an alliance is the way to govern open-ended contracts that contain "gaps." Alliances can use some form of joint decision making to deal with unforeseen circumstances. Alliances create loose groups of partners that remain separate parties, driven by their own interests. Each partner thus runs some risk that the other will act opportunistically and "defect" and work for himself without considering the alliance. Successful alliances depend on each member forgoing short-run opportunistic actions in the interest of maintaining the relationship, which they expect will yield long-run benefits (Buckley and Casson 1988). Like firms, alliances have to develop some degree of "trust" between transacting parties in order to work.

Measuring Performance of Supply Chain Management Alliances

Traditionally, performance measurement is defined as the process of quantifying effectiveness and efficiency of action (Neely et al. 1995) or systems with simple measures such as productivity, unit cost, or timeliness. It is easy to understand that such measures are not very useful in measuring the performance of the partners of an SCM alliance. However, from cybernetics we know that the control of production systems depends on feedback loops, a managerial principle that has been neatly summed up by Sink and Tuttle (1989): "The essence of management is that one cannot manage what one cannot measure." As is well known, performance measurements can also reveal "disconnects" in the system, improve motivation, diagnose problems, etc. According to Chan and Qi (2003) common problems in applying traditional methods to measure performance include: (1) being disconnected from strategic decision making; (2) difficulty in integrating financial and nonfinancial measures; (3) lack of system thinking, in which a supply chain must be viewed as one whole entity, and measured widely across the whole; and (4) loss of chain context, thus leading to local optimums.

Performance measurements of an SCM alliance need to cover every business aspect of the supply chain and, as such, provide an objective view of its performances as a seamlessly integrated production system. It is self-evident that in order to capture the reality overall performance of the system needs to be able to reach across organizational boundaries spanning all the stakeholders. Chan and Qi's (2003) concept model brakes the chain into subprocesses (e.g., inbound logistics) each having its own set of mea-

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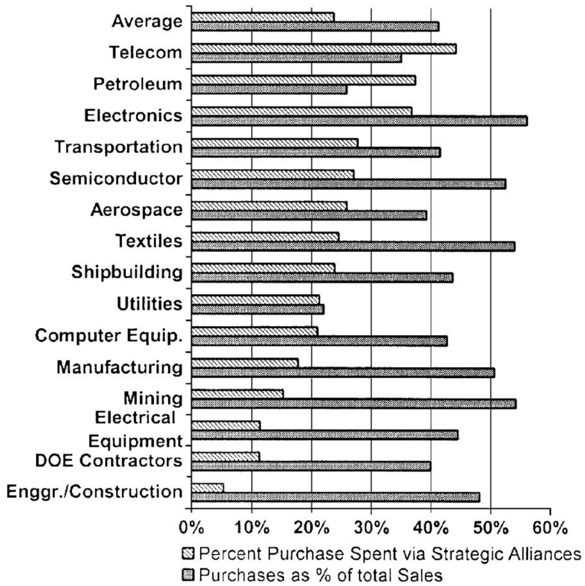

Fig. 2. Use of alliances by industry sector (2001)

sures and weights. Through the use of fuzzy-sets, the model allows the inclusion of human judgment with its inconsistency when asked to assess fuzzy situations.

As will be discussed later, the lack of "tested" performance measurement represents a critical weakness for the companywide adoption process. There is an inherent skepticism by individuals who resist change when one cannot show data that proves that the new approach, SCM, is benefitting the company now and in the future. The following section will provide a comparison of how different industries embrace supply alliances.

Supply Chain Management Alliances by Industries

Each company buys goods and services, ads value through processing the goods, and sells the resulting products. The chart shown in Fig. 2 provides data collected by CAPS Research Inc. (2003) which dollars provides two interesting ratios. The first indicates the percent of the sales in United States dollars that has been purchased from other sources while the second shows the percent of purchases that were done using alliances.

Overall, the 15 different sectors spent 41% of the sales on purchases and 24% of those purchases were done using alliances. With 44%, the telecommunications industry was by far the most active in the use of supplier partnerships followed by petroleum with 37%, which not surprisingly spends only 26% of its sales on purchases. Looking at how the construction industry compares, one realizes that it spends an amazing 48% of its sales on purchasing material, equipment, etc. Most peculiar, of course is the fact that it is, with 5%, last when it comes to using alliances. This low number is even more revealing if one understands that 83% of the sampled companies work in the industrial and an additional 9% in the commercial sector. In a comparative study that included 288 firms in the United Kingdom, Quayle (2003) found a similar distribution which showed 15% of the construction industry uses supply chain management compared to 25% of the manufacturing and high tech sectors. The study also identified common reservations concerning the use of SCM alliances that were mentioned: (1) 80%—overcoming traditional practices; (2) 70%—insufficient knowledge of supply chain management; (3) 60%—cost; (4) 55%—lack of time to train; and (5) 45%—lack of resources.

While it is beyond the scope of this paper to analyze why the construction industry shows such a low interest in supplier alliances, a recent United Kingdom study by Quayle (2003) hints that the entrenched low-bid mentality may be the main contributor to the apparent discrepancy with other main-stay industries.

Supplier Alliances in Construction

In the 1980s some of the construction companies in the United States established project based partnerships that were dissolved after completion. "Partnering" typically included the owner and the EPC contractor and was only implemented after the construction contract had been competitively bid on. There was no opportunity for the EPC contractor or supplier to have input into the design. As an alternative to the limited amount of collaboration supported by partnering the concept of alliances evolved. In its definition CII in 1993 adopted most of the already recognized critical elements and stated that the alliance was: "a long-term association with a nonaffiliated organization, used to further the common interests of the members. The continued association is based upon mutual trust and the satisfactory performance of each participant, and the alliance as a whole, rather than a pure contractual obligation" (CII 1993a). Another report from the same year CII 30-1 (CII 1993b) categorized the benefits of alliances into three major groups dealing with marketing, project execution, and organization and states: "Forming alliances with material suppliers can ensure consistent quality, reduce cost, and improve delivery. This becomes increasingly important as customers demand compressed project schedules" (CII 1993b). The report also identifies characteristics of a well structured alliance: "(1) the alliance produces a comfortable atmosphere built on trust; (2) the purpose of the alliance is clear; (3) cooperative spirit exists among alliance partners; (4) the risks are identifiable and affordable; and (5) the alliance complements the strengths of each partner" (CII 1993b). It is interesting to note, however, that the list does not include an emphasis on the need for a cross-boundary management of the supply chain and the lack of a performance assessment effort.

In 1998, a government-sponsored review of the United Kingdom construction sector called for the adoption of initiatives from the manufacturing industry in order to increase productivity and reduce costs. The report suggested a stronger and more comprehensive role for the evolved construction supply chain because of its recognized importance in driving innovation and in sustaining incremental improvements in the sector's performance (Egan 1998). One response to this call was the Reading Construction Forum (RCF 1998) which suggested "second and third generation partnering" schemes. In the third and most progressive generation of partnering the construction firm would be building virtual supply chains that are efficient, creative, and innovative.

Exposing Barriers to Successful Implementation

In a typical construction supply chain, the general contractor is considered the center hub, linking the client, designers, subcontractors, and main suppliers. In that sense, it resembles a common project organization in the United States. As was pointed out, however, SCM alliances depend heavily on trust leading to open and real time communication across all organizational boundaries and an overarching management applying performance measures for control. As several research efforts have shown, these two requirements are very difficult to implement in construction. For

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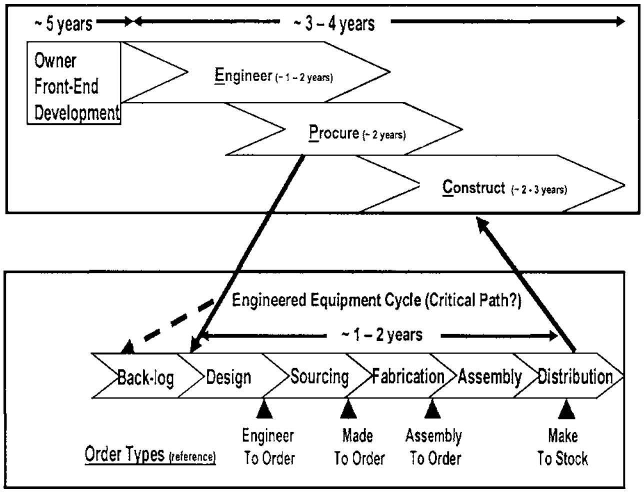


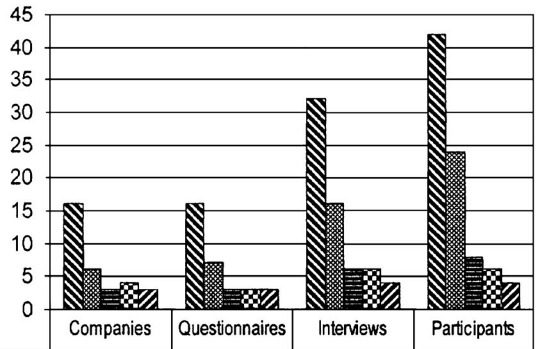
Fig. 3. Capital projects timeline

example, Dainty et al. (2001) found that: "Whilst they (contractors) acknowledged the benefit of project-specific partnerships with clients, these were not seen as applying to downstream supply chain linkages. The lack of trust between the parties, grounded in many years of adversarial working, was also seen as the fundamental barrier to the increased understanding of each other's needs." Resistance to change was also found within companies where some functional areas felt that they themselves had implemented the SCM principles while they blamed other areas within the same company for being obstructive. The 20 suppliers and subcontractors that were interviewed listed a series of complaints that mentioned the lack of trust and also the lack of open communication. "Problems included missing, late, and inaccurate design information, and a general ambivalence towards subcontractors' needs for accurate and prompt project-related data. There was also believed to be a general reluctance to draw upon the expertise of specialist subcontract and supplier companies when resolving problems occurring during projects… . Price remained the primary criterion in subcontractor appointments, and main contractor staff focused on cost issues rather than identifying the added value that a supplier company could offer" (Dainty et al. 2001). The latter finding correlates with observations made when the selection criteria used by purchasing was compared with those of site management (Bernold and Treseler 1991).

Experiences with Capital Projects Supplier Alliances

There are five major equipment item categories on a liquefaction natural gas plant that account for approximately 25% of the total project cost and represents 50% of the materials and equipment budget. Procurement of engineered equipment has traditionally been done using the lowest technically qualified bid process but several large contractors, owners, and suppliers have been involved in supplier alliances. Fig. 3 shows the overall engineer–procure–construct (EPC) timeline with a breakout of the engineered equipment manufacturing schedule. Very often major equipment will lie on the critical path of the overall capital project schedule. It was noted that the normal competitive bid selection process, as a component of sourcing, can take from 4 to 6 months from initial inquiries through supplier selection.

The reminder of this paper will present the results of a study that was designed to identify the state-of-practice and the experiences of 16 companies, represented by 42 experts, with the use of supplier alliances.



	Companies	Questionnaires	Interviews	Participants
Total	16	16	32	42
EPC	6	7	16	24
Owner	3	3	6	8
Supplier	4	3	6	6
Other	3	3	4	4

Fig. 4. Overview of data sources

Data Collection Methods

As shown in Fig. 4, a total of 16 companies participated in this study. The study involved 42 representatives from these companies. Two of the three owners were from the petroleum and one from the electric energy sectors. Four suppliers were represented by six respondents. It was determined that it was necessary to collect a combination of quantitative and qualitative data. In order to obtain quantitative data questionnaires were designed, distributed, and filled out by 16 experts. The questionnaire had four main sections: (1) opportunities and benefits, (2) contracting, (3) metrics, and (4) barriers to supplier integration. Qualitative data were collected via 32 personal interviews with industry experts either through face-to-face or phone conversations. The interviews were semistructured and relied on a set of standard questions that focused on: (1) current process: Respondents were asked to describe how major equipment items are procured today and to discuss any alliance agreements; (2) reengineering the process: Respondents were asked their opinions on identifying ways to improve supplier integration; and (3) future strategies: This was an open-ended question that looked for new ideas to improve supplier integration for major equipment items in capital projects. The average interview lasted 1 h. The initial interviews with eight companies revealed that supplier alliances had not always been successful. Thus, the final questions (survey/interview) focused on identifying critical success factors and barriers in three key areas: (1) development, (2) measurement, and (3) management.

Opportunities and Benefits

Both the questionnaires and the interviews showed two main benefits of integrating suppliers early on: (1) reduction of cycle time and (2) improvement in quality.

Cycle Time Reduction

Ninety four percent of the respondents felt that cycle time reduction was considered a more important benefit than cost, which

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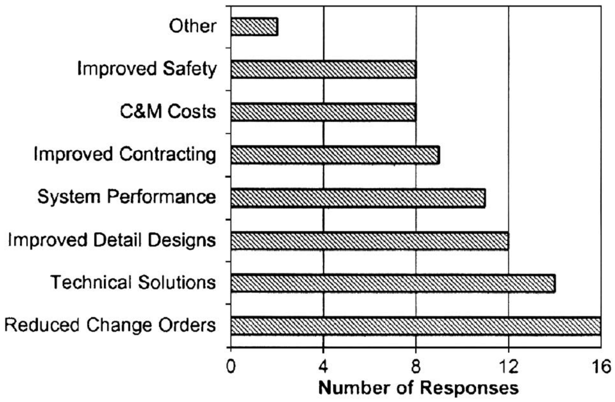

Fig. 5. Benefits due to higher quality

was listed by 75%. The owner gets the facility to start quicker production; the EPC contractor can redeploy their assets to another job sooner; and the supplier can better utilize their resources by minimizing the start and stop cycles common to the traditional procurement process. In general, time savings with alliances were largely attributed to isolating the equipment procurement process (selection, terms and conditions, pricing) from the project schedule to a multiproject, strategic level. The following comment of an interviewee summarizes the common feeling of experts: "Early supplier integration may actually result in higher initial CAPEX (capital expense) costs; however, scope is better defined prior to project execution—thereby reducing mid-project change orders. Early integration also allows design/constructability reviews to take place early to enable scope/functionality optimization, schedule flexibility, and/or production manufacturing slot optimization. All of these can lead to reduced manufacturing costs. Finally, early supplier integration can result in improved field operability and/or maintenance of a piece of equipment, thereby reducing the overall total life cycle cost."

Quality Improvement

As Fig. 4 indicates, 16 respondents felt that increased quality would go hand-in-hand with fewer change orders that result from design errors that are detected during construction. Fourteen experts also believed that better technical solutions would be possible, resulting in better performance of the final system.

Cost Savings

As Fig. 5 shows, the most frequently selected range for initial price reduction was 6–10%. This is consistent with results from a study conducted by CII which found that improved supplier involvement could produce 4–8% cost savings of the traditional EPC process (CII 1998).

As indicated in Fig. 6, a significant number of respondents felt that cost savings in the range of 1–5% could be achieved in installation, startup, and warranty during the construction period. A few experts commented that additional savings could be realized in engineering, which is not considered as part of the sourcing cycle in Fig. 3. One contractor estimated that supplier integration in the engineering phase could reduce the EPC's engineering time, saving 10–20% on the cost. A supplier went even further by claiming that their early involvement could reduce engineering cost by as much as 40%. Cost savings in engineering appears to be a significant saving that needs further study.

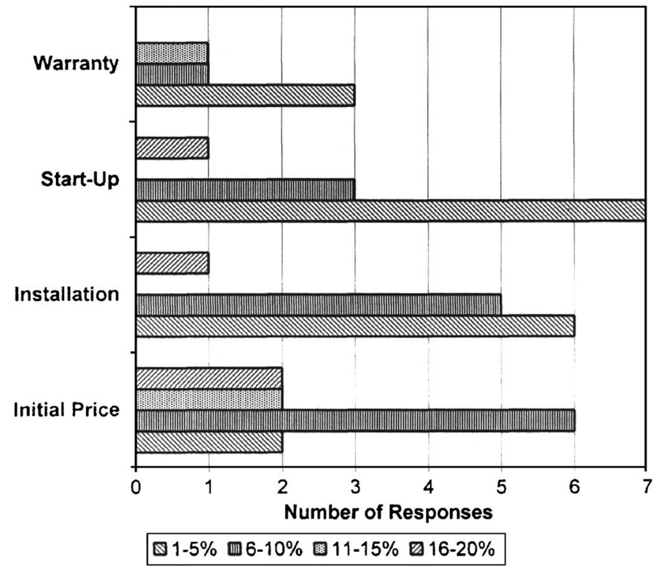

Fig. 6. Range of possible cost savings

Contracting

Most contractors that decide to form an alliance start the selection process with a questionnaire. The first question asks if you are interested in an alliance. This is followed by several questions that help determine the supplier's quality and financial condition. Most selections do not focus on price at this early stage. The initial questionnaire can be followed up with another questionnaire, site visits, negotiations, etc. All of these factors contribute to the length of time that it takes to establish an alliance. Most respondents said that it could take up to 1 year to establish an alliance agreement. While this study did not focus on studying the partner selection process it was noted that several contractors require their suppliers to meet the applicable International Organization for Standardization certifications for quality management practices.

There was a widespread agreement that an important task in any alliance agreement is to align the partner's goals. Defining each party's expectations of the alliance at the beginning makes a world of difference in the execution of the alliance. On the other hand, the term "alliance" has gained a negative "reputation" because early agreements were viewed as only benefitting the supplier. Some companies have renamed their alliance agreements to focus on the key aspects of the agreements. Some new alliance names include: "preferred supplier agreements," "supplier relationship agreements," "supplier agreement," or "partnership."

Respondents were asked to rank in order the top three contracting tools that could improve the integration of suppliers in large-scale capital projects for major equipment items. The top four selections based on a weighted score are: (1) cost sharing agreements, (2) target costing, (3) total cost of ownership, and (4) long-term contracts. Fig. 7 presents a schematic overview that positions alliances relative to other cooperative business arrangements. The model considers three factors in placing these cooperative agreements: (1) ownership commitment, (2) project commitment, and (3) supply chain integration.

Ownership commitment is a major differentiator between alliances and joint ventures or mergers. Alliances and joint ventures can include single (tactical) or multiple (strategic) project focus. Partnering is viewed only as a single project event on one extreme

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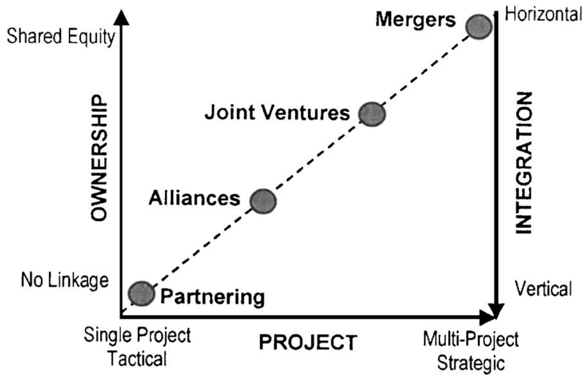

Fig. 7. Capital projects alliance spectrum

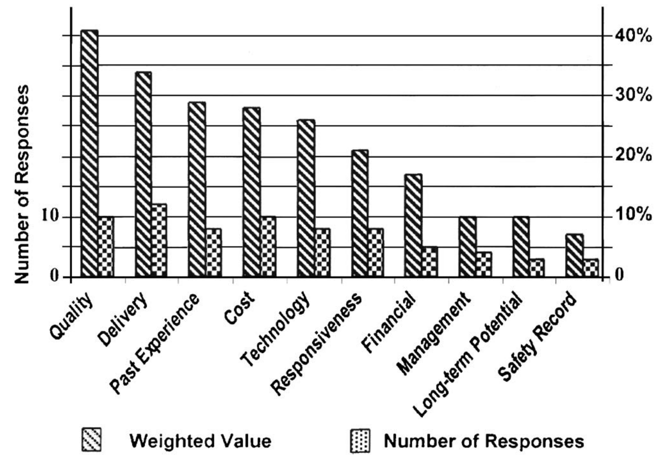

Fig. 8. Ranked overall performance measures

and mergers, including a multiproject focus, on the opposite extreme. Supply chain integration is the third factor of consideration. Alliances, joint ventures, and mergers can include horizontal integration with similar type companies or vertical, integration with upstream or downstream customers in one's supply chain.

Alliance Management

The goal of alliance management is to maintain the alliance. A concern expressed by many companies is that one partner could run into unforeseen problems and bind everybody else. Major worries included: (1) a nonalliance partner developing a new technology that would significantly change the marketplace; (2) a partner running into financial difficulties; (3) not getting competitive market prices from an alliance member; and (4) loss of flexibility due to high switching cost. It is apparent that the goal of managing the alliance would have to develop mechanisms that would allow the alliance to deal with future problems. In fact, most companies interviewed are holding quarterly alliance meetings that involve senior management and line staff to review goals and establish cost, quality, and health/safety/environment targets. One company uses a standardized supplier evaluation process. If poor performance is identified, the company will send a supplier development team to help identify and implement improvements. None of the companies interviewed discussed the dissolution of an alliance agreement.

Performance Metrics

Contractor were asked to rank their top five measures which they use to assess the performance of their suppliers. Fig. 8 presents the feedback in total number and weighted responses. The top five performance measures were: (1) quality of work, (2) delivery delays, (3) past working relationship, (4) cost competitiveness, and (5) technological capability.

It is interesting that safety record was considered less important than financial stability and management skills. While Fig. 7 shows only the response of the contractors participating in the survey, the conducted interviews showed that the supplier adopts a different set of measures. Some of the metrics that suppliers use to assess the contractor include: (1) deviations from common terms and agreed specifications; (2) timing of changes to equipment specifications; and (3) adherence to payment schedule.

Barriers to Supplier Integration

Conflicting goals and the required trust were the top two responses (based on a weighted score) when the respondents were asked to rank three out of seven options such as: (1) lack of management commitment, (2) lack financial incentives, and (3) inadequate information sharing. The fact that conflicting goals is considered the key barrier to supplier integration adds more importance to the establishment of a "healthy" alliance with a common vision, common goals, and a win–win working relationship. The third problem that surfaced was resistance to change, an issue that was ranked highest in a similar survey conducted in the United Kingdom (Quayle 2003).

Summary and Conclusion

The economist Joseph Schumpeter used the phrase "creative destruction" to describe the growth process of a healthy economy that displaces old ways of doing things with new more productive ones. As this paper points out, the construction industry has difficulties in displacing the old "lowest bid" attitude with partnerships that have proven so effective in other industries. As a result, engineering and construction is comparatively slow in using alliances for purchasing engineered equipment and materials. Studies in the United Kingdom showed that the barriers to creating alliances and partnerships reach from a lack of trust, to not wanting to change.

The paper presents a study, in which 16 companies in the capital project market participated, to investigate the industry's assessment of key issues concerning supplier alliances. Four areas of interest stood out: (1) What are opportunities and benefits?; (2) what types of contracts are most successful?; (3) what managerial rules and metrics are most useful; and (4) what are barriers to supplier integration? After analyzing the survey questionnaires as well as face-to-face interviews a series of assertions pertaining to each of those four areas were made. Some of those findings include: (1) supplier alliances result in price savings on engineered equipment from 6 to 10%: (2) time savings of 4–6 months are easy to achieve by eliminating the competitive bid cycle for every engineered equipment order covered by a supplier alliance; (3) the cost of engineering will be significantly reduced (40% according to one supplier); and (4) less design errors/change orders will

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occur because the suppliers' specialized expertise will feed into the design process from the beginning.

While the potential benefits are substantial, the culture of a supplier alliance requires an almost 180° change of direction since it depends on trust between partners, open and fast communication across company boundaries, and the establishment of common goals to create an arrangement that treats everybody fairly. Why should I suddenly share my cards with my former foe? As surveys in the United Kingdom have shown, the last question is the key barrier for smaller contractors while capital project participants feel that the difficulty in identifying common goals is holding them back.

There is an overwhelming agreement that alliances need to be managed and their performance assessed in order to work successfully. It is understandable that each partner will have a separate set of metrics while the alliance has its own. The most important metrics to assess suppliers, mentioned by contractors, are quality, on-time delivery, and past working relationship.

Not every company is "made to join" an alliance. Thus, a company needs to conduct a self assessment, and define its own goals, strengths, and weaknesses including the skill of its own people to participate in an alliance. This study as well as the result of the United Kingdom surveys highlighted that training strategies are critical to engender the necessary cultural change within each partner. Specific training programs in interpersonal skills, communication, performance assessment, team building, and an understanding of the partner's business are as essential as a knowledgeable and supportive upper management. As some crashes of past alliances demonstrate, the "creative destruction" of the adversarial working relationships in construction is risky for those who are running into it without proper preparation and managerial nourishment. The strong sentiment of most of the interviewees of this study, however, led us to believe that the switch from a "zero-sum" to a "win–win" business culture is inevitable.

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