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Effectiveness of Ongoing Alliances Between Operating Companies and Engineering Companies in Western Canada

by

He Zhang ©

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Name of Author: He Zhang

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8-1-301, BeiWuCun, Tianjin

P.R.China, 300073

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University of Alberta

Faculty of Graduate Studies and Research

The undersigned certify that they read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled *Effectiveness of Ongoing Alliances Between Operating Companies and Engineering Companies in Western Canada* submitted by *He Zhang* in partial fulfillment of the requirements for the degree of *Master of Science* in Engineering Management.

Peter C. Flynn

Peter Flynn

Ted Heidrick

Hartman

Francis Hartman

Sept. 1, 2002

Abstract

Operating companies have formed ongoing alliances with engineering contractors to support engineering for revamp work in operating plants. For the operating company, the alliance is a means to reduce overhead through elimination of cyclical work, allowing the company to focus on its core business. Ongoing alliances are different than traditional alliances, in that revamp work is harder to estimate and more likely to grow in scope and cost than new capital projects. Hence, ongoing alliances are fertile grounds for breeding mistrust. The study of five ongoing alliances found three distinct types of alliances. Operating and engineering companies have different motives for forming the alliances. Factors contributing to and impairing success are reported. The study also reports varied satisfaction levels and goal differences between partners, between different levels of staff and among different types of alliances. Best practices and learnings are summarized.

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Chapter 1 Background

1.1 Existing Theories and Studies of Alliance

In the past 20 years, some profound shifts in engineering have occurred in operating companies in the petrochemical sector, such as Imperial Oil / Esso Resources, Dow Chemical, Shell Canada, etc. As cost competitive pressures built in the 1980's, operating companies began to downsize their internal engineering functions and to increasingly outsource engineering and project management functions that had formerly been done by internal staff.

In the continuing evolution of the relationship between operating companies and engineering contractors, two trends developed: alliances for small project work in operating plants, and partnerships for the execution of large projects.

There are many ways for companies to extend their enterprises through each other. Harbison and Pekar (1998) described the term *Alliance* in a very broad way, from transactional alliances to permanent relationships. This is a time-based approach of defining alliances. Nowadays, many alliances focus on a middle ground between transactional alliances and acquisitions, which are called "strategic alliances" or "long-term alliances".

Strategic alliances in many references have a blurred definition of their characteristics. This can vary from "information sharing, resource and funding sharing to cross-equity and shared equity" (Harbison and Pekar, 1998). The alliances studied in this thesis focus on those between engineering companies and operating companies for ongoing plant maintenance and turnaround work in continuous operating plants. This is a kind of long-term outsourcing relationship with both information and resource sharing.

1.1.1 Alliance as strategic outsourcing

Strategic outsourcing is a way that helps the operating companies focus on their core competencies. Mintzberg and Quinn (1996) summarized the existing research related to this field. The basic idea behind core competencies and strategic outsourcing has been well supported by research extending over a 20-year period (Quinn and Hilmer, 1994). Since 1974, many studies have indicated disaggregation strategies in many industries (Rumelt 1974; D'Aveni and Illinich 1992; Barreyri 1988). Some scholars noticed that highly successful companies do not need to be vertically integrated (Maloney 1992, Miles and Snow 1986). Quinn and Hilmer (1994) suggest that many companies can substantially leverage their resources through strategic outsourcing by:

- Developing a few well-selected core competencies of significance to customers and in which the company can be the best in world;
- Focusing investment and management attention on the core competence; and,
- Strategically outsourcing many other activities where they cannot be or need not be best.

1.1.2 Alliance as contracting strategy

Another "commitment" based approach (Badger and Dean, 1991) defines a strategic alliance as "contract work together toward a common goal for their own, and each other's 'common good'". Since one of the main drives of developing an alliance is to reduce the frequent and cumbersome burden of bidding and contracting, some scholars discuss an alliance as a contracting strategy (Cook and Hancher, 1990). The alliance, as a means of "contracting for the future", has many key elements including commitment, trust, mutual advantage and opportunities. Maintaining a functional organization between partners through a contract is very important (Badger and Dean, 1991).

Although the alliance advantages are often discussed in references (Doz & Hamel, 1998) as "a logical and timely response to intense and rapid charges in economic activities, technology and globalization", the strategic alliance is little studied after its identification, valuation and negotiation are done. But in the real world, there are many factors arising after these that are very important for the alliance success. The sustainability of a competitive advantage is not based solely on formation of an alliance but also on the superior operating and implementing skills or processes.

1.1.3 Alliance as a partnership continuum model

Dent (1999) in his book "Partnering Intelligence" presented a "partnership continuum model" to form and maintain healthy successful and mutually beneficial partnerships on a "process" basis. The model includes three components:

- Stages of relationship development (Forming → Storming→ Norming → Performing)
- Stages of partnership development (Assessing → Exploring → Initiating → Committing)
- Past/ Future orientation environment

Dent's view is that the "forming" stage is the time to "clarify the issues and dynamics of the relationships"; usually in this stage people are generally polite to each other. But when the "storming" stage comes, "a clash of ideas and behaviors creates the conditions of conflict". The "norming" stages occurs when partners "identified their own needs", "the value and norms of behavior have integrated into the culture of the partnership". So when the "performing" stage comes, people "perform at highly creative, efficient, and productive levels. The partnership achieves goals that often exceed expectations at the outset".

Dent also argues, a partnership starts with an "assessing" stage. The first stage enables people to "examine their own readiness, willingness, and ability to engage in the process". In the second stage, "exploring areas of common interest and mutual benefit will balance the partnership at the outset." When the "initiating" stage comes, partners can "work one step at a time to test and build the partnership". As they gain more trust and efficiency, partners will "make more commitments and strengthen the partnership" in the fourth stage, the "committing" stage.

This model gives some attention to enhancing partnering skills, such as comfort with change and interdependence, win-win orientation, ability to trust, and self-disclosure and feedback. But the model considered the process and skills of managing an internal team or an external business alliance as the same. How people interact with each other determines the success or failure of a partnership, but the reactions of people dealing with problems with "our people" or "their people" are not always identical.

A summary of Alliance Models is shown in Table 1-1.

Table 1-1 Summary of Alliance Model in References

Representative Authors	Main View Points
Cook and Hancher (1990)	• Partnering is a contracting strategy • Key elements of partnering are commitment, trust and mutual advantages and opportunities • Concerns on partnering strategy development, partner selection, contract negotiation and implementing a partnering agreement
Harbison and Pekar, 1998	• Four stages of alliance methodology: identification, valuation, negotiation and implementation. • Four stages encompass eight activities: defining strategy and objectives; screening for partners; assessing tradable and leverage; defining opportunities; assessing the impact on stakeholders; assessing bargaining power; planning integration and implementation.
Dent, 1999	• A partnering continuum model based on "process" • The model, the process and the skills are the same whether focused on managing an internal team or an external business alliance • Six hallmarks of success include: active support of leaders; appropriate team membership with equal participation; common objectives; clear boundaries and scope; consensus and openness; trust and mutual benefits.

1.1.4 Drivers and risks of alliance

An alliance has both advantages that lead to its formation and risks that have to be considered. Table 1-2 summarized the viewpoints from the literature on the business drivers and risks for alliance.

Table 1-2 Drivers and Risk Analysis of Alliances

<table>
<tr><td><u>Business Drivers for Operating Companies:</u>
• Effective utilization of personnel resources: increase flexibility of owners and gaining a diversity of talent which is not usually found in a single company (Cook and Hancher, 1990)
• More efficient production at low cost (Badger and Dean, 1991)</td><td><u>Business Drivers for Engineering Companies:</u>(Cook and Hancher, 1990)
• Stable revenue and less potential of claim or litigations.
• Opportunity to refine and develop new skills in a controlled and low-risk way.</td></tr>
<tr><td colspan="2"><u>Mutual Benefits</u>
(Cook and Hancher 1990)
• Improve project quality by replacing the adversarial atmosphere with an atmosphere of cooperation and mutual trust.
• Share the benefits of management and technical advances developed.
• Reduce litigation.</td></tr>
<tr><td colspan="2"><u>Risk Analysis</u>
(Cook and Hancher 1990)
• Company weakness and insufficiencies may be accentuated by mutual dependencies.
• Both operating and engineering companies need to evaluate the risk of loss of the commitment of shared information and resources when alliances fail.</td></tr>
</table>

1.2 Studies of the Construction Industry

1.2.1 Alliances in construction

Badger et al. (1992) discussed the characteristics of alliances in international construction. Five factors was summarized as success factors, including:

- Trust atmosphere
- Purpose clarity
- Cooperative spirit
- A well structure of alliance
- Strength complementation

Badger et al. also discussed the culture differences and argued them as "probably the most important" challenges in international construction alliances.

1.2.2 Control of construction project scope

In general, construction projects are "large, well-scoped, time-sensitive projects". But they still have the problem of "poor scope definition" at the time of budget ranking. O'Connor and Vickroy (1986) in their report to CII (Construction Industry Institute) mentioned the reasons why scope definition is a problem in construction projects and the way to solve them. Methods of control the scope changes are recommended in the report including:

- A work breakdown structure as a control tool
- Development of a computerized estimating system to reduce the ambiguity of conceptual estimates
- Reduction of early-stageproblems: owners' scope decisions based on the actual costs of the project.

All these efforts are possible for "large, well-scoped" projects. But for an ongoing, revamp work in operating plants, which have the characteristics of "small poorly defined scope", these approaches are often not practical.

1.2.3 Incentives in construction contracts

Ashley & Workman (1986) argued that incentives are good ways to "reward contractors for efficient project management, not for risk assumption" in construction contracts. They also argued that owners should refrain from passing all risks to the contractor. The purpose of the incentives, they argued is to "motivate the contractor to produce a system that will meet or surpass performance goals, on or before a target date, and within or at a target cost (Finchum, 1972)". Therefore, "competence must be the bench mark from which positive incentives can be set for performance which is clearly superior to the bench mark. (Carmody, 1977)". The ongoing alliances in continuous operating plants are different from the cases studied in Ashley and Workman's report in two aspects:

- They have high risk because of non-specific scope and high tendency of cost overrun.
- They are difficult to benchmark because of scope uncertainty and the novel "one-time" nature of most revamp works.

Therefore, incentives for engineering companies are one focus of the research.

1.3 Psychology of Group and Intergroup Relationships

An alliance is a long-term cooperation between two groups of people. Psychological work on intergroup relations began during the early 1940s when Kurt Lewin achieved a milestone, building on the work of Gordon Allport (Worchel and Austin, 1986). Since then, many theoretical viewpoints have emerged.

1.3.1 Social identity theory of intergroup behavior

A social group is defined as "a collection of individuals who perceive themselves to be members of the same social category, share some emotional involvement in this common definition of themselves, and achieve some degree of social consensus about the evaluation of their group and of their membership in it" (Tajfel and Turner, 1986). Tajfel and Turner also mentioned that "identity" and "competition" are critical in Social Identity Theory. Campbell (1965) referred to a "Realistic Group Conflict Theory" by Sherif (1958), which provides a cause of intergroup hostility, and a theory of competition as realistic and instrumental in character, motivated by rewards. Here, "competition" is identified with a win-lose strategy. Fiedler (1967) pointed out that intergroup competition might enhance intragroup morale, cohesiveness and cooperation.

1.3.2 Bias in the evaluation of in-group and out-group performance

Bias in the evaluation of in-group and out-group performance is natural. Perhaps the most popular and recognized phenomenon is called "ethnocentrism". Early in the 1960s, Sherif et al. (1961) and Blake and Mouton's (1961) studiesidentified a strong tendency for people to "rate in-group performance more favorably than out-group performance". Schopler et al. (1974) also mentioned that, consistent with the "self-enhancement" hypothesis, in-group product ratings were "higher when made publicly than when made privately". In addition, Bass and Dunteman (1963) suggested, "it is group failure rather than group success that alters in-group and out-group performance ratings". Since an alliance is a relationship between two groups of people, it is not surprising to see bias in the evaluation of in-group and out-group performance in this relationship.

1.3.3 Intergroup cooperation and conflict

An alliance is a fertile soil for intergroup conflict, particularly if it has an uncertain scope and difficulty in applying predefined performance measures. Psychological studies suggested several approaches to conflict reduction (Worchel, 1986).

- Communication withdrawal is one of the effects of conflicts that was argued by Newcomb in 1947. Also, in 1954, Allport argued, "prejudice may be reduced by equal status contact between majority and minority groups in pursuit of common goals". Worchel (1986) suggested, "Simple contact is not the panacea for intergroup conflict reduction. While some contact and intergroup communication is probably a necessary condition for the reduction of conflict, it is also an important ingredient in the generation and escalation of conflict. A wide variety of conditions will influence the effect of contact on intergroup relations."

- "Having group leaders and representatives meet together to reach solutions to intergroup conflict" is another approach that Worchel (1986) suggested. Blake and Mouton (1961) found that the representatives may "have difficulty reaching an agreement, and when an agreement was reached, the group often rejected it." Thus, the effectiveness of this method needs further study.

- Intergroup conflict could be reduced by an external threat but this common-enemy approach sometimes may lead to only a temporary reduction, or even worse, lead to an escalation of conflict. (Sherif et al., 1961). Worchel (1986) suggested a further study to explore whether the temporary harmony created by the common enemy could be exploited to lead to a more permanent reduction of conflict.

- An attitude or gesture of "extending a helping hand" can function as a sign that an end to conflict is desired. (Huesmann and Levinger, 1976)

All these efforts focus on ways of enhancing the effectiveness of intergroup cooperation. But Worchel (1986) suggested that cooperation is not a "cure-all" for conflict. There are some conditions determining the effect of intergroup cooperation including:

- Cooperation between equal parties is likely to reduce conflict and hostility.
- Reinforcement Theory applied in intergroup relationship shows that the negative outcome "could lead groups to form negative associations between the other group and the outcome" (Worchel, 1986).

1.4 The Life Cycle of Groups

An alliance has two aspects to its relationship. First, there is a relationship between two or more than two groups of people with different backgrounds and different status in the alliance. Second, no matter how different they are, people from different groups have to cooperate and work as "one" group. Lacoursiere (1980) shows five general development stages of a group, which he called "Group Developmental Stage (GDS) Theory":

- Orientation Stage. At this stage, participants are "mildly to moderately eager" with "a certain amount of anxiety and concern". Normally, they have positive expectations for the group's development.
- Dissatisfaction Stage. This is the stage where participants find that reality does not coincide with their expectation. Frustration arises because of the uncertain scope of the task, the difficulty of defining performance measures, and the question about group members' technical competence.

- Resolution Stage. "What happens in this stage is some rapprochement between expectations and the realities and also some increase in skills to complete the task". The "Dissatisfaction Stage" and "Resolution Stage" are considered as stages for group members to "encounter with reality" and "bottom out", which enable future progress.

- Production Stage. This stage is a group-oriented activity with a social-emotional tone. Members are "working well together with satisfactory agreement- implicit or explicit- about the nature of their relationships".

- Termination Stage.

The GDS theory shows that participants in an alliance will go through "a sequence of feelings and reactions characterized as general development stages". This explains why different types of alliances have similar tough early years. This phenomenon is analyzed in detail in Chapter 6.

1.5 Trust in Different Cultures

Badger et al. (1992) discussed the culture differences as "probably the most important" challenges in international construction alliances. In detail, Fukuyama (1995) specified "trust" is a culture issue and discussed how it related to the global economy. He grouped US, Germany and Japan as "high trust" societies and Italy, France, Korea and China/Taiwan as "low trust" societies. He argued that "the future is the network organization" thus giving high trust societies a natural advantage.

Moreover, "a high level of trust in a society facilitates productive activity for all sizes of organizations by reducing risk and the need to expend resources accumulating information about business counterparts." "Trust within organizations fosters cooperative work in teams and thus creative feedback and innovation."

This study focused on the alliances with continuous operating plants in western Canada. As discussed in Chapter 3 and Appendix IX, most of the participants in this study are multinational companies, but the staff surveyed are Canadians and would reflect a Canadian view of working relationships. Therefore, results cannot be generalized to alliances for ongoing work in other cultures or countries. The influence of culture differences on the alliance relationship is not evaluated in this work, but would be an opportunity for additional research.

1.6 Type of Issues in Alliances

There are three types of issues in an alliance.

- Congruent - both sides want the same outcome
- Distributive- if one gains the other loses an equal amount
- Integrative- if one gains the other loses a lesser amount

At the initial stage of the alliance, which is still in a "contracting" atmosphere, it is not surprising that both partners treat all the issues of the alliance as distributive ones- as what your company gains is what we lose ("us and them" problems). Thus, the perception of mutual gains for both sides is very important for forming a mature alliance. The "real" alliance relationship is not set up until both sides recognize the importance of their long-term relationship, put themselves on the other's shoes, and begin to look for the shared interest of both companies.

Chapter 2 Characteristics of the Engineering Alliance for Ongoing Work

2.1 Background of Engineering Alliance for Ongoing Work

Energy and chemical plants typically run on a continuous basis for one to two years cycles, with an intense "turnaround" to do necessary maintenance and capital work that cannot be completed when the plant is operating. Capital projects usually include debottlenecking (increasing the capacity by eliminating production limitations), efficiency improvements, and safety and operability improvements.

Increasing the capacity of such plants by debottlenecking is one of the key drivers of profitability. Limiting the duration of turnarounds is another key driver of profitabilitywhich, often conflicts with the drive to debottleneck.

The engineering workload for an operating plant can vary widely. It typically cycles between turnarounds, with all engineering being completed and turned over to construction well in advance of the turnaround, so that intense construction planning and preparation can minimize the duration of the turnaround. Engineering workload also varies from one turnaround to another. For example, a facility with a replacement capital value of $1 billion may have capital projects during a turnaround of as little as $3 million and as much as $200 million, depending primarily on the opportunities that exist for debottlenecking and the demand for increased throughput.

At one time, operating companies had significant engineering resources "in house", and would do much of the work to support both maintenance work and capital projects during a plant's turnaround. An engineering contractor would be retained for a major new capital project, such as a new plant or new unit within an existing plant, but once a plant was commissioned the ongoing engineering would shift to the operating company. However, in the last 30 years a major shift has taken place in most operating companies; they de-staffed their engineering functions and passed this work on to engineering contractors. This led to some changes in the nature of the relationship between operating companies and engineering contractors, and has led to a unique alliance relationship.

2.2 Drivers and Motivation for Alliances

From the perspective of an operating company with a continuous operating plant, providing a steady workload for internal engineering resources by leveling of engineering work is a major problem. Between turnarounds, engineering work peaks often about six months before the actual turnaround. By about three months before the turnaround engineering work itself is usually complete and whatever engineering resources are still required have shifted to construction planning. The duration of periods between turnarounds has extended from one to two years, resulting in more engineering downtime, when engineering activity is low (for example first stage or conceptual engineering). During these periods resources required for detailed engineering are often idle.

When intense cost pressures hit operating companies in the 1970's and 1980's, many critically looked at the need for in-house engineering resources and the alternative of outsourcing. Outsourcing may help an operating company to:

- Transfer the responsibility for load leveling.

- Build up a "lean" business and concentrate on its core competencies.

The operating company received other benefits as well. For example, it could tap specialized expertise such as rotating equipment or fired heater specialists in the engineering company. However, the main drive for operating companies to outsource capital projects in an operating plant was, and still is, to reduce overhead by "just in time" use of engineering resources.

Engineering companies inevitably welcomed the work. For an engineering contractor, volume of work is the prime driver of fee and profit, and anything that increased the volume of work done in an engineering firm would be welcome.

In theory, engineering companies are more suitable for "leveling" work than the operating companies. Engineering companies are more clearly understood to be "hire / fire" shops that will lay off workers during sustained periods of low workload. Operating companies did not in the 1970's have this self-image, and most still do not. Operating companies are often focused on attracting most of their staff for long careers. They invest heavily in training and orientation. Having a subset of employees who are laid off on a periodic basis would conflict with the message to other employees that “we want you to stay and make your career with us”. Engineering firms, on the other hand, do not have the cash flow to sustain workers whose time is not being billed out, and few employees in an engineering company expect the company to sustain their employment when work disappears. Severance obligations are often unspecified in operating companies, and usually explicitly defined in engineering companies, which helps set expectations in employees.

When operating companies wanted to outsource engineering for capital projects in ongoing plants, many first tried a traditional strategy of bidding out individual pieces of work. The bid would specify what resources the engineering firm would apply to the project and the cost of those resources. This approach ran into three problems:

1. The scope of the work is very poorly understood for capital projects in ongoing plants, and hence it is hard to prepare a meaningful bid. A typical debottlenecking project starts as a concept that requires multiple reconfirmations during the initial phase of detailed engineering. For example:

    a. Often other restrictions are only discovered during detailed engineering, for example a pump or instrumentation capacity limit may not be fully appreciated during the conceptual engineering of a vessel revamp, or vice versa.

b. Site inspection will often reveal spatial problems or opportunities that were poorly grasped during conceptual engineering. Construction access often presents unique challenges.

c. Inspection of equipment often reveals additional problems that could not be identified at the start of engineering (wear and corrosion issues are often not appreciated until during the turnaround itself).

These factors lead to greater variability in cost estimates for capital projects in ongoing plants as compared to new major capital projects.

2. Bidding is a costly process and became a significant factor in the cost of small jobs. For a $500 million new capital project, bidding cost is minor compared to the engineering work and fees that will go to the successful bidder; the engineering firm can see the cost of bidding as the cost of doing business, to be absorbed in overhead. However, for both the operating company and the engineering contractor the proportional cost of bidding for a debottleneck project of $1 to 2 million becomes significant.

3. Perhaps most significantly, a portion of every third party engineering job is learning the operating company's standards (usually written), practices (often unwritten), and politics (always unwritten). This learning is affordable on a large job, but not on a small job. Familiarization with standards is a major cost

element in engineering a $2 million job. To lose this expertise after every job was a prohibitive cost for operating companies.

The alliance relationship addressed these problems, especially the problem of retaining the knowledge of company standards and practices. In an alliance relationship, an operating company "marries" an engineering firm for a fixed duration, renewable by mutual consent. The operating company agrees to give all (or most) of its capital projects in an ongoing plant to a single firm for a fixed period of time. There is no commitment to volume of work; rather, the operating company pledges that the engineering company will be the exclusive or preferred supplier of whatever work arises. From the views of both sides, this helps to improve project execution because it reduces the inefficiency of working with a new partner piece by piece. On its part, the engineering firm bids to get the alliance, identifying key resources that will be available or dedicated to the work and the rate at which resources will be charged. Ideally a core team stays dedicated to the operating company. This core team becomes intimately familiar with the operating company's specifications and procedures, and usually involves the key operating company staff in the review and approval of engineering work. Within the engineering company, this core team is a resource available to others who work temporarily on the alliance. The person temporarily assigned to the alliance does not need to learn the specifications from a cold start, he can ask a core team member. This unique resource of the alliance helps to boost the quality and cost effectives of engineering. At the same time, this may also help the engineering company in a bid on a large project, which is one of the drivers that motivates an engineering company to pursue the alliance.

Thus the alliance relationship for capital projects in operating plants quickly emerged because it offered the operating company the benefit of load leveling without the cost of having a third party engineering firm constantly relearning specifications and procedures. Over time, the core of engineers and technicians in an alliance become well known to the operating company. The core team often has site access to an operating plant on the same basis as an operating company employee.

2.3 Unique Issues in Alliances for Ongoing Work in Operating Plants

All relationships between operating companies and engineering contractors function best in a climate of trust (Hartman 1999; Romanhn and Hartman 1999). However, alliance relationships for ongoing work in operating plants have particular issues that can strain relationships if not managed. Key issues include:

- Traditional performance measures for work done by alliance engineering contractors are unreliable when applied to revamp work. When new major capital projects are undertaken there is often a base of information available on expected performance of the engineering contractor, usually expressed as engineering cost as a percent of total installed cost (TIC). Thus, refineries, units within refineries, power generation facilities and chemical plants can usually find a target for engineering cost based on past experience. The problem with revamp capital projects within operating plants is that all are virtually unique, based not only on unique debottlenecking or efficiency opportunities but also based on the state of surrounding equipment and the specific plant layout. Hence projects have a wide range of engineering requirements, and no consistent pattern emerges from job to job or even year-to-year. Thus, there is no objective measure of financial performance, which puts a strain on trust. Those suspicious of the performance of an alliance for ongoing work have ample opportunity to complain, and rebuttals are usually non-quantitative.

- The variable scope for each individual job creates further opportunity for mistrust. Many technical problems that arise are simply not predictable at the stage of conceptual engineering and initial cost estimate. For example, a compressor debottleneck was found in the detailed engineering stage to create a harmonic vibration that was specific to the original foundation design (which was fit for purpose at the original design throughput). Major foundation modifications were required, significantly changing the original cost and scope. This kind of change can only be detected in the later stages of detailed engineering when piping layouts are completed. In a second example, a burner revamp in a furnace experienced a major increase in cost when refractory was found to have detached from the furnace wall, requiring a far greater replacement program than initially projected by the operating company and the engineering contractor. To anyone familiar with debottlenecking, this change in scope is expected, but again it creates an environment ripe for suspicion and blame.

- Part of the appeal of the alliance to the operating company is the opportunity to shed the cost of engineering resources when they are not needed, i.e. to achieve a "just in time" allocation of engineering resources. However, the benefit of the retention of company specific knowledge requires that a core group of engineers and technicians be maintained. If the engineering company reassigns people to another company's project, it cannot simply pluck them back at the whim of the alliance partner, since the second company has some expectation of continuity of staffing. In mature alliances, this problem is recognized and the operating company and the engineering contractor work actively to ensure a base load of work for a core team who essentially stay dedicated to the operating company and are the nucleus of the expanded team as work builds up. However, in immature alliances, especially with companies who are placing extreme focus on cost containment within a short time period, the desire to de-staff and re-staff on whim creates powerful frustrations.

- Engineering staff are transient and lack of experience specific to the operating company's site. Even though an engineering alliance partner is relatively familiar with the operating company's standard, the alliance still cannot avoid the transient nature of an "external partner". This may be a tradeoff of the "just in time" nature of the alliance. In an immature alliance, this transient nature can become the source of cost, schedule, and quality problems. In a mature alliance, the operating company tries very hard to keep the core team of people in the alliance by providing a level of "secured" job load for their partner.

2.4 The Challenge in Alliances for Ongoing Work in Operating Plants

An alliance offers real benefits to operating companies: they provide a means to build a core group of knowledgeable staff that can be readily expanded during periods of peak demand, and they eliminate the need for the operating company to be a "hire / fire" in one part of its operation while promoting long term employment in another. Alliances offer real benefits to engineering companies in terms of diversity and volume of work and the reduction of costly bidding for small projects.

Realizing the full potential of alliances requires a constant effort to build trust and to avoid the many temptations of blaming and destructive behavior. When alliances are first created, they frequently follow a major reduction in operating company in-house engineering resources, and suspicion and complaint are often reflections of resentment in surviving operating company staff. Given the ongoing uncertainty of scope and the difficulty in estimating the cost of in-plant work, ongoing alliances are particularly vulnerable to blaming. But this study confirms that patient effort can pay off and build a long-term climate of trust, not only at the corporate level, but also within individuals working on the alliance.

Operating companies in alliances face a challenge of psychological change. At the initial stage of the alliance the operating companies are in a strong bargaining position. But as the two partners begin to integrate with each other, the operating companies start to have a kind of dependence on the engineering company. The more mature of the alliance, the more interdependence between the two partners. Not all the operating companies feel comfortable with this change. But as an inevitable fact, the operating companies have to accept the change and to be ready to act as a "real" alliance partner if they want the full benefit of the alliance.

In this thesis, a study of alliances in five operating plants is presented. The variety in alliance structure, the perceived success of the alliance by engineering contractor and operating company personnel, and what factors contribute to the success or failure of the alliance are also assessed.

Chapter 3 Study Methodology

In this chapter the methods that used to conduct the research are described. The following is the sequential procedure of the study:

- An extensive literature review regarding partnerships.

- A preliminary questionnaire to identify common themes and elements of alliance relationships between operating companies and engineering contractors. Open-ended questions are used.

- A second statistical survey incorporating the findings of the preliminary questionnaire and identifying the frequency of occurrence of success factors and problems in alliance relationships. Five-point or four-point scales are used in this survey.

- Selective interviews with staff within operating companies and engineering contractors to clarify survey responses, as needed.

- Critical analysis of the surveys and interview data, in particular trying to identify points of commonality and difference between operating companies and engineering contractors, between senior and working level staff, and among different alliances.

- Analysis of the results.

- Presentation of results to participants.

3.1 Survey Design

3.1.1 Purpose of the study

The purpose of the overall study is to assess the effectiveness of alliance relationships for ongoing turnaround and maintenance in continuous operating plants, and to identify key success factors, and best practices. Therefore, the Preliminary Questionnaire was designed to identify common themes and elements of the participating alliance. To identify common themes, open-ended questions were used. Information from the preliminary survey was used to help design the second follow up survey (the Statistical Survey). The objective of the second survey was to identify the frequency of occurrence of success factors and problems in alliance relationships

3.1.2 Participants

Five alliances with nine companies participated in the survey. Thirty responses were collected in the first survey and thirty-six responses were collected in the second survey.

Alliances that participated in the study are listed in Table 3-1. A brief introduction of companies that participated in the study is shown in Appendix IX.

Demographic analysis of individual participants is shown in Table 3-2. The survey coordinator (the senior participant in each company)nominated the participants.

Table 3-1 Alliances participated in the study

Operating companies	Engineering Companies
Esso Strathcona	Bantrel Co.
Shell Scotford Ltd.	Colt Engineering Co.
Suncor Energy Inc.	Fluor Daniel
Syncrude Canada Ltd.	Cosyn Technology (Owned by Colt Engineering Co.)
Dow Chemical Canada	SNC Lavalin Group

Table 3-2 Demographic analysis of individual samples

	# of participants from OC	# of participants from EC	Total #
# of senior managers	3	4	7
# of managers	6	5	11
# of senior engineers	8	6	14
# of engineers	1	3	4
Total #	18	18	36

3.1.3 Alliance factors

Factors studied in the preliminary questionnaire include:

- Scope of the alliance.
- Alliance experience.
- Alliance partner selection procedure.
- Alliance drivers.

- Level of satisfaction with the alliance.
- Alliance integration.
- Alliance performance measurement.
- Key success factors.
- Key factors that impair alliance success.
- Disadvantages of, or concerns with, the alliance.
- Conflicts and problem solving.
- Communication effectiveness.

Factors studied in the statistical survey include:

- Reasons for forming an alliance.
- The key factors of alliance success.
- Factors that impair alliance success.
- Disadvantages of the alliance.
- Alliance capabilities.

3.1.4 Implications of the study design

The study was executed under several constraints. The following are the key limitations and implications of the study.

The limitations of time

An interview approach was used for data collection. Participants were generally senior or experienced people with heavy workloads. Alternative approaches including the Delphi Technique and a grounded theory based method (with all their variants) were considered but discarded. The tradeoff was between a more rigorous theoretical methodology and the opportunity to gain richer data for subsequent analysis. Data richness was considered more important for this study.

The limitations of the participants' knowledge

In order to get diversified samples for the study, the participants were selected from different levels of the companies, with different work experiences and different numbers of years that involved in the alliances. There is a possibility that some of the participants were not involved in alliances for a very long time and have limited understanding of the alliances. The limitations of some of the participants' knowledge may cause some unknown limitations of the study results.

Geographic factors

The research was limited by its geographic area. Only alliances in Western Canada were surveyed, thus there may be cultural factors unique to Western Canada. Fukuyama (1995) notes that people from a "low-trust society" may have different practices than people from a "high-trust society"

Small sample size

Although the diversified sample approach helps to minimize the sampling error, the sample size for both surveys were relatively small, especially the number of samples for each sub-grouping, for example, engineering companies vs. operating companies; managers vs. engineers. Results based on small sample size can be highly variable. More confirmed results would be possible with increased sample size and a real assessable level of data saturation.

Concerns of statistical significance

Statistical significance calculated in the study is based on an assumption that the original population has a normal distribution. This assumption is considered weak when the sample size is relatively small. Another concern is that samples were not randomly selected. The coordinator in each company selected their participants. An effort was made to get diversified samples from every level of the companies, but relying on the coordinator to select participants may lead to some unknown influence in the study results.

3.2 Data Analysis

3.2.1 Data Grouping

Responses were segmented by:

- Type of company: operating companies and engineering companies.

- Alliance organization design: alliances of different types in terms of scope, workload, location of engineering work, management styles and measures.
- Participants' level: from the first working level to higher management including: senior managers, supervisors, senior engineers, engineers.
- Maturity of alliance: from less than one year to more than five years.

3.2.2 Text analysis for the preliminary survey

For the preliminary questionnaire and interview inputs, text analysis techniques (see, for example, http://www.megaputer.com/tech/wp/tm.php3, December 2000), were applied including:

- Filter and categorize open-ended response.
- Set matrix of similarities and hierarchical cluster.

The frequencies of key points in different clusters were defined in order to design the statistical survey.

3.2.3 Statistical analysis for the second survey

Statistical techniques were applied in the analysis of the second survey as followings.

Two types of errors

Sample surveys are subject to two types of errors, non-sampling and sampling errors (see, for example, http://www.bls.gov/opub/hom/homch16_f.htm, December 2000).

Non-sampling errors can be attributed to many sources, such as definitional difficulties, difference in the interpretation of questions etc. To minimize non-sampling errors, the survey was distributed with detailed instructions by email, with follow-up discussion on an as-needed liaise.

Sampling error occurs because observations are not taken from the entire population, i.e., all employees involved in an alliance. The size of sampling error depends on the number of subjects surveyed. Thus, the margin of sampling error increases as the sample size decreases. The standard error is a measure of the precision of a survey statistic (see, for example, http://www.eia.doe.gov/emeu, December 2000).

The sampling error of the mean value for the response of each question is shown in Appendix VI.

Central tendency and dispersion

The arithmetic mean is used in analysis of the second survey to describe the central tendency, an aggregate measure to represent the whole group. Also, the standard deviation is used to show the spread of the values or dispersion around the mean. Mean values are shown in both figures in Chapter 5 and 6 and Appendix VI, VII and VIII. Standard deviation is shown in Appendix VI, VII and VIII.

Statistical difference

Gap analysis in Chapter 5 and 6 shows the differences among clusters, such as engineering company vs. operating company, managerial level vs. engineering level, and, among different types of alliances. The results with 90% confidence interval are shown both in the figures with shaded bars. Confidence intervals were calculated by using t-values of corresponding groups. A detailed explanation of t- test is shown in Appendix IX. The results of t-tests and confidence intervals are shown in Appendix VI, VII and VIII.

Correlation statistics

The Spearman Correlation Coefficient is applied to the statistical survey to determine the relationships between factors, i.e. overall effectiveness level vs. effectiveness level of each capability of the alliance. This analysis demonstrates the most important factors that affect the overall effectiveness level. The Spearman Correlation Coefficient is explained in Appendix IX while the results are presented in Chapter 5.

Chapter 4 Alliances of Different Types

As discussed in Chapter 2, long-term alliance relationships for ongoing work in operating plants have emerged as a dominant means for managing such work. Even though different operating companies organize their alliance relationships in different ways, alliances between operating companies and engineering companies have never been an equal alliance relationship between partners. The operating company is always the dominant party while the engineering company is the less powerful party a "Master-Servant" relationship. Three types of alliances will be discussed in this study, named as "Leftovers", "Separate" and "Integrated" alliances.

4.1 A General Approach

A general definition of different types of alliances is shown in Table 4-1. While "Leftover" alliances do occasional projects, "Separate" and "Integrated" alliances do most of the in-plant engineering work. Figure 4-1 shows the workload in different types of alliance. Some degree of guaranteed workloads are applied in "Integrated" and "Separate" alliances to maintain core teams. In "Leftover" and "Separate" alliances, most of the work is taken back from the operating company to engineering company's home offices. The partners work as two separate teams. A person from the operating company coordinates projects. In comparison, partners in "Integrated" alliances are usually co-located. Projects are coordinated by a steering committee with representatives from both companies.

Table 4-1 A General Approach to Different Types of Alliance

Factors	"Leftover" Alliance	"Separate" Alliance	"Integrated" Alliance
Type of work	Occasional projects	Most of the in-plant engineering work	Most of the in-plant engineering work
Location of engineering work	EC office	EC office	EC and OC staff are co-located in joint team
Core team	No	Yes	Yes
Workload	No workload guaranteed	Minimum level to maintain core team	Minimum level to maintain core team
Coordination	A coordinator from OC	A coordinator from OC	Coordinated by steering committee from both EC and OC
Performance monitoring and problem resolution	OC's coordinator evaluates problems, no formal performance review	OC periodically reviews performance, problems resolved by senior managers from OC and EC. Some focus on continuous improvement.	Periodic review by joint management team, which also resolves problems. High focus on continuous improvement.

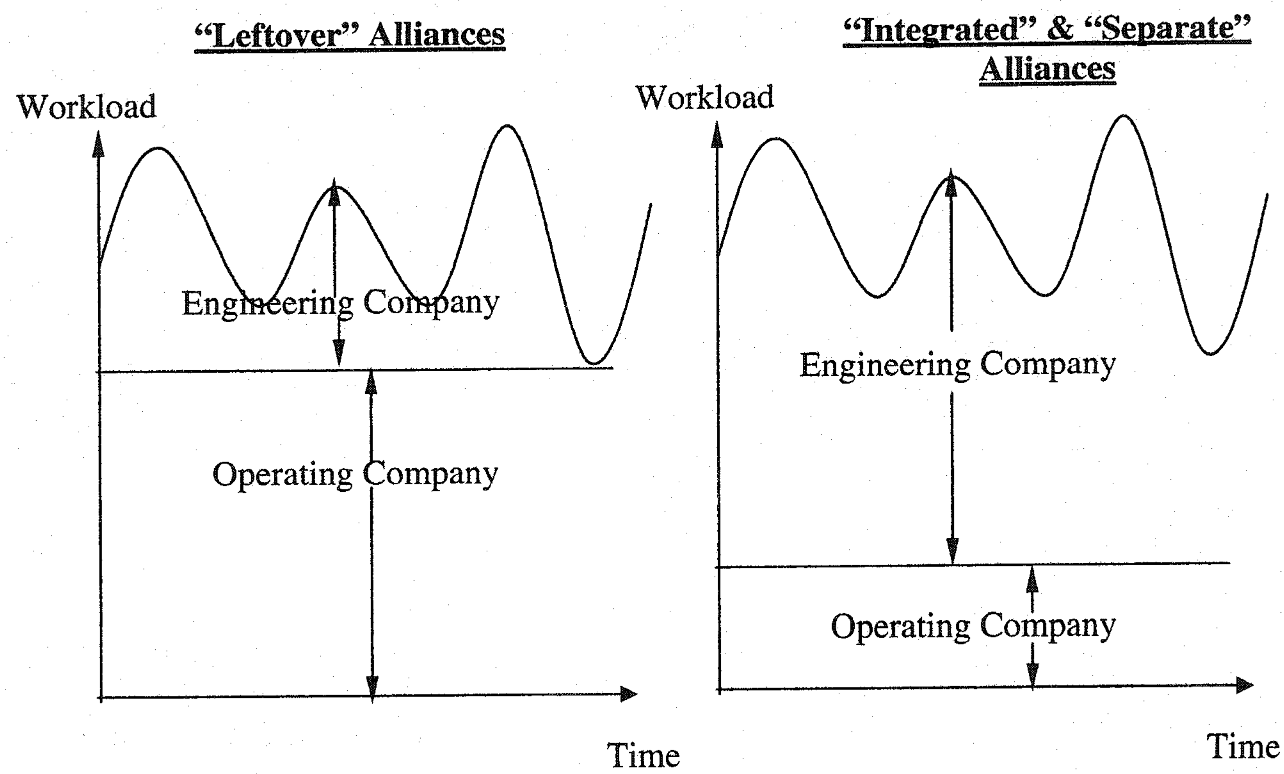


Figure 4-1 Workload for Different Types of Alliances

4.2 Types of Alliance Applied in the Study

Alliances in this study have specific characteristics as follows:

4.2.1 "Leftover" alliance

The engineering partner in "Leftover" alliances in this study concentrate on detailed engineering, capital cost estimates, and sometimes, on partial procurement. The alliance replaces some work that was previously undertaken in-house or contracted out when on site resources could not manage it. On the engineering company's part, there are no core team people reserved for the alliance. At the same time, the operating company does not have a workload reserved for their engineering partner.

The engineering company and operating company operate as a distinct and separate team in the "Leftover" alliance. Most work is brought back to the engineering company's home office. Normally the engineering company does not locate its staff at the operating company's site. The interface between the two partners is usually a coordinator from the operating company. The coordinator is responsible for evaluating problems and determining solutions.

Even though some partners in this type of alliance do not consider this an "alliance" as such, or the partners interpret it in different ways, this long-term relationship is still considered as one type of the alliance because:

- Both partners expect a long-term relationship.

- The bidding process is reduced for this long-term relationship;
- Both partners are making effort to build up a successful alliance relationship.

4.2.2 "Separate" alliance

In this study, "Separate" alliances concentrate on some conceptual engineering, detailed engineering, procurement and project management. Unlike a "Leftover" alliance, an engineering company in this type of alliance has some people assigned exclusively to the operating company's project, which are called "core team staff". An effort is made to maintain the core team staff in the alliance. Engineering companies are involved and have access to the operating companies' schedule and budgets and therefore have better knowledge of the workload.

"Separate" alliances replace in-house engineering that used to be present in operating companies as well as the outsourcing of many projects to multiple EPC firms. Similar to a "Leftover" alliance, engineering and operating partners in this type operate as separate teams in separate locations.

To assess the effectiveness of the alliance, "Separate" alliances have some formal measures including: reviewing deliverables, and a monthly scorecard. They also have periodic reviews for higher-level management. At the same time, informal measures through meetings and discussions provide a tool to gauge the effectiveness of the alliance to some extent.

4.2.3 "Integrated" alliance

Compared to the two types of alliances discussed above, "Integrated" alliances in this study have a wider scope, including: preliminary studies and cost estimates; conceptual engineering; detailed engineering; capital cost estimates; procurement; and construction management. Normally, the alliance did not start out with this broad a scope. One of the survey participants from an "Integrated" alliance commented, "It started by performing well-defined engineering projects based on approved engineering design specifications. As the alliance matured, it began to perform basic engineering studies, as well as performing basic and conceptual engineering and procurement. Further, the alliance will be adding construction management to its scope of services as well. This has happened because we have developed a mutual trust between two alliance partners and we now, for the most part, consider ourselves to be on the same team." Even though the level of work can fluctuate based on factors such as the price of oil or other strategic initiatives, operating companies in this type of alliance make an effort to give some degree of guaranteed work in order to keep core team staff from the engineering companies. As a result, the core team is maintained, which is seen by both partners in the alliance, as one of the key factors for success.

As commented before, "Integrated" alliances evolved from being an arm's length organization to being included as an integrated team in the same location, and at the same time having people from each company identify with the team. The alliance is coordinated by a steering committee formed by both companies.

"Integrated" alliances have systems of measurement and performance reviews of their effectiveness. The procedure is a joint procedure (two-way feedback) by both partners including quarterly reviews, yearly reviews and project reviews. One of the survey participants commented, "Each project is reviewed and a customer satisfaction survey is done. At the start of a project, the team sits down and agrees on what the minimum conditions of satisfaction are for the job. These include issues related to schedule, quality, budget, innovation, field support, etc. At the end of the job, these items are reviewed as well as other project performance parameters and the performance of individual disciplines. On a quarterly and yearly basis the results of all of the customer satisfaction surveys are compiled and presented in a comprehensive report highlighting the key successes and lessons learned over the period. These results are then combined with a corporate assessment. Open and frank feedbacks are strongly encouraged with an eye to improve relationship and project performance."

Chapter 5 Survey Results

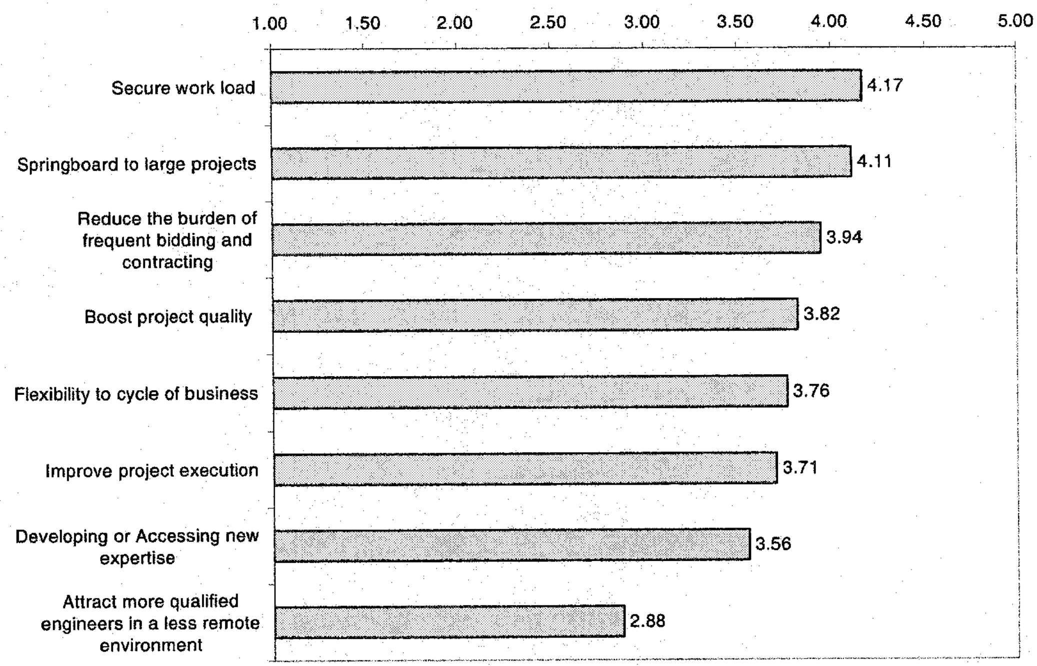
In this chapter, the survey findings re: goal differences, key factors that contribute to and that impair success, different satisfaction levels and some concerns of the disadvantages of alliances are vdiscussed.

5.1 Goal Difference

Responses about goals in forming alliances are shown in Figure 5-1 to Figure 5-4.

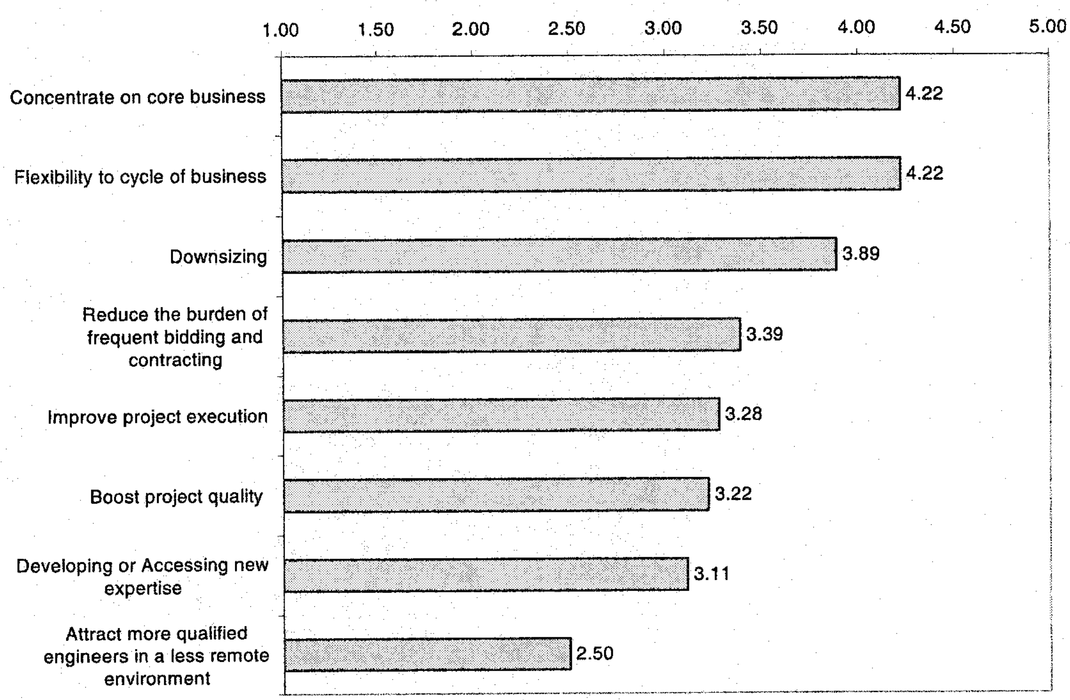
5.1.1 Goal differences between engineering companies and operating companies

This survey shows that when an alliance was formed, the drives and goals of each alliance partners were different. When forming alliances, engineering companies value "secure work load", "springboard to large projects" and "reduce the burden of frequent bidding and contracting" as their main factors, while operating companies make "concentrate on core business", "flexibility to cycle of business" and "downsizing" as their main considerations. (Figure 5-1 and Figure 5-2). Considering the common goals, alliance partners also have different weighting on these factors. Engineering companies give more weight to "boost project quality" and "reduce frequent bidding and contracting" while operating companies give more weight to "flexibility to cycle



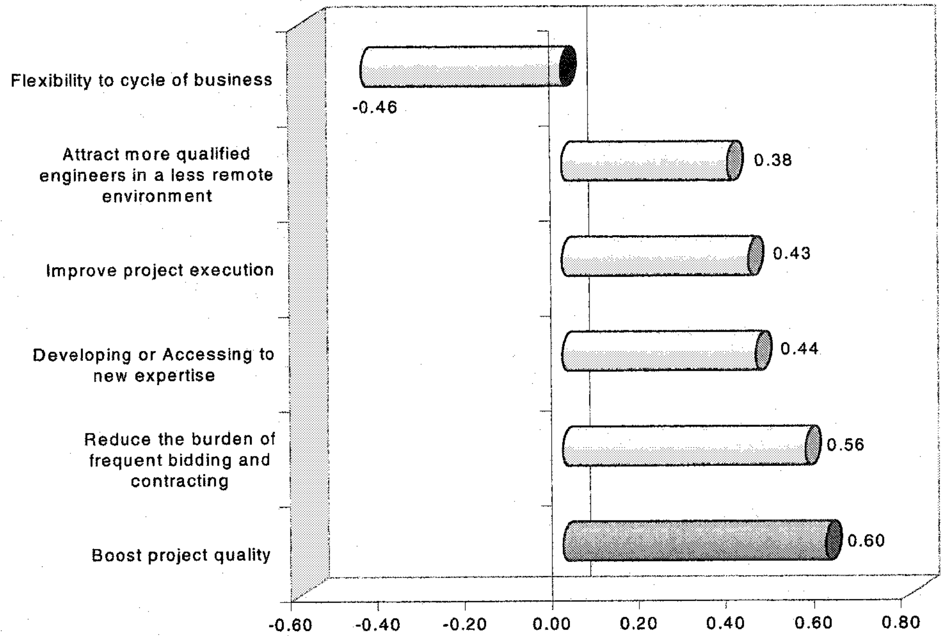
On a scale where "5" means strongly agree (SA) and "1" means strongly disagree (SD) in a subject.

Figure 5-1 Goals for Engineering Companies in Forming Alliances



On a scale where "5" means strongly agree (SA) and "1" means strongly disagree (SD) in a subject.

Figure 5-2 Goals for Operating Companies in Forming Alliances



Difference between engineering company and operating company.
Gap<0 means operating company's rating is higher than engineering company's.
Gap>0 means engineering company's rating is higher than operating company's.
Shaded Bars: Confidence $\geq$ 90% that the measured difference is significant.

Figure 5-3 Gap Analysis (EC vs. OC) of Goals in Alliances

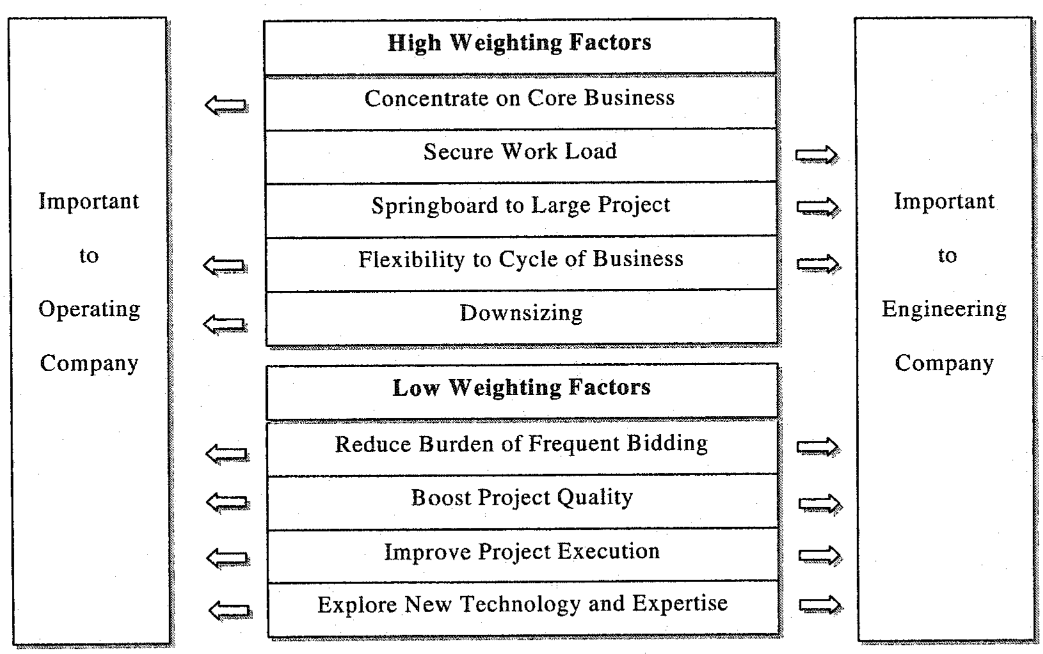


Figure 5-4 Drives and Needs From Both Partner's Consideration

of business" (Figure 5-3). Figure 5-3 also shows that "Boost project quality" is the one factor that presents a significant difference between operating companies and their engineering partners. Engineering companies hold more optimistic opinions on this issue, i.e., that an alliance can deliver improved quality to the operating company. Operating companies focus more on the cost savings from an alliance and show less optimism regarding enhanced quality.

Figure 5-4 lists the unique and common goals of engineering companies and operating companies ranked by the mean value of each items. The sole high weighting factor cited by both operating companies and engineering companies is enhancing flexibility to meet the business cycle: the operating company does this by pushing cyclical work to an outside party, and the engineering company does this by expanding its base workload, so that it can more easily shift resources within the engineering company as project workloads change.

Many problems may arise because of the goal differences between operating companies and engineering companies. It is important to manage these problems effectively to ensure positive outcomes for the alliance as a whole (Nauta & Sanders, 2001). Some participants mentioned that, "attitude become the biggest potential problem in alliance." As one engineer said, trying to capture the need for empathy and cooperation: "People from both sides need to know that we have to have a feeling of each side and deal with the factors, we have to do the business together."

5.1.2 Goal differences among different types of alliances

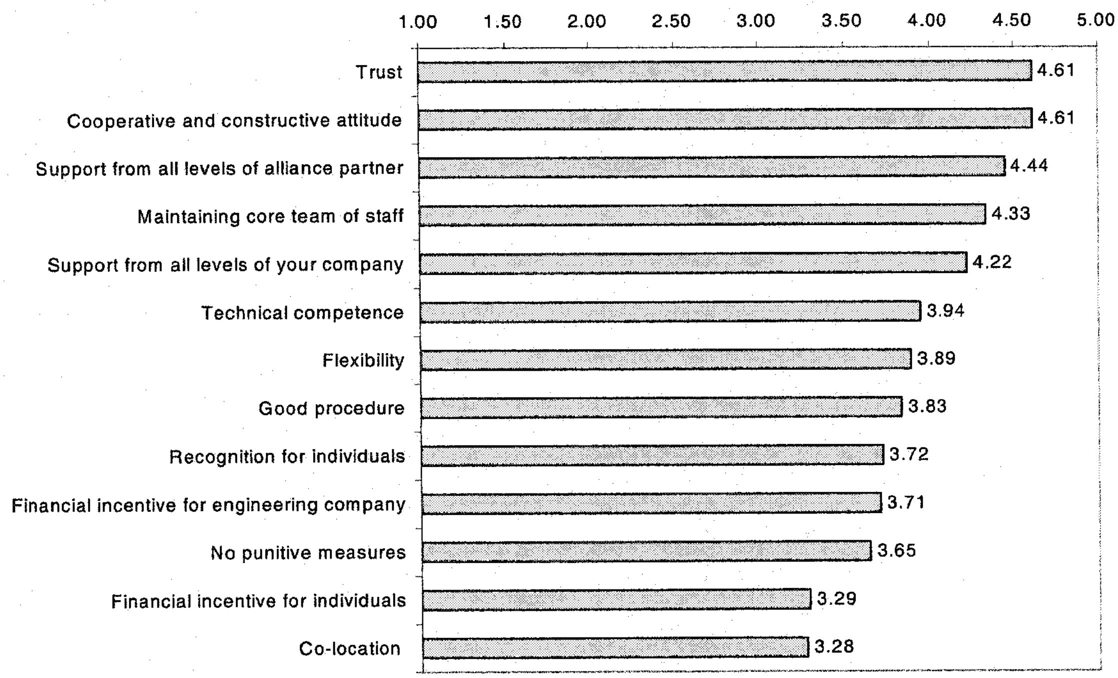
Different types of alliances place a different weight on goals when forming an alliance (see Appendix VIII). The most significant difference occurs for "Reduce the burden of frequent bidding and contracting". "Leftover" alliances do not consider this as a goal but "Integrated" alliances see it as one of the most important motives.

5.1.3 Management and engineers see different goals

"Flexibility to cycle of business" is a critical reason when senior managers decide to set up an alliance relationship. From this survey (Appendix II), lower level staff do not appear to share the senior managers' view for this factor. The t-test was used in the study to do the gap analysis showing the differences among clusters. The probabilities that senior managers have different opinion with supervisors, senior engineers or engineers on the issue of "Flexibility to cycle of business" are 93.6%, 97.0% and 97.3% respectively. This means it is highly likely that the other three clusters have a different opinion than senior mangers regarding the importance of "flexibility to cycle of business" as a goal in forming an alliance for ongoing work.

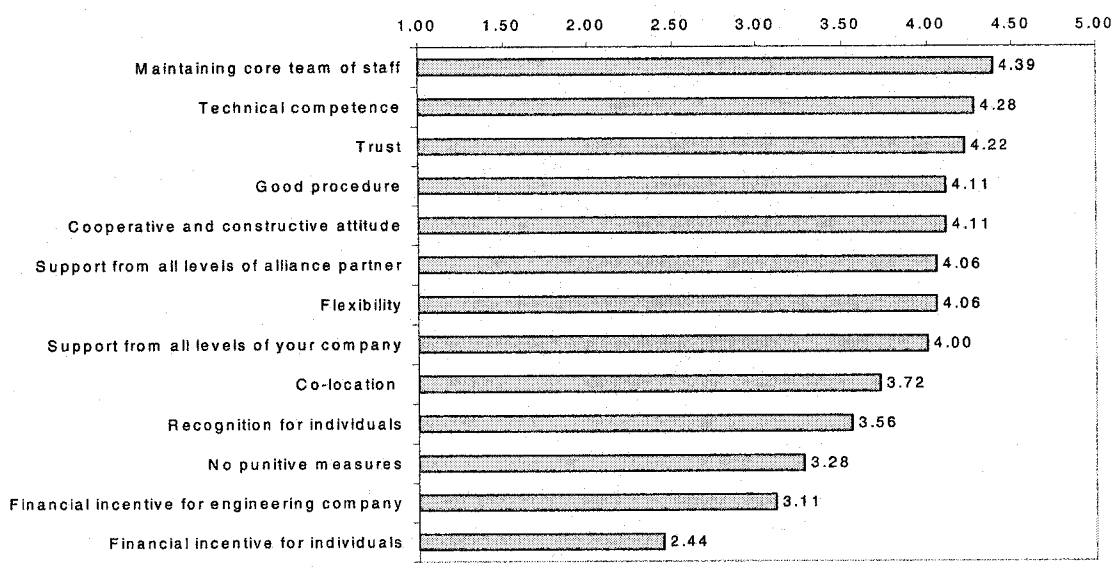
5.2 Key Factors of Success

Responses about key factors of success in alliances are shown in Figure 5-5 to Figure 5-8 and are discussed in section 5.2.1 to 5.2.3.



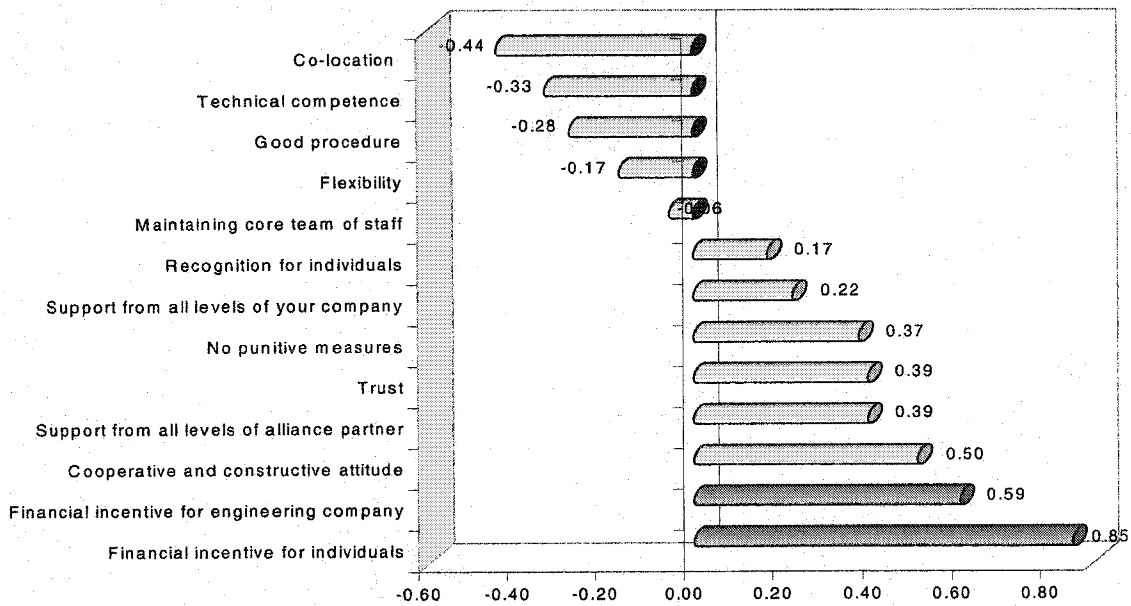
On a scale where "5" means strongly agree (SA) and "1" means strongly disagree (SD) in a subject.

Figure 5-5 Key Factors of Success- Engineering Companies



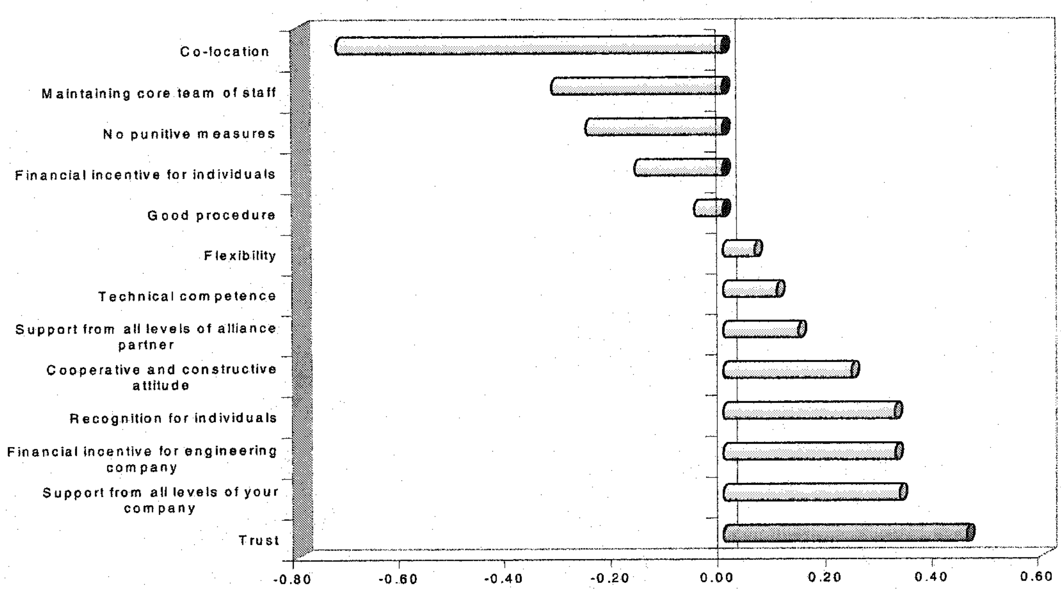
On a scale where "5" means strongly agree (SA) and "1" means strongly disagree (SD) in a subject.

Figure 5-6 Key Factors of Success- Operating Companies



Difference between engineering company and operating company.
Gap<0 means operating company's rating is higher than engineering company's.
Gap>0 means engineering company's rating is higher than operating company's.
Shaded Bars: Confidence ≥ 90% that the measured difference is significant.

Figure 5-7 Gap Analysis (EC vs. OC): Key Factors of Success



Difference between managerial level and engineering level.
Gap<0 means engineering level's rating is higher than managerial level's.
Gap>0 means managerial level's rating is higher than engineering level's.
Shaded Bars: Confidence ≥ 90% that the measured difference is significant.
Managerial level: Senior managers and managers in OC and EC
Engineering level: Senior engineers and engineers in OC and EC

Figure 5-8 Gap Analysis (Managerial vs. Engineering): Key Factors of Success

5.2.1 Trust as a major issue

Figure 5-5 and Figure 5-6 show the key success factors from the views of engineering companies and operating companies. For engineering companies, factors that related to "trust" but not directly related to "technical competence" are listed as top five success factors. Engineering companies rated "trust" as the top one factor of success. Other factors that help to build an environment of the "trust", such as "cooperative and constructive attitude"; "support from all levels of the alliance " are also emphasized. "Core team" was rated as the forth-key factor of the alliance success. Compared with this, operating companies rated "core team" as the number one key factor and the "technical competence" as the second most important factor. In general, from both the engineering companies' and operating companies' perspectives, "trust" is one of the most important factors of success.

Even though most of the time it works as an "atmosphere" in an alliance, constructing trust is a process. Nooteboom (1996) discussed that trust "concerns a partner's ability to perform according to agreements (competence trust), or his intentions to do so (goodwill trust)". Risks due to failure of competence are of high concern to the dominant party of an alliance (the operating company). From the study, it is found that trust is not only highly correlated with perception of competence (correlation coefficient=0.60) and intention (e.g. cooperative and constructive attitude, correlation coefficient=0.66; organizational support, correlation coefficient=0.73 and 0.57), but also with right "procedures" (e.g. good procedures, correlation coefficient=0.47,

Appendix V). Mooteboom (1996) notes that "trust is not unbounded, it cannot be taken for granted and it may breakdown". "Right procedures", which include the right processes and right approach of cooperation, helps to build up trust but at the same time it must be flexible (correlation between trust and perception of flexibility=0.58) to avoid bureaucracy. A model of success in alliances for ongoing work will be presented in Chapter 6.

From the study, trust as a key factor of alliance success is both highly recognized by managerial staff and engineering staff although they consider it in different ways. Managers see the importance of support from all levels of the company. To engineers, working together with the staff of their alliance partners (co-location) is a more practical way to build up a climate of trust (Figure 5-8).

5.2.2 Maintaining a core team is important

Figure 5-5, Figure 5-6 and Figure 5-7 shows an area that both operating companies and engineering companies agree strongly on is the need to "maintain core team of staff". Operating companies need to realize that they themselves play the key role in maintaining the core team. Engineering companies do not have the margins or cash reserves to maintain idle staff, so the key to a core team is a managed minimum flow of work from the operating company that will keep the core team members occupied. A further discussion will be presented in Chapter 6.

5.2.3 Financial incentives are less important

The gap analysis between operating companies and engineering companies (Figure 5-7) shows that the alliance partners agree with each other that a core team is a key success factor. The largest divergence occurs regarding "incentives". Engineering companies, even though they do not consider incentives as highly weighted factors, do not show as much rejection of it as operating companies. In general, "financial incentives" are the least important "key factors of success" for both operating and engineering companies. A further discussion will be presented in Chapter 6.

5.3 Factors That Impair Alliances

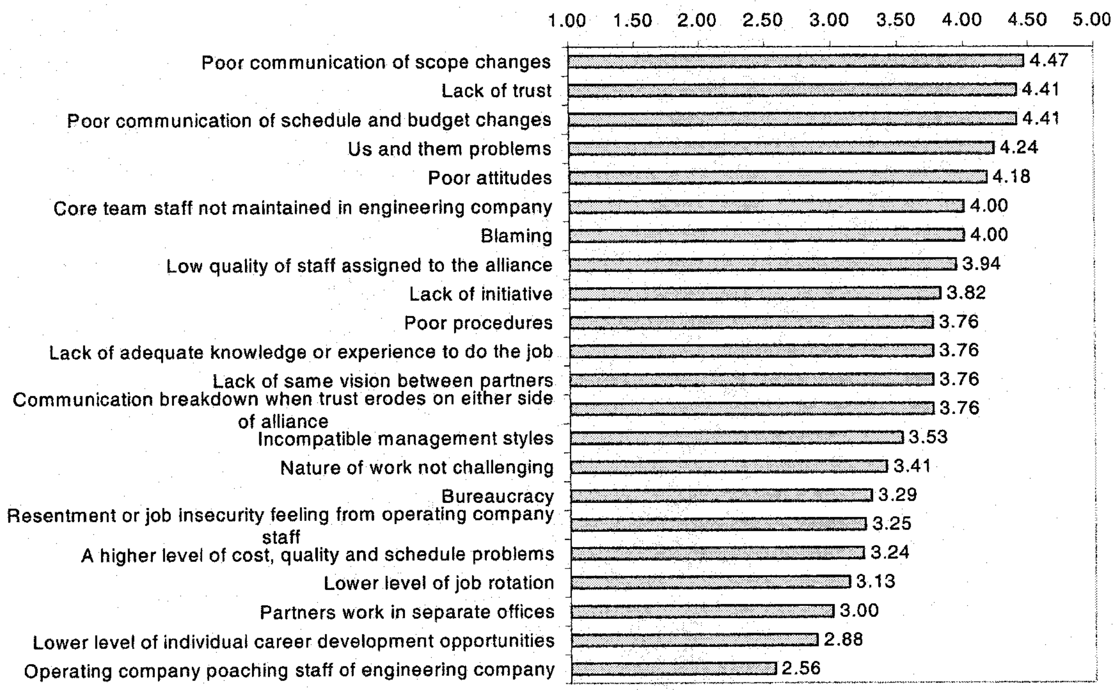
Responses about key factors that impair alliance success are shown in Figure 5-9 to Figure 5-13.

5.3.1 Operating companies and engineering companies have different concerns

If not managed well, key factors of success become key factors that impair success. There is a large gap between operating companies and engineering companies on what factors impair alliance success. Figure 5-9 and Figure 5-10 show different concerns of alliance partners. While "trust" related factors still sit at the top of the factors impairing the alliance success (for example, "lack of trust"; "us and them problems"), operating companies are more concerned about "low quality of staff assigned to the alliance". Compared with this, engineering companies put more attention on the communication of changes (on both scope changes and schedule and budget changes). Operating companies are not concerned about whether the nature of the work is not challenging. But for engineering companies, this is a factor, even though it is not highly emphasized. Here, again, the different motives and power within the alliance show up. The alliance is not a meeting of equals but rather more of a master/ servant relationship. All the time that the "servants" think they are doing a good job, it is easy for the masters to doubt whether "the servants are good enough". Worchel (1986) argued that when groups failed a task, "the failure led subjects to search for reasons for their poor performance". Figure 5-11 also shows that while engineering companies focus more on the nature of work, operating companies blame the competence of the alliance, such as higher level of cost, quality and schedule problems.

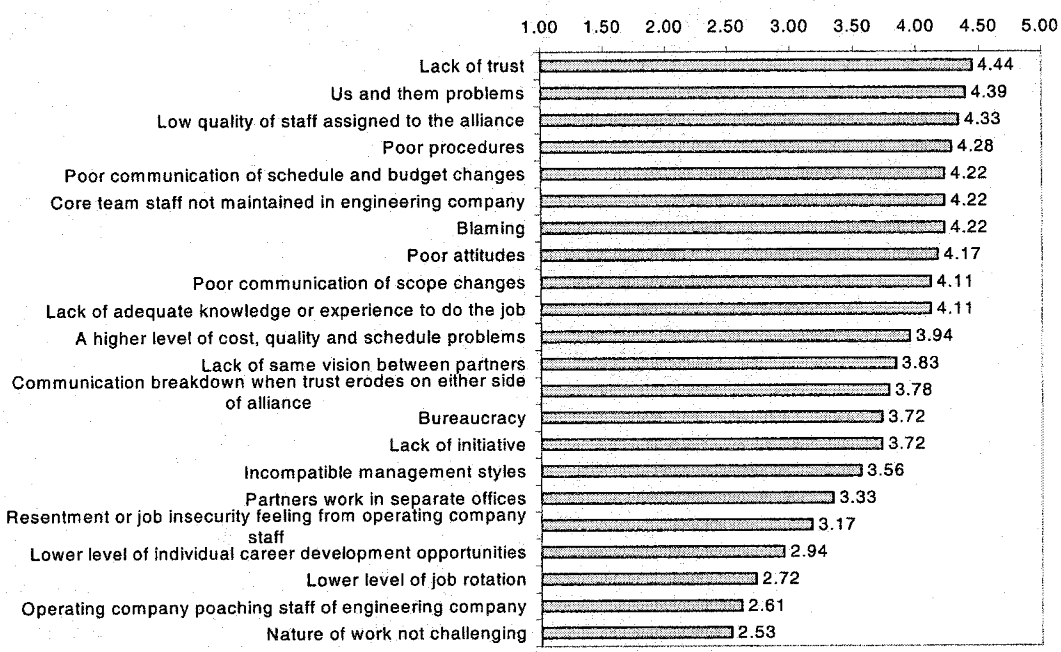
5.3.2 Managers and engineers have different opinions

Senior and junior staff, especially senior mangers and junior engineers, have very different opinions on whether "Lack of same vision between partners" is a factor impairing the alliance. Senior managers do not count it as a factor while junior engineers give it a very high rank (Appendix VII).



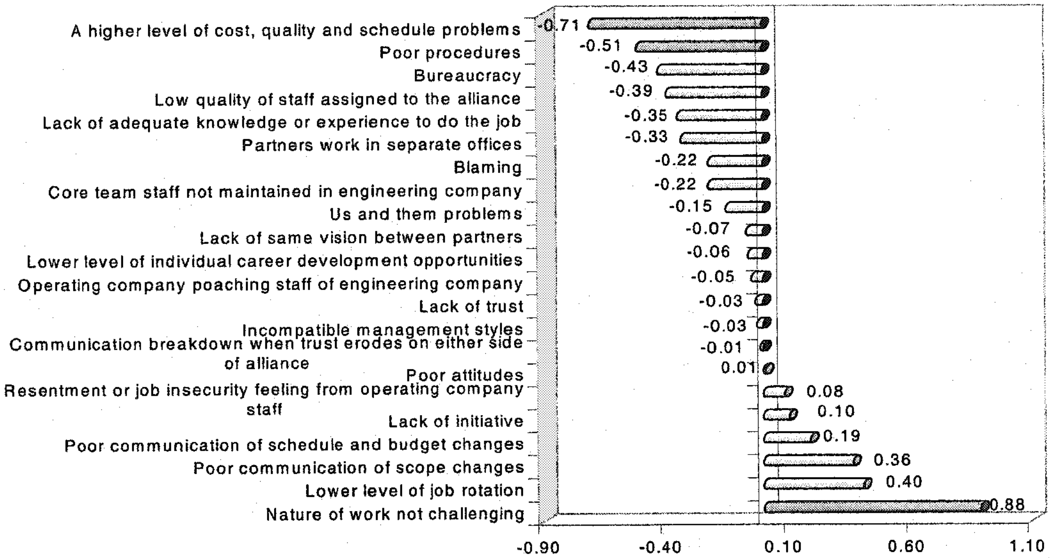
On a scale where "5" means strongly agree (SA) and "1" means strongly disagree (SD) in a subject.

Figure 5-9 Factors Impairing the Alliance- Engineering Companies



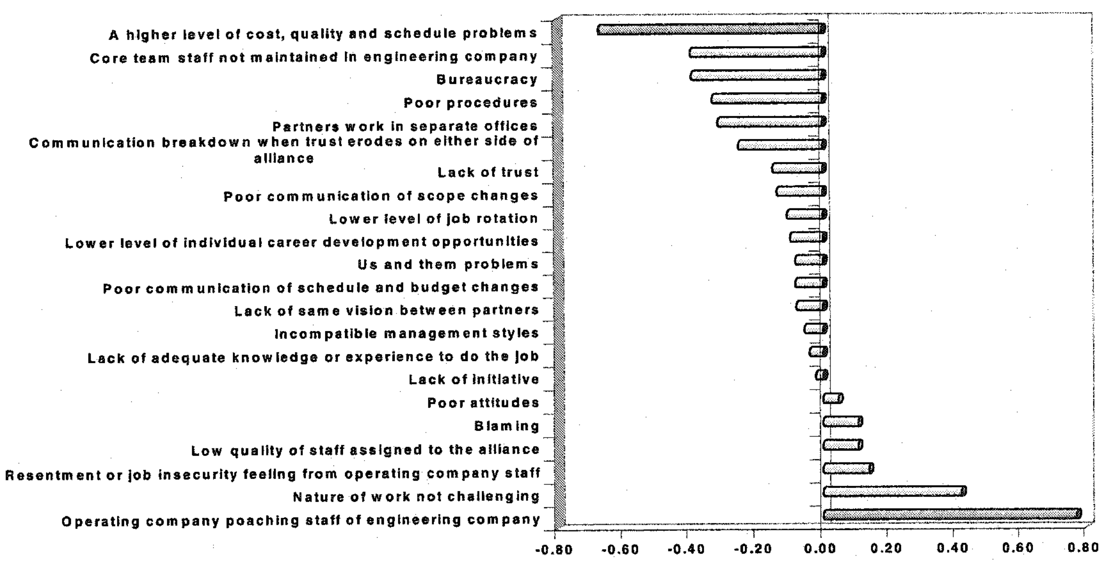
On a scale where "5" means strongly agree (SA) and "1" means strongly disagree (SD) in a subject.

Figure 5-10 Factors Impairing the Alliance- Operating Companies



Difference between engineering company and operating company.
Gap<0 means operating company's rating is higher than engineering company's.
Gap>0 means engineering company's rating is higher than operating company's.
Dark Shaded Bars: Confidence ≥ 90% that the measured difference is significant.

Figure 5-11 Gap Analysis (EC vs. OC): Factors Impair Alliance



Difference between managerial level and engineering level
Gap<0 means engineering level's rating is higher than managerial level's.
Gap>0 means managerial level's rating is higher than engineering level's.
Dark Shaded Bars: Confidence ≥ 90% that the measured difference is significant.
Managerial level: Senior managers and managers in OC and EC
Engineering level: Senior engineers and engineers in OC and EC

Figure 5-12 Gap Analysis (Managerial vs. Engineering): Factors Impair Success

Managerial staff do not attach as much importance as engineering staff to "a higher level of cost, quality and schedule problems" that impair alliance success (Figure 5-12). The biggest gap on this issue is between supervisors and senior engineers (Appendix VII). At the same time, senior managers have some concern about "nature of work not challenging" while the others do not count it at all.

5.3.3 The highest level of blaming occurs in "Separate" alliances

"Leftover" alliances are much like "Separate" alliances on the factors that impair alliances except for the "blaming" issue (Figure 5-13). In fact, "blaming as a factor impairing success" is significantly higher with "Separate" alliances than with the other two types of alliances. The probabilities that the opinions on the blaming issue in "Leftover" and "Integrated" alliance differ from that in "Separate" alliance are 90.3% and 99.1% respectively (Appendix VIII). One possible reason why "Leftover" alliances may have less complaints than "Separate" alliances is that operating companies in "Leftover" alliances may be very pleased to give away their "junk" work and are thus less critical of the engineering company's performance. However, in a "Separate" alliance the operating company has given most of their work to their engineering partner and the work is done in a location away from operating company staff. In this situation, the operating company can be very critical if the alliance's performance is not satisfactory, which in turn breaks down a climate of trust.

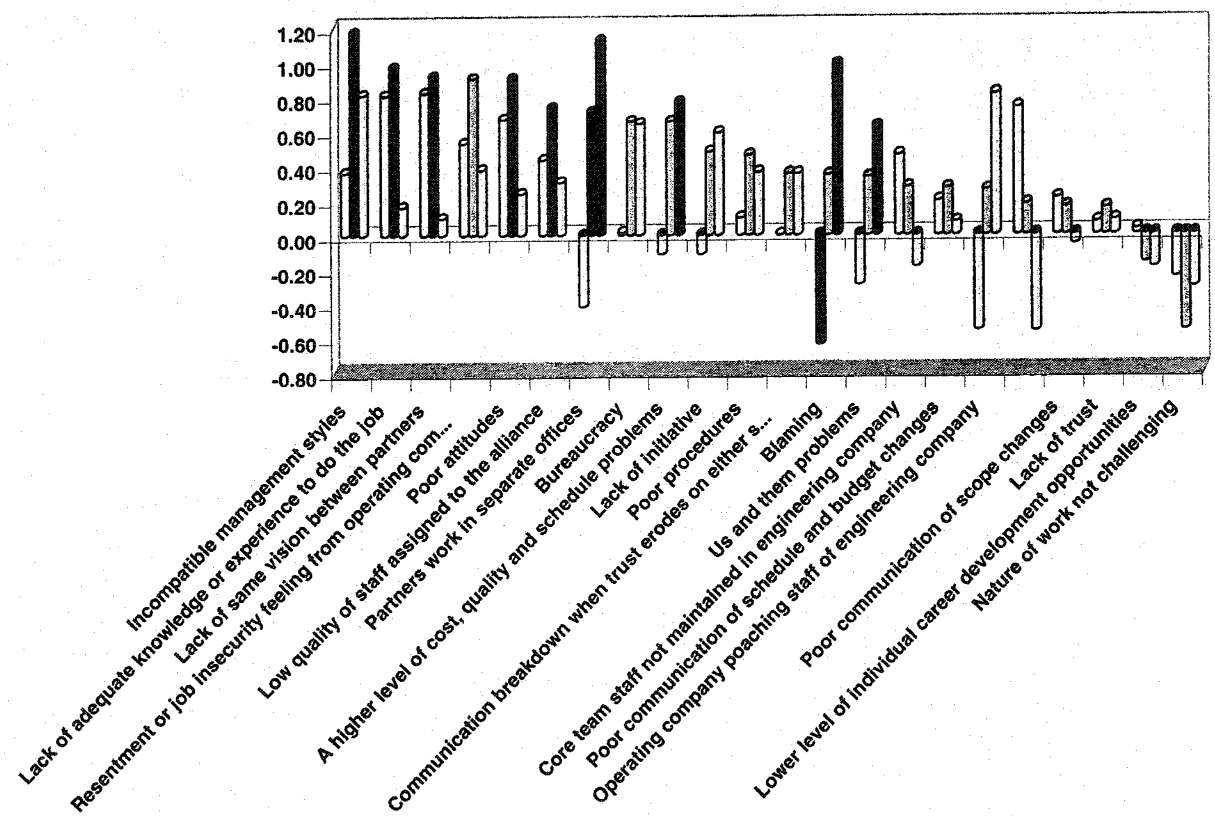
5.3.4 Factors that do not impair alliance success

The factors that do not impair alliances' success from the perspective of either partners, for all types of alliances, are "Lower level of individual development opportunities" and "Operating companies poaching staff from engineering companies". For individual development, some study participants commented that the alliance has offered them "good opportunities to interact with client operating personal and understand the client requirements and extent of engineering services required", which in turn they saw as providing opportunities for individual development. For the fear of "operating companies poaching staff from engineering companies", even though this is a problem that some engineering partners worry about, many companies comment that they usually have an agreement in advance to avoid it happening. Table 5-1 shows factors that are not considered as breakdown factors in different types of alliances (Factors that rating ≤ 3 in different types of alliances).

Table 5-1 shows that integrated alliances have the highest number of factors that do not impair alliance success. This is discussed further in Chapter 6.

Table 5-1 Factors that NOT Considered as Breakdown Factors in Different Types of Alliances

Leftover	Separate	Integrated
Operating company poaching staff of engineering company		Operating company poaching staff of engineering company
Nature of work not challenging	Nature of work not challenging	
Lower level of individual career development opportunities	Lower level of individual career development opportunities	Lower level of individual career development opportunities
	Lower level of job rotation	Lower level of job rotation
		Resentment or job insecurity feeling from operating company
		Incompatible management styles.



1st bar of each factor: leftover alliances-separate alliances; 2nd bar of each factor: leftover alliances – integrated alliances; 3rd bar of each factor: separate alliance-integrated alliances

Black Shaded Bars: Confidence ≥ 90% that the measured difference is significant.

Figure 5-13 Gap Analysis (Among Three Types of Alliances): Factors Impairing Success

5.4 Satisfaction Levels with Alliance Capabilities

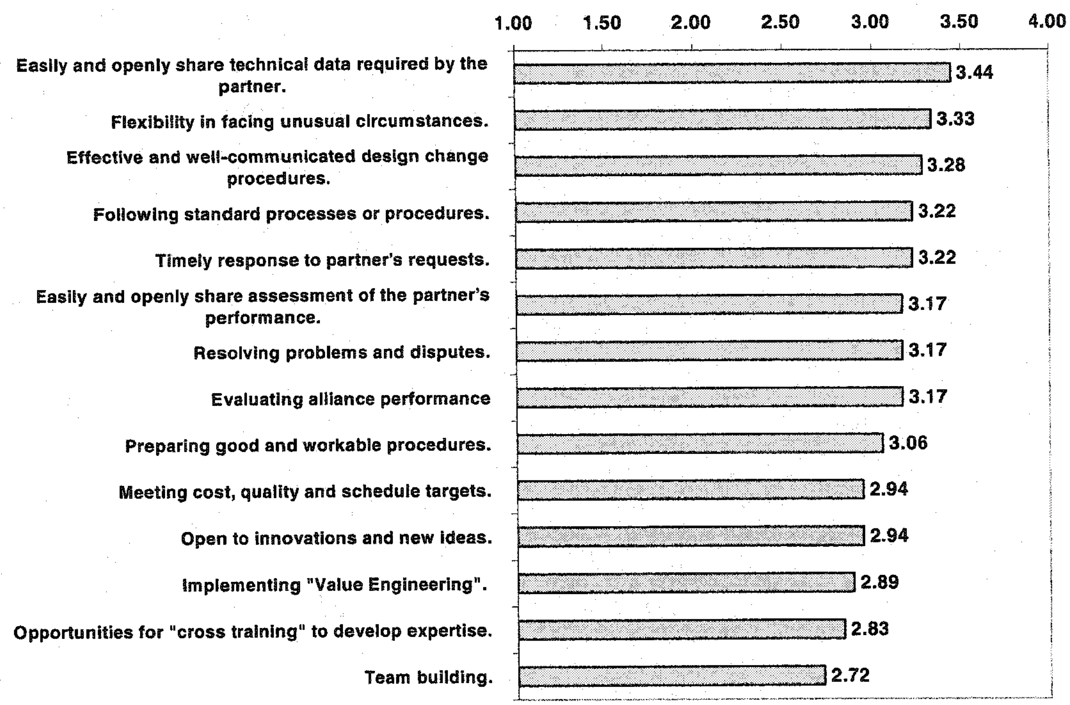
Responses about satisfaction levels with alliance capabilities are shown in Figure 5-14 to Figure 5-18.

5.4.1 Engineering companies have higher satisfaction

Engineering companies have a higher level of satisfaction with alliance capabilities. They rate most of the alliance capabilities as "above good" while operating companies rate most of the alliance capabilities between "fair" and "good". "Procedures" is the only issue that is rated as "good enough" (i.e. scored as 3-good) by operating companies. Engineering companies on average rate all the capabilities higher than their partners. The largest gap between operating companies and engineering companies is on the issue of the capability of "meeting cost, quality and schedule" (Rated lower than "fair" by operating companies and "nearly good" by engineering companies. See, Figure 5-14, Figure 5-15 and Figure 5-16).

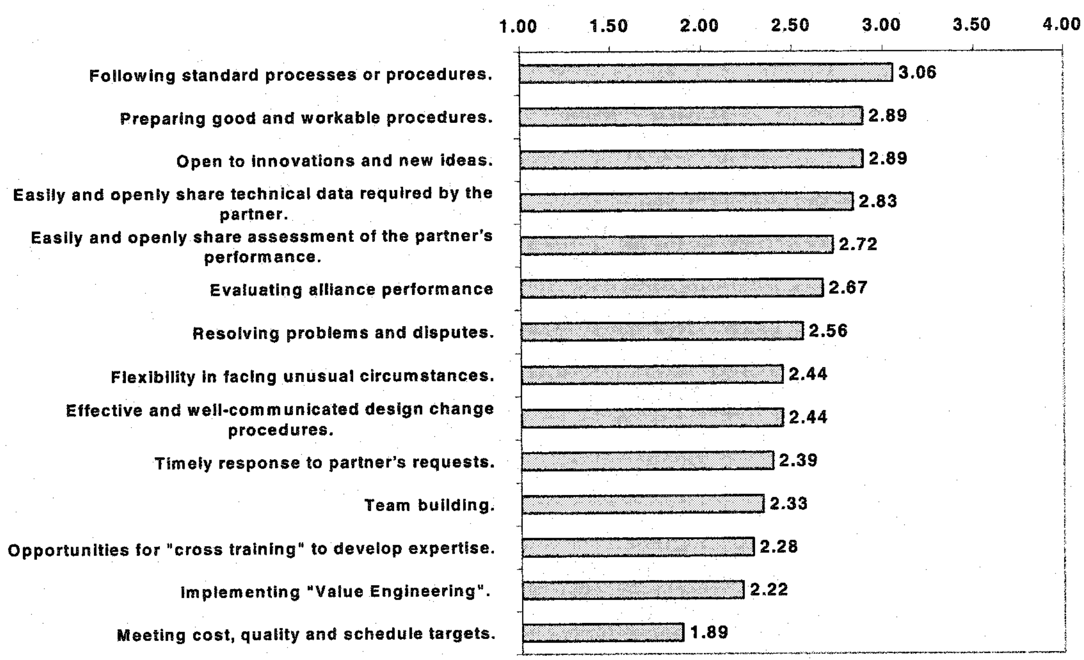
We believe the bias in the evaluation of alliance performance reflects the nature of the partners' relationship. The alliances in this study have the following characteristics:

- Although the partners cooperate, one partner is dominant;
- The scope of the work covered by the alliance is not specifically identified.



On a scale where "5" means strongly agree (SA) and "1" means strongly disagree (SD) in a subject.

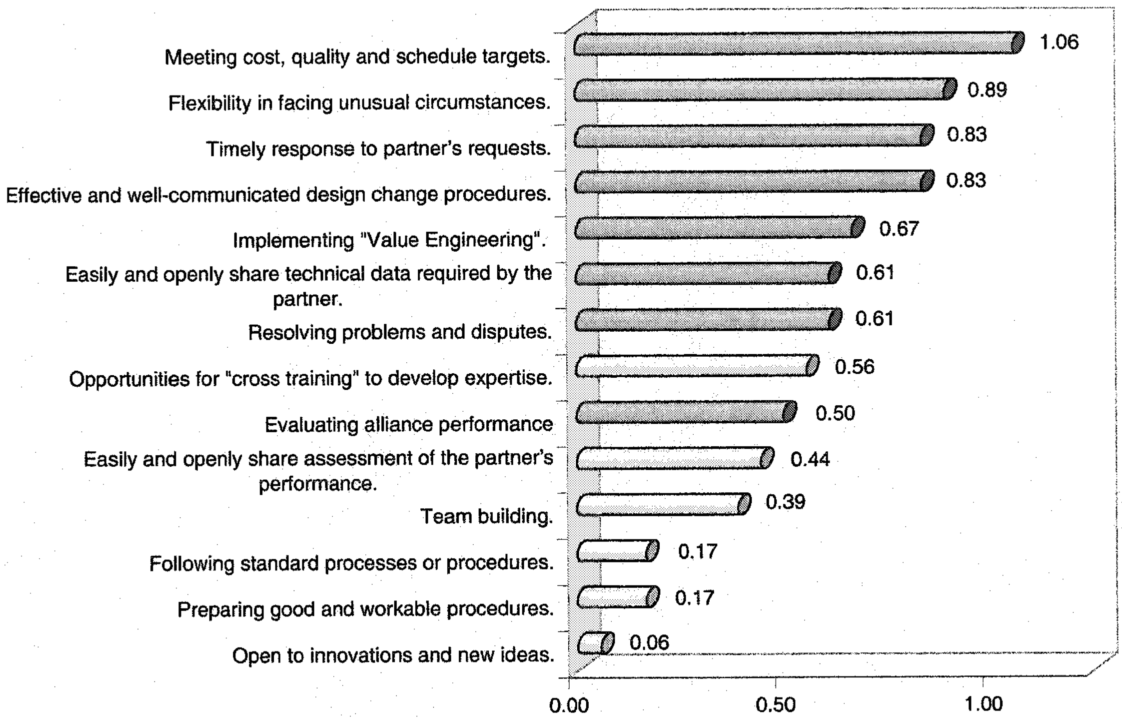
Figure 5-14 Rating of Alliance Capability- Engineering Companies



On a scale where "5" means strongly agree (SA) and "1" means strongly disagree (SD) in a subject.

Figure 5-15 Rating of Alliance Capability- Operating Companies

Both these factors make it easy for the operating companies to complain about cost, quality, and schedule problems. Many staff in operating companies have a concern that the alliance does not meet its targets. A few wish for the return to their "beautiful" old past, i.e., an in-house engineering department.



Difference between engineering companies and operating companies.

Gap<0 means operating company's rating is higher than engineering company's.

Gap>0 means engineering company's rating is higher than operating company's.

Dark Shaded Bars: Confidence ≥ 90% that the measured difference is significant.

Figure 5-16 Gap Analysis (EC vs. OC): Rating of Alliance Capability

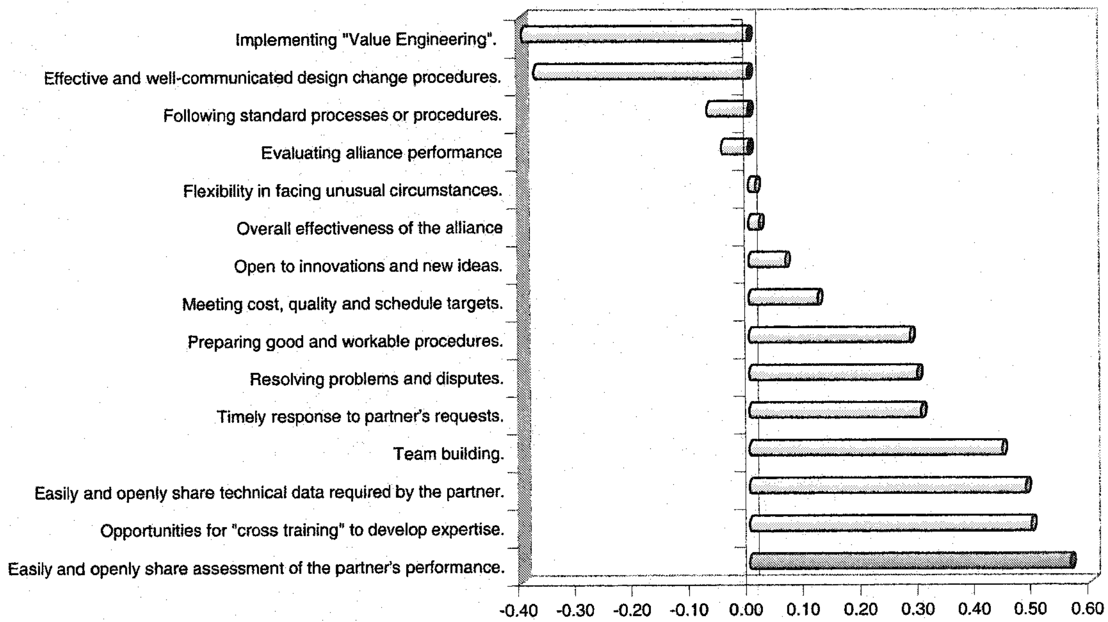
5.4.2 "Integrated" alliances have highest satisfaction level

Among the three types of alliances identified, the "Integrated" type has the highest satisfaction level. People in "Integrated" alliances think the overall performance of the alliance is "more than good". The lowest satisfaction level happens in the "Separate" alliance, which is "slightly higher than fair" (Figure 5-18).

On most of the issues studied, "Separate" alliances' satisfaction levels of all the alliance performance measures are significantly lower than "Integrated" alliances, except for "preparing good and workable procedures" and "effective and well-communicated design change procedures". "Preparing good and workable procedures" is the only issue that "Separate" alliances rate as "good enough". People in "Separate" alliances are not satisfied with the performance of "Meeting cost, quality and schedule target"; "Timely response to partner's requests"; "Opportunities for "cross training" to develop expertise" and "Team building"" (See, Appendix VIII). The result corresponds with the "blaming" issue discussed earlier.

"Easily and openly share technical data required by the partner" is the only issue that "Leftover" alliance count as "good enough". But unlike the "Separate" alliance, they consider other issues of alliance capability as "above fair".

People in "Integrated" alliances consider most issues of alliance capability as "above good" but think the capability of "meeting cost, quality and schedule targets"; "implementing value engineering" and "team building" still have room to improve (Appendix VIII).



Difference between managerial level and engineering level.

Gap<0 means engineering level's rating is higher than managerial level's.

Gap>0 means managerial level's rating is higher than engineering level's.

Dark Shaded Bars: Confidence ≥ 90% that the measured difference is significant.

Managerial level_ Senor managers and managers in both OC and EC

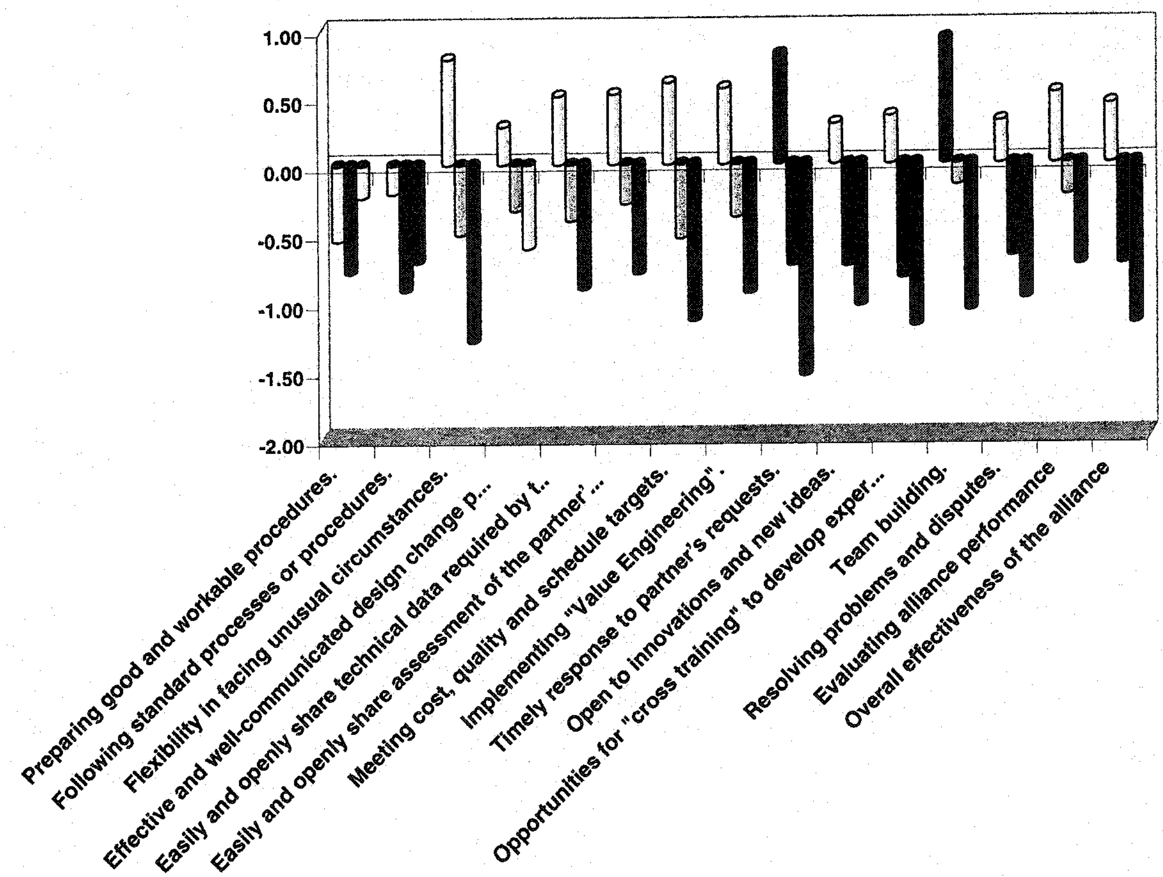
Engineering level: Senior engineers and engineers in both OC and EC

Figure 5-17 Gap Analysis (Managerial vs. Engineering): Rating of Alliance Capability

5.4.3 Managers and engineers have different comments

Senior staff, especially senior managers have higher satisfaction levels than other staff but the overall satisfaction level of managerial staff and engineering staff are nearly the same (Figure 5-17). The largest gap between managerial staff and engineering staff is whether the alliance "easily and openly shares assessment of the partner's performance". Managerial staff, especially senior managers think the capability on this issue is "much more than good" but obviously the engineering staff do not agree with them.

A big gap between senior managers and engineering staff is the alliance capability of "preparing good and workable procedures". Again, senior managers give more optimistic comments here. There is a 90.2% probability that supervisors and senior engineers have different opinions on the alliance capability of "Effective and well-communicated design change procedures". Senior engineers rate this capability much higher than supervisors. There is a 93.1% probability that senior managers have different views on the alliance capability of "Easily and openly share technical data required by the partner". Senior managers think this process is nearly "excellent" while senior engineers do not think it is "good". At the same time, engineers do not agree with the senior managers that the capability of problem and dispute solving is good; supervisors do not agree with senior managers that the capability of evaluating alliance performance is good (Appendix VII).



1st bar of each factor: leftover alliances-separate alliances; 2nd bar of each factor: leftover alliances – integrated alliances; 3rd bar of each factor: separate alliance-integrated alliances

Black Shaded Bars: Confidence ≥ 90% that the measured difference is significant.

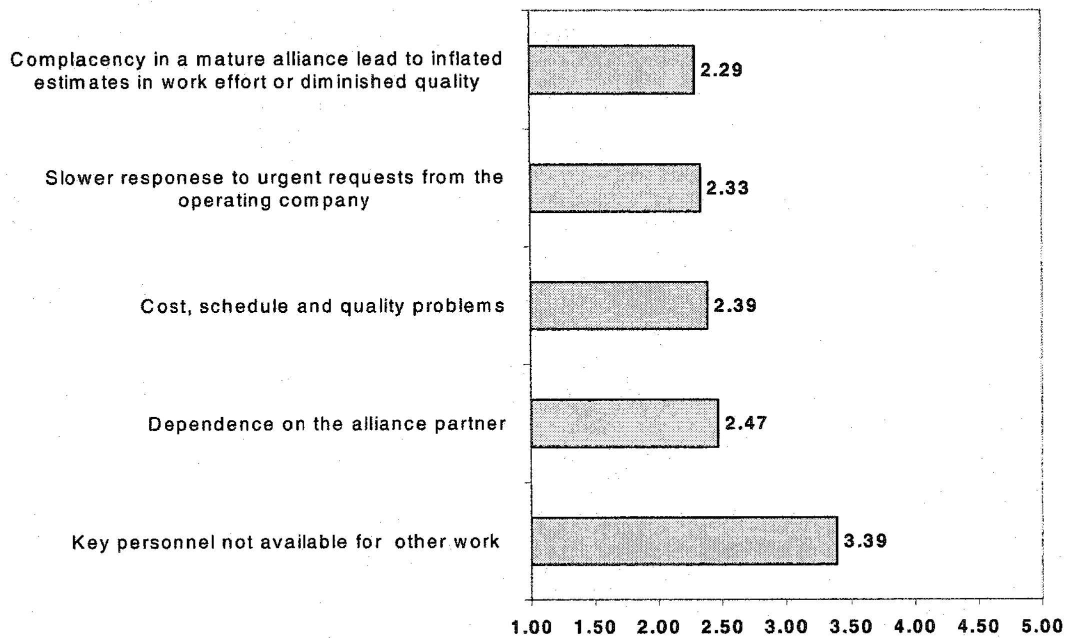
Figure 5-18 Gap Analysis (Among Three Types of Alliances): Rating of Alliance Capability

5.5 Disadvantages of Alliance

Responses about disadvantages of alliance are shown in Figure 5-19 to Figure 5-21.

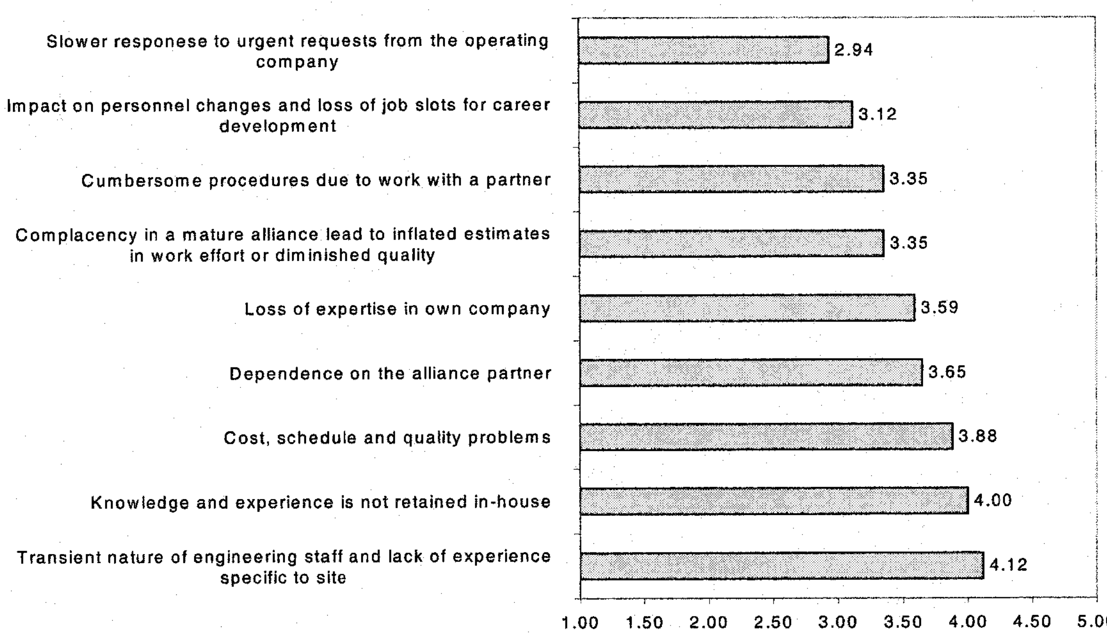
Figure 5-19 shows that engineering companies do not have very significant concerns about the negative effects of the project performance due to an alliance, except that they have some concern about the issue of "key personnel not available for other work may limit the engineering company's opportunities to go after new work".

Compared with engineering companies, operating partners have a higher concern about the negative effects of the alliance, especially the transient nature of the alliance and lack of knowledge or experience retained in-house, which makes the operating companies dependent on the engineering companies (Figure 5-20). Again, the cost, quality and schedule problems present the largest difference between operating and engineering companies (Figure 5-21).



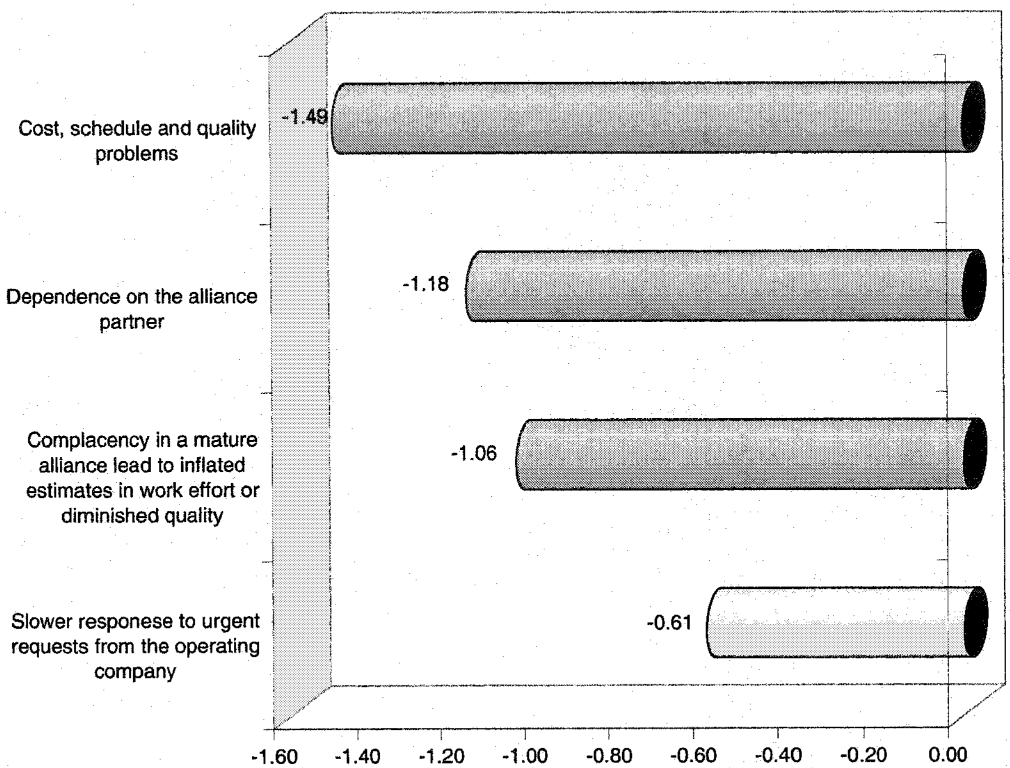
On a scale where "5" means strongly agree (SA) and "1" means strongly disagree (SD) in a subject.

Figure 5-19 Disadvantage of Alliance- Engineering Companies



On a scale where "5" means strongly agree (SA) and "1" means strongly disagree (SD) in a subject.

Figure 5-20 Disadvantage of Alliance- Operating Companies



Difference between engineering company and operating company.

Gap<0 means operating company's rating is higher than engineering company's.

Gap>0 means engineering company's rating is higher than operating company's.

Shaded Bars: Confidence ≥ 90% that the measured difference is significant.

Figure 5-21 Gap Analysis (EC vs. OC): Disadvantage of Alliance

Chapter 6 Learnings and Best Practices

In this chapter, The learnings, a model of alliance success, and best practices based on the survey results are discussed.

6.1 Learnings

6.1.1 Ongoing alliances have tough early years

An alliance is a logical and timely response to intense and rapid changes in economic activity, technology and globalization (Doz and Hamel 1998). But leaving aside the advantages of the alliances mentioned in most of the references, growing pains among alliance partners are also evident. Many alliance relationships experience problems when first created.

All of the ongoing alliances in this study were born in downsizing by the operating company. But aggressive downsizing may increase many early-stage problems. "At the beginning of the alliance, our centralized engineering division was dismantled and some of the engineers were assigned to different strategy areas as front line support", said one of the participants in our preliminary survey. A department manager in an engineering company said, "The client's on-site personnel felt threatened by our presence at site, some client staff are openly hostile as they prefer another contractor". It is easy to understand this reaction by staff in the operating company. Operating company staff who were not downsized have lost former colleagues, have a change in the way work is done, and face the uncertainty that future downsizing may eliminate their own position. This can readily lead to resentment of the new alliance partner, as shown conceptually in Figure 6-1.

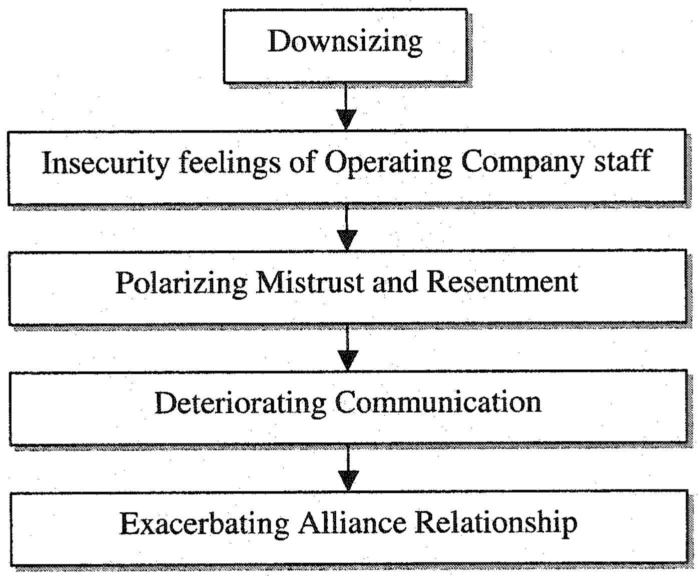


Figure 6-1 Alliances Born in Downsizing And Resentment

Psychologically, in the early stage of alliance, staff in operating companies will often protect their boundaries and keep themselves separate from the staff from engineering companies. A similar phenomenon was identified by Fried and Defazio (1974) where "the approach forces bonding group members together add additional differentiation of the group from the surrounding population". "The closer the intruder comes, the stronger becomes the person's desires to avoid or escape the encroachment, the intimacy, the vulnerability". Further, people may also protect space from invasion even if it is not occupied (Knowles, 1989).

Several studies demonstrated that positive attitudes tend to draw people together while negative attitudes and feelings tend to separate people (Campbell et al., 1966). One study participant noted, "It is like a marriage. In every marriage, there is a bit of a fight. I think if you are committed, you will say, well, we have a bit of problem, but we have to deal with the factors together, we have to do the business together, figure out the best way to do business."

Alliances between operating companies and engineering companies may be more like a marriage without a "honeymoon". Another participant commented, "operations and maintenance personnel historically don't trust engineers-combine that mistrust with engineers from another company and one has a recipe for a long and difficult process," Patience and getting the staff of operating companies working jointly with engineering company staff (e.g. co-location) can help to build a cooperative and constructive attitude and mutual support. This is crucial at the initial stages of an alliance. As one of the survey participants described, "While admitting that no alliance is a perfect 'honeymoon', client frustration does occur, especially when cost overruns and construction delays take place. It is possible to overcome these situations by understanding the role of all personnel involved and defining the roles and responsibilities in a wider spectrum. Alliances may not see results in the short term but if long-term benefits are to be reaped, then its working members must put 'their shoulders together to the wheel'".

In order to mitigate the resentment in the early stage of the alliance, the outplacement and teambuilding need to be emphasized. Outplacement will help to reduce the feeling of insecurity of the staff that remains in the operating company. Teambuilding can be applied as a continuous developing tool of the alliance success, and should help to reduce antagonism directed towards engineering contractor staff.

Some teambuilding techniques may be needed in this period of time. Setting up the organizational, technical and interpersonal interfaces (the formal and informal reporting system) might be one of the ways to discover the problems in their early stages and thus mitigate the frictions of the alliance members (Duncan, 1996). Some other teambuilding activities, such as improving team climate, attitudes, cohesiveness (Kerrie et al., 2000) by discouraging blaming, accepting the dependency on the alliance partner, having a regular status review meeting and sharing the necessary information with the alliance partner are issues that need to be focused.Dependency as the price of shedding cyclical work

As discussed in the last chapter, staff in operating companies worry that the transient nature of the engineering staff and the loss of expertise in their own companies may lead to an unexpected dependency on their engineering partner. In fact, dependency is the price of shedding cyclical work, and cannot be avoided. Also, maintaining a core team in the alliance can mitigate the alliance's transient nature by preserving a knowledge team in the engineering company that knows the operating company staff, procedure and standards. At the same time, engineering companies are also worried that the "key personnel not available for other work may limit the engineering company's opportunities to go after new work", which is a kind of dependency on the operating company. Both partners see the dependency as a disadvantage of alliance. But everything has its flip side. Dependency can be transferred into interdependence and "a team with a high level of task interdependence is critical to its effectiveness." (Hackman, et. al, 2000) In fact, dependency/interdependency itself is not a weakness of the alliance. But the fear of "dependency" is harmful. In order to increase the alliance effectiveness, the alliance partners need to accept the dependency/interdependency as one of the fact of the alliance. The study shows the closer the partners cooperate and become interdependent, the higher the effectiveness of the alliance. Close alliances have high satisfaction levels. Furthermore, cooperation and team effectiveness can be reinforced by the interdependency, which gives a sense that a condition that what benefits one party is also of the benefit to the other, and a loss to one party is also a loss to the other.

6.1.2 Traditional measures of financial performance and incentive fees do more harm than good

Engineering performance on new capital projects is often successfully measured as a percentage of total installed cost (TIC) of the project. Measures such as this are not valid in revamp work, and often drive wrong behaviors. The study demonstrates that the strongest alliances show the highest rejection of financial incentives for the engineering company. Reducing engineering to meet arbitrary and inapplicable performance targets is dangerous for the operating company, since in revamp work a full assessment of the upstream and downstream impact of changes is critical. Further, the study found some evidence that tying engineering fees to financial performance damages trust: the engineering contractor is in an adversarial role with the operating company in a battle over fees, and the operating company acts as both prosecutor and judge. This damages the delicate climate of trust that is so important to the success of the ongoing alliance.

"Reward and recognition systems are formal management actions which promote or reinforce desired behavior" (Duncan, 1996). Which kind of reward and recognition system can help to improve alliance performance is not a research focus in this study but the selected interviews with participants show that even though project cost based traditional measures do more harm than good, other kinds of measures such as quality based measures may contribute to improved alliance effectiveness. A focus on continuous improvement of alliances is recommended.

6.1.3 Co-location reduces blaming and mistrust

Most participants in the survey gave a positive rating to "co-location as key factor of success". Although staff in "Separate" alliance gave a neutral rating to co-location as a success factor, they agree that co-location can reduce blaming and mistrust among partners. Mintzberg (1996) also comments "Face to face collaboration is a richer medium because it allows nonverbal communication, facilitating the delicate process of integrating ideas and energies." The most important difference between "Separate" alliances and "Integrated" alliances is engineering companies in "Separate" alliances bring the work back to their own offices while "Integrated" alliance partners co-locate in a joint team. On both measures of satisfaction (a high assessment of alliance capability and a low assessment of factors impairing alliance success), integrated alliances test highest. Both operating and engineering companies in integrated alliances are satisfied with the alliances and think they perform better. We believe that this occurs because the level of trust is highest in the integrated alliance: blaming is reduced because operating and engineering company staff work together. Unpleasant surprises, such as increases in the capital cost of a revamp project, are less likely to be blamed on technical incompetence and more likely to be assessed as unavoidable scope increase when co-located integrated teams are performing the work.

6.1.4 Core team is critical to alliance effectiveness

Almost all the participants in the survey strongly agree with "maintaining core team of staff" as a key factors of alliance success. Operating companies in "Integrated" and "Separate" alliances try very hard to secure a basic workload for engineering companies in order to maintain a core team staff for alliance. This is because:

- The core team can reduce the disadvantages of the "transient nature of engineering staff and lack of experience specific to site."

- People in core teams are familiar with specifications and procedures of the operating company, which reduces the cost, quality and schedule problems of the project.
- The core team helps to develop individual ties in the alliance, which may reduce mistrust.
- Core teams help to set up on-site training.

As noted above, key role in maintaining a core team is by the operating company control of flow of work to the alliance.

6.1.5 "Integrated" alliance has more satisfaction and effectiveness

Compared with operating companies in other types of alliances, operating companies in "Integrated" alliances had significantly higher satisfaction with the alliance performance. Engineering and operating partners in "Integrated" alliances have similar satisfaction levels in rating the alliance capabilities, which is not true for "Separate" alliances. "Integrated" alliances are the only type where both partners rate the overall effectiveness as "above good". The largest discrepancy in rating of alliance capabilities happens in "Separate" alliances where engineering companies rate effectiveness as "good", while operating companies far less satisfied with it ("less than fair"). "Integrated" alliances place less emphasis on factors impairing success and seem more confident of success as a result. The aboveshows that trust and a sense of satisfaction exists between partners in "Integrated" alliances. To the extent that the corporate culture of the operating company permits, the closer it integrates with its engineering alliance partner the more satisfaction it will find from the alliance. Co-located joint engineering teams of operating and engineering company staff have the highest level of satisfaction and the lowest level of blaming. Moving toward "Integrated" alliance is a win-win strategy for both the operating company and their engineering partner.

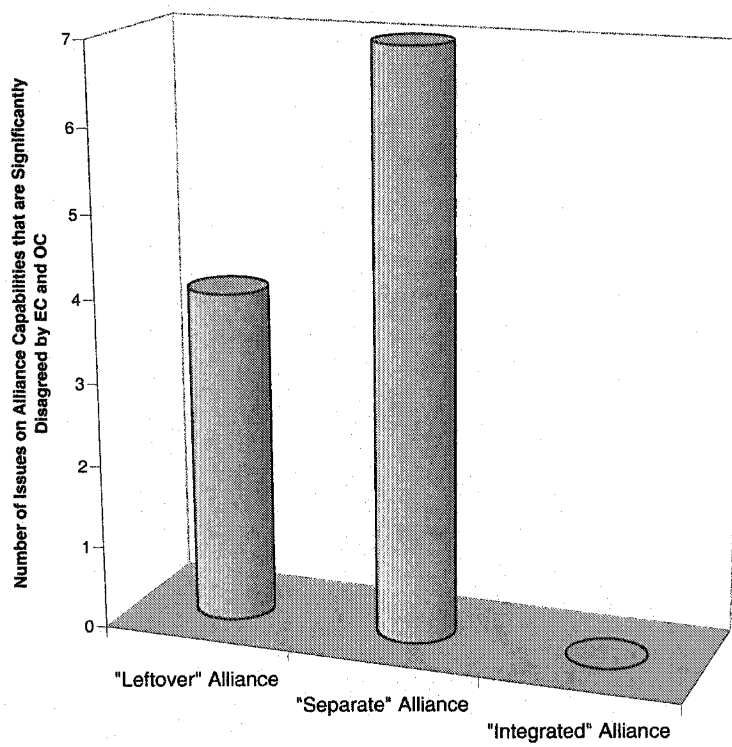


Figure 6-2 EC and OC of "Integrated" Alliances Have Consensus on its Capability

6.1.6 Team building to strengthen the effectiveness of an alliance

The operating companies consider the alliances' capability of "team building" as a main challenge of overall effectiveness (correlation coefficient=0.829). According to Kerrie et al. (2000), team building has several aspects including:

- Team member selection. The member should possess abilities of goal setting and planning for a team in order for it to be effective. At the same time, they must be able to deal with and manage interpersonal situations and group problem solving. Diversity is another element of team composition and team development that requires careful consideration.
- Improve team norms, attitudes, climate and cohesiveness.
- Team training.
- Leadership development

Once an alliance is initialized, team building becomes a daily issue throughout its life. The main task of the alliance is to bring people from different companies together into one team and make it work as a whole. This is not a simple task for an ongoing alliance struggling in the early stages with an uncertain scope of work and with the difficulty of applying predefined and often inappropriate performance measures. There is clear evidence that alliances can be designed to improve team building by integrating the alliance partners.

6.2 Best Practices

From this study, five "best practices" will increase the likelihood of a successful ongoing alliance:

6.2.1 Patience is needed in the beginning

As discussed in Chapter 5, ongoing alliances have tough early years; alliances start like a marriage with no honeymoon. Both engineering companies and operating companies need to accept this fact and show their patience and commitments to their partners. There is clear evidence that startup difficulties can be resolved and the benefits of alliances can be realized.

6.2.2 Maintain a core team

The core ongoing team that is dedicated to an alliance is the reservoir of knowledge of the operating company's standards and procedures. From this study, it is clear that operating companies recognize the benefit of a core team, but they often do not recognize their role in maintaining it. An engineering company does not have the margins or cash reserves to maintain idle staff, so the key to a core team is a managed minimum flow of work from the operating company that will keep the core team members occupied. This is a key determinant of the cost effectiveness and quality of engineering work throughout the work cycle, since members added to an alliance team during peak activity periods look to the core team for help with standards and procedures.

6.2.3 Build a climate of trust

Ongoing alliances have ample factors that can breed mistrust and blaming, and working to avoid this is critical. Failure to do so reduces satisfaction and increases the amount of time and effort spent on defensive behaviors. Senior management support is critical.

6.2.4 Avoid traditional measures of financial performance and incentive fees

The operating company needs to accept that appropriate measures of engineering contractor performance are not as available for revamp work as for new capital construction projects. Inappropriate performance measures and incentive based fees will drive behaviors that damage the alliance and the interests of the operating company. Specifically, measures of performance related to the total installed cost (TIC) and engineering company fees tied to TIC are not recommended for ongoing alliances. These measures are inappropriate, drive wrong behaviors, and damage trust between alliance partners.

6.2.5 Move toward integration

To the extent that the corporate culture of the operating company permits, the closer it integrates with its engineering alliance partner the more satisfaction it will find from the alliance. Co-located joint engineering teams of operating and engineering company staff have the highest level of satisfaction.

6.3 A model of success in ongoing alliances

Although operating and engineering staff cite some differences in key success factors, the results can be combined into a model of success. As illustrated in Figure 6-3, three clusters of factors contribute to the success of an ongoing alliance: the right resources, the right procedures, and the right attitude.

It is clear that technical competence is recognized as a factor that contributes to the alliance success. What is not obvious but is a key finding of this study is the function of core team. A core team builds up a detailed knowledge of both the formal design standards and procedures of the operating company and the informal (and often undocumented) practices. When new staff are added to the team during the periods of peak work, the core team becomes the "go to" people who can advise new team members of the appropriate specs and procedures. Maintaining a core engineering team that is permanently assigned to an alliance is a key factor of success.

Good procedures for communicating scope changes and controlling documents are also necessary for a successful alliance.

Another key finding of the study is that "right attitude" is critical for the success of an ongoing alliance. Factors such as "organizational support"; "non-blaming climate"; "acceptance of the uncertainty of scope" and "flexibility" are key factors that help to build the right attitude in the alliance. These are also the factors that have been enhanced in the co-located integrated alliances. Focus on the continuous improvement of these factors help an alliance building up a climate of trust, which lead to a high satisfaction with the alliance. (Figure 6-3)

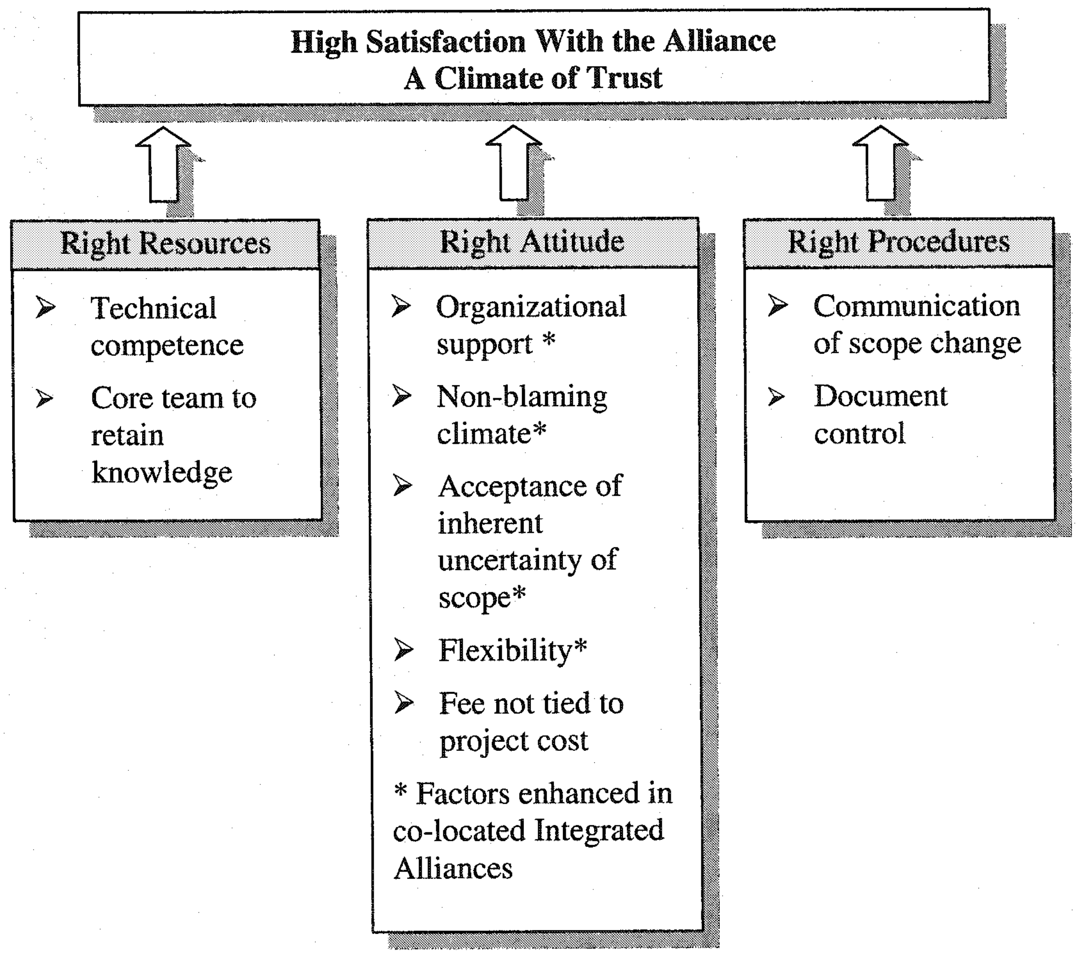


Figure 6-3 A Model of Success in Ongoing Alliances

Chapter 7 Conclusions

7.1 Conclusions emerging from this study:

- An ongoing alliance, with its non-specified scope of work and variable engineering content, is different from a traditional alliance for building a one-time project. Revamp work has a greater tendency to grow in scope than new capital construction. Hence, ongoing alliances are fertile grounds for breeding mistrust.

- Three distinct types of alliances were found in this study, named "Leftover" alliance, "Separate" alliance and "Integrated" alliance. The type of alliance has a strong impact on level of satisfaction; "Integrated" alliances report the highest level of satisfaction for both partners.

- When forming an alliance, the operating company and engineering company cite different reasons, which represent their different motivations, power and positions in the alliance.

- Applying traditional measures of financial performance and incentive fees in an ongoing alliance does more harm than good. Tying engineering fees to financial performance damages the delicate climate of trust that is important to the success of the ongoing alliance.

- The core team that is dedicated to an ongoing alliance is the reservoir of knowledge of the operating company's standards and procedures. The operating company plays a key role in the core team by regulating the flow of work to the engineering contractor.

- Building a climate of trust is critical of ongoing alliances. A model of success in ongoing alliances cites the three clusters of factors that contribute to success: the right resources, the right procedures and the right attitude.

- Moving toward an "Integrated" alliance is a win-win strategy for both the operating company and their engineering partner.

Ongoing alliances for maintenance and turnaround work in operating plants can be a good strategy for both operating and engineering partners, but some effort is needed to make it successful. Ongoing alliances are a long-term strategy that needs long-term effort.

7.2 Further studies

Due to the constraints of the study, there are several issues that could be clarified by further study:

- Participants in the study were from companies in Western Canada. Thus, it is not clear that the results of the study can be fully applied in a different cultural background of ongoing alliances. Further study in different locations could explore this.

- The study was based on a small sample size that led to high variability in results. Further study with a larger sample size would help confirm results.

- There are no effective measuring and rewarding metrics for ongoing alliances between operating companies and engineering companies. A further study of this would be highly welcome in the industry.

- Some companies have a corporate culture that is averse to integration. Further study could focus specifically on how to improve satisfaction levels in separate alliances.

Appendix I Preliminary Questionnaire for Engineering Company

Preliminary Questionnaire: Engineering Company

The purpose of the Preliminary Questionnaire is to identify common themes and elements of Alliance relationships between operating companies and engineering contractors for ongoing maintenance and turnaround work in operating plants. To identify common themes, open-ended questions are used. Later in the study a second questionnaire will be developed based on the themes and issues identified from this questionnaire.

The purpose of the overall study is to assess the effectiveness of these relationships and to identify key success factors, "best practices", and frictions / problems.

Please fill out all questions. If a particular question is not relevant to you, please indicate by NA (not applicable). Please also feel free to add comments throughout this questionnaire.

Note: **all replies to this survey will be kept confidential**, and data from the survey will only be released on an aggregated basis. No individual responses or comments will be attributed to a specific company or individual.

Part I: Demographic Information

1. Name:

2. Company:

3. Job Title:

4. Years with Company:

5. Years in Current Role:

6. What alliance are you involved in:

7. Please describe your role in the alliance:

8. Did you play an active role in creating or renegotiating the current alliance (describe):

9. Have you been involved in another alliance? If yes, please describe.

Part II: The Alliance

1. How long has the current alliance been in place?

2. What is the scope of the current alliance:

- What specific task does your alliance partner offer (conceptual engineering, detailed engineering, procurement, construction management, construction, other)?

- Does your company reserve specific people for the alliance partner?

- Is there a guarantee of level of work from the alliance partner? How do your company adjust to changes in level of workload (up and down)?

- What other comments do you have on the scope of the current alliance?

3. Why did you company enter the alliance, i.e. what were the company's goals in creating the alliance? Please list all reasons, and then please put a check mark by those you consider to be of high importance.

4. What do you think are the reasons that your company's alliance partner entered the alliance?

5. Could you tell us your personal satisfaction level with the alliance and why?

6. Please tell us your company's satisfaction level with the alliance and why?

7. What do you think is the satisfaction level of your company's alliance partner with the alliance? Why? Do you have any insight into frustrations or problems that your partner has with the alliance?

8. What did the alliance replace, i.e. before the current alliance partner how was the maintenance and turnaround engineering work done that is now performed by the partner? (Examples: in house engineering resources, individual bid packages, previous alliance partner, etc.) In your opinion, was the quality of engineering work and project management better or worse under the previous system? Was the cost higher or lower under the previous system?

9. How does your company fit into your alliance partner's organization? In your perception, is your company:

   - Integrated into your alliance partner's organization as a co-mingled team?
   - Operating as a separate team?
   - A mix of these two, or other? (Please be specific.)

10. What measures do you or your company use to assess the effectiveness of the alliance (e.g. intuitive judgment, informal measures, formal measures)? If formal measures, what are they?

11. Does your alliance partner use the same measures to assess the effectiveness of the alliance? If no, what other measures do they use?

12. Is there a periodic review of your company's performance? If yes, how often does this occur, is the feedback one-way or two ways, and what factors are considered?

13. What factors do you consider in general to be key to the success of an alliance for ongoing work in an operating plant? To what extent are these present in your company's current alliance?

14. What factors do you think impair the effectiveness of an ongoing alliance? To what extent are these present in your company's current alliance?

15. How would you change the alliance to make it more effective?

16. Are there any disadvantages of the alliance? e.g. unexpected dependency on the alliance partner?

17. (1) Are you aware of any conflicts, tension, problems and issues between your company and your alliance partner? If yes, please list.

(2) Is there any process to deal with the problems? If yes, please describe.

(3) Is the process effective? Please provide examples.

(4) Are there any problems in Alliance that are attempted to resolved but failed? Please list and provide examples.

(5) How would you make changes to the problem resolution process to make it more effective?

18. Are there effective mechanisms in place to communicate between your company and its alliance partner? From your perspective, how effective is the communication in the following areas, and what changes would you make to improve communication:

Area	Mechanism	Effective?	Improvements?
Design intent or overall objective			
Changes in design intent			
Conceptual design			
Detailed design			
Changes in conceptual or detailed design			
Constructability			
Construction packages			
Individual merit and performance			
Overall effectiveness and achievement of alliance			
Other			

19. Are incentives used to improve the effectiveness or efficiency of the alliance? If yes, in your opinion are the incentives effective in shaping the desired behavior? Do you think

existing or new incentives would help the alliance better meet your company's needs in the future?

20. Based on your experience to date, when the existing alliance relationship comes up for renewal, would you recommend renewal as is? If no, why?

21. Please add any other comments you have based on your current and past experience with alliance relationships for ongoing maintenance and turnaround work in operating plants. Please use the back side for additional comments.

Appendix II Preliminary Questionnaire for Operating Company

Preliminary Questionnaire: Operating Company

The purpose of the Preliminary Questionnaire is to identify common themes and elements of Alliance relationships between operating companies and engineering contractors for ongoing maintenance and turnaround work in operating plants. To identify common themes, open-ended questions are used. Later in the study a second questionnaire will be developed based on the themes and issues identified from this questionnaire.

The purpose of the overall study is to assess the effectiveness of these relationships and to identify key success factors, "best practices", and frictions / problems.

Please fill out all questions. If a particular question is not relevant to you, please indicate by NA (not applicable). Please also feel free to add comments throughout this questionnaire.

Note: **all replies to this survey will be kept confidential**, and data from the survey will only be released on an aggregated basis. No individual responses or comments will be attributed to a specific company or individual.

Part I: Demographic Information

1. Name:

2. Company:

3. Job Title:

4. Years with Company:

5. Years in Current Role:

6. What alliance are you involved in:

7. Please describe your role in the alliance:

8. Did you play an active role in creating or renegotiating the current alliance (describe):

9. Have you been involved in another alliance? If yes, please describe.

Part II: The Alliance

22. How long has the current alliance been in place?

23. What is the scope of the current alliance:

- What specific roles does your alliance partner perform (conceptual engineering, detailed engineering, procurement, construction management, construction, other)?

- Does your company reserve certain kinds of work for the alliance partner? Are there any kinds of task that are excluded in the alliance?

- Is there a guarantee of level of work for the alliance partner? How does the alliance partner adjust to changes in level of workload (up and down)?

- What other comments do you have on the scope of the current alliance?

24. Is the current alliance partner the first engineering contractor to have an ongoing alliance relationship at your plant? If no, please briefly recap the history of previous

partners, using the backside if necessary. In particular, can you please identify why your company changed alliance partners?

25. How did your company select your current alliance partner?

26. Why did your company enter the alliance, i.e. what were the company's goals in creating the alliance? Please list all reasons, and then please put a check mark by those you consider to be of high importance.

27. What do you think are the reasons that your company's alliance partner entered the alliance?

28. Could you tell us your personal satisfaction level with the alliance and why?

29. What's your company's satisfaction level with the alliance and why?

30. What do you think is the satisfaction level of your company's alliance partner with the alliance? Why?

31. What did the alliance replace, i.e. before the current alliance partner how was the maintenance and turnaround engineering work done that is now performed by the partner? (Examples: in house engineering resources, individual bid packages, previous alliance partner, etc.) In your opinion, was the quality of engineering work and project management better or worse under the previous system? Was the cost higher or lower under the previous system?

32. How does your alliance partner fit into your company's organization? In your perception, is your company's alliance partner:

- Integrated into your company's organization as a co-mingled team?

- Operating within your company as a separate team?

- A mix of these two, or other? (Please be specific.)

33. What measures do you or your company use to assess the effectiveness of the alliance (e.g. intuitive judgment, informal measures, formal measures)? If formal measures, what are they?

34. Does your alliance partner use the same measures to assess the effectiveness of the alliance? If no, what other measures do they use?

35. Is there a periodic review of the performance of your company's alliance partner? If yes, how often does this occur, is the feedback one-way or two ways, and what factors are considered?

36. What factors do you consider in general to be key to the success of an alliance for ongoing work in an operating plant? To what extent are these present in your company's current alliance?

37. What factors do you think impair the effectiveness of an ongoing alliance? To what extent are these present in your company's current alliance?

38. Are there any disadvantages of the alliance? e.g. unexpected dependency on the alliance partner?

39. (1) Are you aware of any conflicts, tension, problems and issues between your company and your alliance partner? If yes, please list.

(2) Is there any process to deal with the problem? If yes, please describe.

(3) Is the process effective? Please provide examples.

(4) Are there any problems in Alliance that are attempted to resolved but failed? Please list and provide examples.

(5) How would you make changes to the problem resolution process to make it more effective?

40. Are there effective mechanisms in place to communicate between your company and its alliance partner? From your perspective, how effective is the communication in the following areas, and what changes would you make to improve communication:

Area	Mechanism	Effective?	Improvements?
Design intent or overall objective			
Changes in design intent			
Conceptual design			
Detailed design			
Changes in conceptual or detailed design			
Constructability			
Construction packages			
Individual merit and performance			
Overall effectiveness and achievement of alliance			
Other			

41. Are incentives used to improve the effectiveness or efficiency of the alliance? If yes, in your opinion are the incentives effective in shaping the desired behavior? Do you think existing or new incentives would help the alliance better meet your company's needs in the future?

42. Based on your experience to date, when the existing alliance relationship comes up for renewal, would you recommend renewal with the current partner? With a new partner? A different method to execute the work the alliance partner now performs? Why? Please be as specific as possible about what changes you would recommend, and what benefit they would convey to your company.

43. Please add any other comments you have based on your current and past experience with alliance relationships for ongoing maintenance and turnaround work in operating plants. Please use the backside for additional comments.

Appendix III Statistical Survey for Engineering Company

Statistical Survey : Engineering Company

The purpose of this second follow up statistical survey is to incorporate the findings of the preliminary questionnaire and identify the frequency of occurrence of success factors and problems in alliance relationships. We estimate that this survey will take ½ hour to complete.

The purpose of the overall study is to assess the effectiveness of these relationships and to identify key success factors, "best practices", and frictions / problems.

Please fill out all questions. If a particular question is not relevant to you, please indicate by NA (not applicable). Please also feel free to add comments throughout this questionnaire.

Note: **all replies to this survey will be kept confidential**, and data from the survey will only be released on an aggregated basis. No individual responses or comments will be attributed to a specific company or individual.

Name: ______________________

Company: ___________________

Alliance involving: ________________

On a scale where "5" means you strongly agree (SA) in a subject and "1" means you strongly disagree (SD), how would you rate your agreement with the following items? Please put your answer in the right-hand-side shaded column.

1. Factors that you think your company values in forming an alliance.

		SD				SA	
a.	Develop new expertise	1	2	3	4	5	
b.	Secure work load	1	2	3	4	5	
c.	Improve project execution	1	2	3	4	5	
d.	Springboard to large project	1	2	3	4	5	
e.	Flexibility to cycle of business	1	2	3	4	5	
f.	Boost project quality	1	2	3	4	5	
g.	Attract more qualified engineers in a less remote environment	1	2	3	4	5	
h.	Reduce the burden of frequent bidding and contracting	1	2	3	4	5	
i.	Others (Please list) ______________________	1	2	3	4	5	

2. The key factors of alliance success.

		SD				SA	
a.	Trust	1	2	3	4	5	
b.	Maintaining core team of staff	1	2	3	4	5	
c.	Support from all level of your own company	1	2	3	4	5	
d.	Support from all level of your alliance partner	1	2	3	4	5	
e.	Good procedure	1	2	3	4	5	
f.	Cooperative and constructive attitude	1	2	3	4	5	
g.	Technical competence	1	2	3	4	5	
h.	Flexibility	1	2	3	4	5	
i.	Co-location ("Engineering company and operating company personnel in the same location")	1	2	3	4	5	
j.	No punitive measures	1	2	3	4	5	
k.	Financial incentive for engineering companies	1	2	3	4	5	

		SD				SA	
	companies						
l.	Financial incentive for individuals	1	2	3	4	5	
m.	Recognition for individuals	1	2	3	4	5	
n.	Others (Please list) ______________________	1	2	3	4	5	

3. Factors impair the alliance success.

		SD				SA	
a.	Lack of trust	1	2	3	4	5	
b.	Poor procedures	1	2	3	4	5	
c.	Poor attitudes	1	2	3	4	5	
d.	Poor communication of scope changes	1	2	3	4	5	
e.	Poor communication of schedule and budget changes	1	2	3	4	5	

		SD				SA	
f.	Lack of adequate knowledge or experience to do the job	1	2	3	4	5	
g.	Partners work in separate offices	1	2	3	4	5	
h.	Bureaucracy						
i.	Incompatible management styles	1	2	3	4	5	
j.	Lack of same vision between partners	1	2	3	4	5	
k.	Low quality of staff assigned to the alliance	1	2	3	4	5	
l.	Core team staff not maintained in engineering company	1	2	3	4	5	
m.	Blaming	1	2	3	4	5	
n.	Lack of initiative	1	2	3	4	5	
o.	"Us and them" problems	1	2	3	4	5	
p.	Resentment or job insecurity feeling from operating company staff	1	2	3	4	5	

		SD				SA	
q.	A higher level of cost, quality and schedule problems	1	2	3	4	5	
r.	Communication breakdown when trust erodes on either side of alliance	1	2	3	4	5	
s.	Operating company poaching staff of engineering company	1	2	3	4	5	
t.	Nature of work not challenging	1	2	3	4	5	
u.	Lower level of individual career development opportunities	1	2	3	4	5	
v.	Lower level of job rotation	1	2	3	4	5	
w.	Others (Please list) ____________________	1	2	3	4	5	

4. Disadvantages of the alliance

		SD				SA	
a.	Dependence on the alliance partner	1	2	3	4	5	

		SD				SA	
b.	Key personnel not available for other work may limit the engineering company's opportunities to go after new work	1	2	3	4	5	
c.	Cost, schedule and quality problems	1	2	3	4	5	
d.	Complacency in a mature alliance leading to inflated estimates in work effort or diminished quality	1	2	3	4	5	
e.	Slower response to urgent requests from the operating company	1	2	3	4	5	
f.	Others (Please list) ______________________	1	2	3	4	5	

5. Please rate the alliance's capability to perform the following steps.

	Poor	Fair	Good	Excellent	
a. Preparing good and workable procedures.	1	2	3	4	
b. Following standard processes or procedures.	1	2	3	4	

	Poor	Fair	Good	Excellent	
procedures.					
c. Flexibility in facing unusual circumstances.	1	2	3	4	
d. Effective and well-communicated design change procedures.	1	2	3	4	
e. Easily and openly share technical data required by the partner.	1	2	3	4	
f. Easily and openly share assessment of the partner's performance.	1	2	3	4	
g. Meeting cost, quality and schedule targets.	1	2	3	4	
h. Implementing "Value Engineering".	1	2	3	4	
i. Timely response to partner's requests.	1	2	3	4	
j. Open to innovations and new ideas.	1	2	3	4	
k. Opportunities for "cross training" to develop expertise.	1	2	3	4	

	Poor	Fair	Good	Excellent	
l. Team building.	1	2	3	4	
m. Resolving problems and disputes.	1	2	3	4	
n. Evaluating alliance performance	1	2	3	4	
o. How would you rate overall effectiveness of the alliance?	1	2	3	4	

6. How much do you agree with each of the following statements?

	SD				SA	
a. "Selecting the right partner" is more important than "having good communication, procedures and attitudes"	1	2	3	4	5	
b. Objective ("Hard") performance measures do not work for the alliance.	1	2	3	4	5	
c. In the early days an alliance always have problems.	1	2	3	4	5	
d. Financial incentives for the engineering company help to improve performance.	1	2	3	4	5	

	SD				SA	
e. Co-location (Engineering company and operating company personnel working in the same location") reduces blaming and mistrust.	1	2	3	4	5	
f. Measuring individual merit and performance helps alliance effectiveness.	1	2	3	4	5	
g. Punishment creates dissension and reduces trust.	1	2	3	4	5	
h. Alliance helps to gain a diversity of talent that is not usually found in a single company.	1	2	3	4	5	

7. Demographic Information

1) What is your role in the alliance?

   a. Senior Manager

   b. Supervisor

   c. Senior Engineer

   d. Engineer

   Your answer: ________________

2) How long you have been involved in the current alliance?

a. Less than two year

b. Two-three years

c. Four-five years

d. More than five years

Your answer: _______________

3) Has your company been involved in any other alliances?

a. None

b. One

c. Two

d. Three or more than three

Your answer: ________________

Appendix IV Statistical Survey for Operating Company

Statistical Survey : Operating Company

The purpose of this second follow up statistical survey is to incorporate the findings of the preliminary questionnaire and identify the frequency of occurrence of success factors and problems in alliance relationships. We estimate that this survey will take ½ hour to complete.

The purpose of the overall study is to assess the effectiveness of these relationships and to identify key success factors, "best practices", and frictions / problems.

Please fill out all questions. If a particular question is not relevant to you, please indicate by NA (not applicable). Please also feel free to add comments throughout this questionnaire.

Note: **all replies to this survey will be kept confidential**, and data from the survey will only be released on an aggregated basis. No individual responses or comments will be attributed to a specific company or individual.

Name: ______________________

Company: ___________________

Alliance involving: ________________

On a scale where "5" means you strongly agree (SA) in a subject and "1" means you strongly disagree (SD), how would you rate your agreement with the following items? Please put your answer in the right-hand-side shaded column.

1. Factors that you think your company values in forming an alliance.

		SD				SA	
a.	Access to new expertise	1	2	3	4	5	
b.	Concentrate on core business	1	2	3	4	5	
c.	Downsizing	1	2	3	4	5	
d.	Improve project execution	1	2	3	4	5	
e.	Flexibility to cycle of business	1	2	3	4	5	
f.	Boost project quality	1	2	3	4	5	
g.	Attract more qualified engineers in a less remote environment	1	2	3	4	5	
h.	Reduce the burden of frequent bidding and contracting	1	2	3	4	5	
i.	Others (Please list) ____________________	1	2	3	4	5	

2. The key factors of alliance success.

	SD				SA	
a. Trust	1	2	3	4	5	
b. Maintaining core team of staff	1	2	3	4	5	
c. Support from all levels of your company	1	2	3	4	5	
d. Support from all levels of alliance partner	1	2	3	4	5	
e. Good procedure	1	2	3	4	5	
f. Cooperative and constructive attitude	1	2	3	4	5	
g. Technical competence	1	2	3	4	5	
h. Flexibility	1	2	3	4	5	
i. Co-location ("Engineering company and operating company personnel in the same location")	1	2	3	4	5	
j. No punitive measures	1	2	3	4	5	
k. Financial incentive for engineering company	1	2	3	4	5	
l. Financial incentive for individuals	1	2	3	4	5	

	SD				SA	
m. Recognition for individuals	1	2	3	4	5	
n. Others (Please list) ________________________	1	2	3	4	5	

3. Factors that impair alliance success.

	SD				SA	
a. Lack of trust	1	2	3	4	5	
b. Poor procedures	1	2	3	4	5	
c. Poor attitudes	1	2	3	4	5	
d. Poor communication of scope changes	1	2	3	4	5	
e. Poor communication of schedule and budget changes	1	2	3	4	5	
f. Lack of adequate knowledge or experience to do the job	1	2	3	4	5	
g. Partners work in separate offices	1	2	3	4	5	

	SD				SA	
h. Bureaucracy	1	2	3	4	5	
i. Incompatible management styles	1	2	3	4	5	
j. Lack of same vision between partners	1	2	3	4	5	
k. Low quality of staff assigned to the alliance	1	2	3	4	5	
l. Core team staff not maintained in engineering company	1	2	3	4	5	
m. Blaming	1	2	3	4	5	
n. Lack of initiative	1	2	3	4	5	
o. "Us and them" problems	1	2	3	4	5	
p. Resentment or job insecurity feeling from operating company staff	1	2	3	4	5	
q. A higher level of cost, quality and schedule problems	1	2	3	4	5	
r. Communication breakdown when trust erodes on either side of alliance	1	2	3	4	5	

	SD				SA	
s. Operating company poaching staff of engineering company	1	2	3	4	5	
t. Nature of work not challenging	1	2	3	4	5	
u. Lower level of individual career development opportunities	1	2	3	4	5	
v. Lower level of job rotation	1	2	3	4	5	
w. Others (Please list) ________________________	1	2	3	4	5	

4. Disadvantages of the alliance

	SD				SA	
a. Dependence on the alliance partner	1	2	3	4	5	
b. Loss of expertise in own company	1	2	3	4	5	
c. Transient nature of engineering staff and lack of experience specific to site	1	2	3	4	5	
d. Cost, schedule and quality problems	1	2	3	4	5	

	SD				SA	
e. Cumbersome procedures due to work with a partner	1	2	3	4	5	
f. Impact on personnel changes and loss of job slots for career development	1	2	3	4	5	
g. Complacency in a mature alliance leading to inflated estimates in work effort or diminished quality	1	2	3	4	5	
h. Slower response to urgent requests from the operating company	1	2	3	4	5	
i. Knowledge and experience is not retained in-house	1	2	3	4	5	
j. Others (Please list) ______________________	1	2	3	4	5	

5. Please rate the alliance's capability to perform the following steps.

	Poor	Fair	Good	Excellent	
a. Preparing good and workable procedures.	1	2	3	4	

	Poor	Fair	Good	Excellent	
b. Following standard processes or procedures.	1	2	3	4	
c. Flexibility in facing unusual circumstances.	1	2	3	4	
d. Effective and well-communicated design change procedures.	1	2	3	4	
e. Easily and openly share technical data required by the partner.	1	2	3	4	
f. Easily and openly share assessment of the partner's performance	1	2	3	4	
g. Meeting cost, quality and schedule targets.	1	2	3	4	
h. Implementing "Value Engineering".	1	2	3	4	
i. Timely response to partner's requests.	1	2	3	4	

	Poor	Fair	Good	Excellent	
j. Open to innovations and new ideas.	1	2	3	4	
k. Opportunities for "cross training" to develop expertise.	1	2	3	4	
l. Team building.	1	2	3	4	
m. Resolving problems and disputes.	1	2	3	4	
n. Evaluating alliance performance	1	2	3	4	
o. How would you rate overall effectiveness of the alliance?	1	2	3	4	

6. How much do you agree with each of the following statements?

	SD				SA	
a. "Selecting the right partner" is more important than "having good communication, procedures and attitudes"	1	2	3	4	5	

	SD				SA	
b. Objective ("Hard") performance measures do not work for the alliance.	1	2	3	4	5	
c. In the early days an alliance always have problems.	1	2	3	4	5	
d. Financial incentives for the engineering company help to improve performance.	1	2	3	4	5	
e. Co-location (Engineering company and operating company personnel working in the same location") reduces blaming and mistrust.	1	2	3	4	5	
f. Measuring individual merit and performance helps alliance effectiveness.	1	2	3	4	5	
g. Punishment creates dissension and reduces trust.	1	2	3	4	5	
h. Alliance helps to gain a diversity of talent that is not usually found in a single company.	1	2	3	4	5	

7. Demographic Information

1) What is your role in the alliance?

e. Senior Manager

f. Supervisor

g. Senior Engineer

h. Engineer

Your answer: _______________

2) How long you have been involved in the current alliance?

e. Less than two years

f. Two-three years

g. Four-five years

h. More than five years

Your answer: ________________

3) Has your company been involved in any other alliances?

a. None

b. One

c. Two

d. Three or more

Your answer: _________________

Appendix V Correlations Between Key Success Factors

	2-a	2-b	2-c	2-d	2-e	2-f	2-g	2-h	2-I	2-j	2-k	2-l	2-m
2-a	1												
2-b	0.412028	1											
2-c	0.570664	0.442144	1										
2-d	0.735215	0.401176	0.686554	1									
2-e	0.471935	0.537864	0.549327	0.574301	1								
2-f	0.660601	0.461754	0.643743	0.619113	0.584064	1							
2-g	0.600245	0.481267	0.569415	0.687181	0.697725	0.567705	1						
2-h	0.584677	0.397757	0.627129	0.441028	0.45078	0.535342	0.625068	1					
2-I	0.016274	0.257092	0.159845	0.067799	0.260593	0.187757	0.148848	0.21814	1				
2-j	-0.14947	-0.059316	-0.227459	-0.159843	-0.1999	-0.123893	-0.205071	-0.073463	-0.150957	1			
2-k	-0.021615	-0.116819	-0.097681	0.03708	-0.045962	-0.052721	-0.172988	-0.140928	-0.35894	0.40022	1		
2-l	0.280607	0.306231	0.315412	0.376509	0.356186	0.419627	0.226181	0.234378	-0.100463	0.194459	0.566087	1	
2-m	0.524018	0.381247	0.534213	0.527447	0.578257	0.687624	0.530652	0.601016	0.047105	0.106468	0.145986	0.54616	1

Appendix VI Statistical Data: Engineering Company vs. Operating Company

Engineering Companies								
	1	company values in forming an alliance						
	1-a	1-b	1-c	1-d	1-e	1-f	1-g	1-h
Mean	3.56	4.17	3.71	4.11	3.76	3.82	2.88	3.94
Standard Deviation	0.78	0.86	0.85	0.90	0.75	0.53	0.86	1.11
Standard Error for the Mean	0.18	0.20	0.21	0.21	0.18	0.13	0.21	0.26
Frequency Distribution								
Number of r=1	0	0	0	0	0	0	1	0
Number of r=2	1	0	1	1	0	0	4	3
Number of r=3	8	5	6	3	7	4	8	2
Number of r=4	7	5	7	7	7	12	4	6
Number of r=5	2	8	3	7	3	1	0	7
Operating Companies								
	1	company values in forming an alliance						
	1-a	1-b	1-c	1-d	1-e	1-f	1-g	1-h
Mean	3.11	4.22	3.89	3.28	4.22	3.22	2.50	3.39
Standard Deviation	1.18	1.22	1.02	1.23	1.06	1.22	1.34	1.46
Standard Error for the Mean	0.28	0.29	0.24	0.29	0.25	0.29	0.32	0.34
Frequency Distribution								
Number of r=1	2	1	0	1	0	1	5	3
Number of r=2	3	1	3	5	2	5	5	2
Number of r=3	6	2	1	3	2	4	4	3
Number of r=4	5	3	9	6	4	5	2	5
Number of r=5	2	11	5	3	10	3	2	5
T-test (OC vs. EC)	19.4%			23.7%	14.9%	6.8%	32.0%	20.8%

Engineering Companies													
	2 key factors of success												
	2-a	2-b	2-c	2-d	2-e	2-f	2-g	2-h	2-I	2-j	2-k	2-l	2-m
Mean	4.61	4.33	4.11	4.44	3.83	4.61	3.94	3.89	3.28	3.65	3.71	3.29	3.72
Standard Deviation	0.50	0.59	0.58	0.70	0.92	0.61	0.73	0.68	1.41	1.06	0.85	0.85	1.02
Standard Error for the Mean	0.12	0.14	0.14	0.17	0.22	0.14	0.17	0.16	0.33	0.26	0.21	0.21	0.24
Frequency Distribution													
Number of r=1	0	0	0	0	0	0	0	0	3	1	0	0	0
Number of r=2	0	0	0	0	1	0	0	0	2	0	1	3	2
Number of r=3	0	1	2	2	6	1	5	5	4	7	6	7	6
Number of r=4	7	10	12	6	6	5	9	10	5	5	7	6	5
Number of r=5	11	7	4	10	5	12	4	3	4	4	3	1	5
Operating Companies													
	2 key factors of success												
	2-a	2-b	2-c	2-d	2-e	2-f	2-g	2-h	2-I	2-j	2-k	2-l	2-m
Mean	4.22	4.39	4.00	4.06	4.11	4.11	4.28	4.06	3.72	3.28	3.11	2.44	3.56
Standard Deviation	1.00	0.78	1.03	0.87	0.96	1.23	0.96	1.16	1.27	1.07	1.08	1.04	1.29
Standard Error for the Mean	0.24	0.18	0.24	0.21	0.23	0.29	0.23	0.27	0.30	0.25	0.25	0.25	0.30
Frequency Distribution													
Number of r=1	1	0	1	1	1	2	1	1	1	1	1	4	2
Number of r=2	0	1	1	0	0	0	0	1	2	2	4	5	2
Number of r=3	1	0	0	0	1	0	0	2	5	9	7	6	2
Number of r=4	8	8	11	13	10	8	9	6	3	3	4	3	8
Number of r=5	8	9	5	4	6	8	8	8	7	3	2	0	4
T-test (OC vs. EC)	15.4%	81.1%	69.3%	15.1%	38.3%	13.5%	24.8%	60.3%	32.7%	31.3%	7.8%	1.2%	67.0%

Engineering Companies															
	3	Factors that impair alliance success													
	3-a	3-b	3-c	3-d	3-e	3-f	3-g	3-h	3-I	3-j	3-k	3-l	3-m	3-n	3-o
Mean	4.41	3.76	4.18	4.47	4.41	3.76	3.00	3.29	3.53	3.76	3.94	4.00	4.00	3.82	4.24
Standard Deviation	0.80	0.75	0.81	0.51	0.62	1.03	1.03	1.10	1.12	1.15	0.83	1.06	1.00	0.95	0.75
Standard Error for the Mean	0.19	0.18	0.19	0.12	0.15	0.24	0.25	0.26	0.27	0.27	0.19	0.25	0.24	0.22	0.18
Frequency Distribution															
Number of r=1	1	1	1	0	0	1	1	1	0	2	1	1	0	1	0
Number of r=2	0	0	1	1	1	2	4	3	6	1	1	2	2	1	2
Number of r=3	3	7	1	0	1	5	9	6	1	4	3	3	5	6	0
Number of r=4	4	7	9	9	8	5	1	6	8	6	9	5	4	5	10
Number of r=5	10	3	6	8	8	5	2	2	3	5	4	7	7	5	6
Operating Companies															
	3	Factors that impair alliance success													
	3-a	3-b	3-c	3-d	3-e	3-f	3-g	3-h	3-I	3-j	3-k	3-l	3-m	3-n	3-o
Mean	4.44	4.28	4.17	4.11	4.22	4.11	3.33	3.72	3.56	3.83	4.33	4.22	4.22	3.72	4.39
Standard Deviation	0.70	0.89	1.20	1.08	0.94	0.96	1.03	1.13	1.20	1.15	1.08	1.06	0.81	0.96	0.85
Standard Error for the Mean	0.17	0.21	0.28	0.25	0.22	0.23	0.24	0.27	0.28	0.27	0.26	0.25	0.19	0.23	0.20
Frequency Distribution															
Number of r=1	0	0	1	0	0	0	1	1	0	0	1	1	0	0	0
Number of r=2	0	1	1	2	2	1	2	1	5	4	0	0	0	2	0
Number of r=3	2	2	2	3	0	4	7	5	3	1	2	2	4	5	4
Number of r=4	6	6	4	4	8	5	6	6	5	7	4	6	6	7	3
Number of r=5	10	9	10	9	8	8	2	5	5	6	11	9	8	4	11
T-test (OC vs. EC)	48.0%	4.0%	66.5%	48.2%	85.2%	17.6%	26.8%	23.4%	77.8%	58.9%	12.9%	32.1%	30.2%	87.5%	34.8%

Engineering Companies									
	4	Disadvantage of the alliance							
	4-a	4-b	4-c	4-d	4-e	4-f	4-g	4-h	4-l
Mean	2.47	3.39	2.39	2.29	2.33				
Standard Deviation	0.80	0.98	1.09	1.10	1.19				
Standard Error for the Mean	0.19	0.23	0.26	0.27	0.28				
Frequency Distribution									
Number of r=1	2	0	6	4	6				
Number of r=2	6	4	1	7	4				
Number of r=3	8	5	9	4	4				
Number of r=4	1	7	2	1	4				
Number of r=5	0	2	0	1	0				
Operating Companies									
	4	Disadvantage of the alliance							
	4-a	4-b	4-c	4-d	4-e	4-f	4-g	4-h	4-l
Mean	3.65	3.59	4.12	3.88	3.35	3.12	3.35	2.94	4.00
Standard Deviation	1.08	1.53	0.92	0.99	1.18	1.35	1.20	1.28	1.00
Standard Error for the Mean	0.26	0.36	0.22	0.23	0.28	0.32	0.28	0.30	0.24
Frequency Distribution									
Number of r=1	0	3	0	0	0	2	0	1	0
Number of r=2	3	1	1	2	6	4	5	8	1
Number of r=3	5	3	3	4	5	4	6	2	5
Number of r=4	5	3	6	7	3	4	2	4	4
Number of r=5	5	8	8	5	4	4	5	3	8
T-test (OC vs. EC)									

Engineering Companies															
	5 Rate the alliance's capability to perform the following steps														
	5-a	5-b	5-c	5-d	5-e	5-f	5-g	5-h	5-i	5-j	5-k	5-l	5-m	5-n	5-o
Mean	3.06	3.22	3.33	3.28	3.44	3.17	2.94	2.89	3.22	2.94	2.83	2.72	3.17	3.17	3.17
Standard Deviation	0.73	0.65	0.77	0.75	0.78	0.86	0.54	0.76	0.73	0.87	1.15	0.83	0.62	0.62	0.51
Standard Error for the Mean	0.04	0.04	0.04	0.04	0.04	0.05	0.03	0.04	0.04	0.05	0.06	0.05	0.03	0.03	0.03
Frequency Distribution															
Number of r=1	1	0	0	0	0	1	0	1	1	1	3	1	0	0	0
Number of r=2	1	2	3	3	3	2	3	3	0	4	4	6	2	2	1
Number of r=3	12	10	6	7	4	8	13	11	11	8	4	8	11	11	13
Number of r=4	4	6	9	8	11	7	2	3	6	5	7	3	5	5	4
Number of r=5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operating Companies															
	5 Rate the alliance's capability to perform the following steps														
	5-a	5-b	5-c	5-d	5-e	5-f	5-g	5-h	5-i	5-j	5-k	5-l	5-m	5-n	5-o
Mean	2.89	3.06	2.44	2.44	2.83	2.72	1.89	2.22	2.39	2.89	2.28	2.33	2.56	2.67	2.50
Standard Deviation	0.76	0.94	1.10	0.92	0.99	0.83	0.83	0.81	1.04	0.90	0.96	0.91	0.70	0.84	0.79
Standard Error for the Mean	0.18	0.22	0.26	0.22	0.23	0.19	0.20	0.19	0.24	0.21	0.23	0.21	0.17	0.20	0.19
Frequency Distribution															
Number of r=1	1	2	5	3	1	1	6	3	4	2	5	4	1	1	2
Number of r=2	3	1	3	6	6	6	9	9	6	2	4	5	7	7	6
Number of r=3	11	9	7	7	7	8	2	5	5	10	8	8	9	7	9
Number of r=4	3	6	3	2	3	3	1	1	3	4	1	1	1	3	1
Number of r=5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
T-test (OC vs. EC)	50.5%	53.9%	0.8%	0.6%	4.8%	12.3%	0.0%	1.5%	0.9%	85.2%	12.5%	18.8%	0.9%	5.1%	0.5%

Engineering Companies							
	6 How much you agree with each of the following statements						
	6-a	6-b	6-c	6-d	6-e	6-f	6-g	6-h
Mean	2.61	2.28	3.88	3.17	3.56	3.44	4.22	3.94
Standard Deviation	0.92	1.13	0.93	1.25	1.25	0.86	1.00	0.73
Standard Error for the Mean	0.05	0.06	0.05	0.07	0.07	0.05	0.06	0.04
Frequency Distribution								
Number of r=1	1	5	0	2	2	0	1	0
Number of r=2	9	6	1	4	1	2	0	0
Number of r=3	4	5	5	3	4	8	1	5
Number of r=4	4	1	6	7	7	6	8	9
Number of r=5	0	1	5	2	4	2	8	4
Operating Companies								
	6 How much you agree with each of the following statements							
	6-a	6-b	6-c	6-d	6-e	6-f	6-g	6-h
Mean	2.94	2.56	3.94	2.88	4.00	3.76	4.06	3.17
Standard Deviation	1.26	1.20	1.26	1.22	0.91	0.83	0.97	1.10
Standard Error for the Mean	0.30	0.28	0.30	0.30	0.21	0.20	0.23	0.26
Frequency Distribution								
Number of r=1	3	3	1	2	0	0	0	2
Number of r=2	4	8	2	5	1	1	1	2
Number of r=3	3	2	2	5	4	5	4	6
Number of r=4	7	4	5	3	7	8	5	7
Number of r=5	1	1	8	2	6	3	7	1
T-test (OC vs. EC)	37.1%	47.9%	86.9%	50.0%	23.1%	27.0%	62.7%	1.8%

Appendix VII Statistical Data: Different Level of Staff

		1	company values in forming an alliance						
		1-a	1-b	1-c	1-d	1-e	1-f	1-g	1-h
T-test	Manegrial vs. Engineering	91.4%				28.5%	55.5%	69.5%	93.4%
	Senior vs. Jr.	67.2%				47.9%	93.9%	77.2%	68.3%
	Senior Manager vs. Supervisor	40.3%				6.4%	47.6%	76.4%	32.0%
	Senior Manager vs. Senior Engineer	53.2%				3.0%	29.1%	55.3%	41.1%
	Senior Manager vs. Engineer	86.7%				2.7%	59.4%	100.0%	76.7%
	Supervisor vs. Senior Engineer	76.4%				86.7%	79.1%	72.3%	84.7%
	Supervisor vs. Engineer	48.8%				68.5%	100.0%	71.3%	78.4%
	Senior Engineer vs. Engineer	64.7%				80.0%	84.7%	47.6%	88.1%
Mean Value	Senior Manager	3.57				4.67	3.83	2.50	4.00
	Supervisor	3.17				3.92	3.50	2.67	3.50
	Senior Engineer	3.31				3.85	3.38	2.85	3.62
	Engineer	3.50				3.75	3.50	2.50	3.75
	Senior	3.40				4.11	3.53	2.74	3.75
	Jr.	3.25				3.88	3.50	2.63	3.56
	Managiral Level	3.32				4.17	3.61	2.61	3.68
	Engineering Level	3.35				3.82	3.41	2.76	3.65
Gap	Managiral - Engineering	-0.04				0.34	0.20	-0.15	0.04

		2 key factors of success												
		2-a	2-b	2-c	2-d	2-e	2-f	2-g	2-h	2-I	2-j	2-k	2-l	2-m
T-test	Manegrial vs. Engineering	8.4%	15.6%	23.3%	60.1%	86.8%	48.1%	73.0%	85.4%	10.4%	48.5%	35.3%	64.8%	41.8%
	Senior vs. Jr.	79.8%	40.4%	96.6%	70.0%	88.1%	94.2%	77.7%	87.9%	80.2%	83.0%	39.0%	28.5%	16.2%
	Senior Manager vs. Supervisor	34.5%	75.5%	36.7%	91.5%	76.6%	33.2%	95.5%	63.2%	97.6%	46.8%	86.5%	77.5%	50.0%
	Senior Manager vs. Senior Engineer	1.1%	45.0%	5.3%	69.3%	73.3%	12.6%	97.3%	49.5%	56.3%	36.4%	45.8%	96.5%	61.8%
	Senior Manager vs. Engineer	0.1%	61.2%	39.4%	92.7%	83.9%	70.9%	50.4%	86.1%	6.7%	53.1%	100.0%	15.6%	46.0%
	Supervisor vs. Senior Engineer	48.4%	20.2%	52.6%	63.2%	100.0%	69.1%	97.3%	86.2%	35.5%	78.2%	34.8%	72.4%	23.2%
	Supervisor vs. Engineer	16.6%	40.2%	87.6%	84.5%	100.0%	79.1%	49.7%	58.2%	0.2%	100.0%	85.4%	15.5%	87.9%
	Senior Engineer vs. Engineer	19.0%	91.0%	74.9%	75.5%	100.0%	57.6%	47.7%	49.0%	2.0%	84.7%	42.2%	11.3%	24.0%
Mean Value	Senior Manager	4.86	4.29	4.43	4.29	3.86	4.71	4.14	4.14	3.14	3.00	3.50	2.67	3.57
	Supervisor	4.50	4.17	4.08	4.33	4.00	4.33	4.17	3.92	3.17	3.50	3.58	2.83	3.92
	Senior Engineer	4.23	4.54	3.85	4.15	4.00	4.15	4.15	3.85	3.62	3.62	3.15	2.69	3.31
	Engineer	4.00	4.50	4.00	4.25	4.00	4.50	3.75	4.25	4.75	3.50	3.50	3.75	4.00
	Senior	4.45	4.45	4.05	4.20	3.95	4.35	4.15	3.95	3.45	3.42	3.26	2.68	3.40
	Jr.	4.38	4.25	4.06	4.31	4.00	4.38	4.06	4.00	3.56	3.50	3.56	3.06	3.94
	Managiral Level	4.63	4.21	4.21	4.32	3.95	4.47	4.16	4.00	3.16	3.33	3.56	2.78	3.79
	Engineering Level	4.18	4.53	3.88	4.18	4.00	4.24	4.06	3.94	3.88	3.59	3.24	2.94	3.47
Gap	Managiral - Engineering	0.46	-0.32	0.33	0.14	-0.05	0.24	0.10	0.06	-0.72	-0.25	0.32	-0.16	0.32

		3 Factors that impair alliance success												
		3-a	3-b	3-c	3-d	3-e	3-f	3-g	3-h	3-I	3-j	3-k	3-l	3-m
T-test	Manegrial vs. Engineering	63.2%	32.5%	90.4%	67.1%	78.2%	91.3%	36.5%	29.8%	88.8%	84.4%	77.8%	31.3%	74.6%
	Senior vs. Jr.	56.3%	71.6%	84.8%	84.3%	70.1%	71.9%	55.3%	55.5%	14.9%	3.4%	34.5%	87.5%	96.9%
	Senior Manager vs. Supervisor	69.5%	80.1%	56.2%	22.6%	75.5%	74.4%	72.9%	37.1%	22.0%	11.0%	46.4%	73.9%	91.2%
	Senior Manager vs. Senior Engineer	69.8%	57.9%	43.2%	47.5%	75.3%	81.4%	62.7%	26.4%	52.0%	40.4%	90.1%	45.6%	79.1%
	Senior Manager vs. Engineer	18.4%	50.4%	61.2%	35.2%	25.4%	65.9%	20.5%	27.9%	29.0%	7.3%	55.0%	28.8%	85.2%
	Supervisor vs. Senior Engineer	95.1%	46.2%	88.4%	71.7%	97.4%	88.2%	85.0%	78.9%	41.0%	23.0%	48.9%	62.5%	82.0%
	Supervisor vs. Engineer	33.6%	42.2%	32.2%	7.0%	12.7%	88.4%	24.9%	55.1%	76.1%	50.8%	100.0%	37.7%	90.1%
	Senior Engineer vs. Engineer	23.1%	76.8%	22.7%	16.5%	15.1%	76.5%	27.7%	64.1%	46.8%	15.8%	59.4%	58.1%	100.0%
Mean Value	Senior Manager	4.14	3.86	4.29	4.43	4.29	3.71	2.86	3.00	3.00	3.00	3.86	3.71	4.14
	Supervisor	4.33	3.75	4.00	4.00	4.17	3.92	3.08	3.50	3.75	4.08	4.25	3.92	4.08
	Senior Engineer	4.31	4.08	3.92	4.15	4.15	3.85	3.15	3.62	3.38	3.54	3.92	4.15	4.00
	Engineer	4.75	4.25	4.50	4.75	4.75	4.00	4.00	4.00	4.00	4.50	4.25	4.50	4.00
	Senior	4.25	4.00	4.05	4.25	4.20	3.80	3.05	3.40	3.25	3.35	3.90	4.00	4.05
	Jr.	4.44	3.88	4.13	4.19	4.31	3.94	3.27	3.63	3.81	4.19	4.25	4.06	4.06
	Managiral Level	4.26	3.79	4.11	4.16	4.21	3.84	3.00	3.32	3.47	3.68	4.11	3.84	4.11
	Engineering Level	4.41	4.12	4.06	4.29	4.29	3.88	3.31	3.71	3.53	3.76	4.00	4.24	4.00
Gap	Managiral - Engineering	-0.15	-0.33	0.05	-0.14	-0.08	-0.04	-0.31	-0.39	-0.06	-0.08	0.11	-0.39	0.11

		5 Rate the alliance's capability to perform the following steps												
		5-a	5-b	5-c	5-d	5-e	5-f	5-g	5-h	5-I	5-j	5-k	5-l	5-m
T-test	Manegrial vs. Engineering	25.1%	79.2%	97.2%	23.2%	12.3%	5.2%	68.2%	15.2%	36.7%	82.7%	16.8%	12.9%	22.6%
	Senior vs. Jr.	13.4%	8.7%	48.8%	10.3%	66.0%	23.1%	80.6%	25.3%	76.3%	54.1%	52.9%	87.0%	41.2%
	Senior Manager vs. Supervisor	13.8%	26.4%	50.9%	51.1%	16.5%	7.0%	42.1%	56.7%	29.9%	84.6%	85.0%	67.4%	22.4%
	Senior Manager vs. Senior Engineer	9.4%	76.6%	68.1%	27.7%	6.9%	3.7%	35.1%	70.8%	20.5%	100.0%	49.0%	26.4%	16.5%
	Senior Manager vs. Engineer	8.4%	39.4%	57.1%	63.5%	14.2%	2.1%	74.0%	75.0%	50.7%	43.1%	63.0%	15.1%	8.9%
	Supervisor vs. Senior Engineer	77.3%	15.7%	68.8%	9.8%	52.3%	64.4%	94.3%	10.0%	71.6%	82.2%	18.6%	43.6%	82.6%
	Supervisor vs. Engineer	27.6%	81.6%	100.0%	91.3%	47.5%	8.5%	78.3%	18.9%	100.0%	50.1%	51.3%	22.7%	38.2%
	Senior Engineer vs. Engineer	21.6%	44.5%	76.1%	34.7%	76.8%	13.2%	74.0%	95.1%	85.3%	41.0%	94.5%	44.3%	47.2%
Mean Value	Senior Manager	3.43	3.43	3.14	2.86	3.71	3.57	2.71	2.57	3.29	3.00	2.71	2.86	3.29
	Supervisor	2.92	2.92	2.75	2.58	3.17	3.00	2.33	2.25	2.75	2.92	2.83	2.67	2.83
	Senior Engineer	3.00	3.31	2.92	3.23	2.92	2.85	2.31	2.77	2.62	3.00	2.31	2.38	2.77
	Engineer	2.25	2.75	2.75	2.50	2.75	2.00	2.50	2.75	2.75	2.50	2.25	2.00	2.50
	Senior	3.15	3.35	3.00	3.10	3.20	3.10	2.45	2.70	2.85	3.00	2.45	2.55	2.95
	Jr.	2.75	2.88	2.75	2.56	3.06	2.75	2.38	2.38	2.75	2.81	2.69	2.50	2.75
	Managiral Level	3.11	3.11	2.89	2.68	3.37	3.21	2.47	2.37	2.95	2.95	2.79	2.74	3.00
	Engineering Level	2.82	3.18	2.88	3.06	2.88	2.65	2.35	2.76	2.65	2.88	2.29	2.29	2.71
Gap	Managiral - Engineering	0.28	-0.07	0.01	-0.37	0.49	0.56	0.12	-0.40	0.30	0.07	0.50	0.44	0.29

		6	How much you agree with each of the following statements						
		6-a	6-b	6-c	6-d	6-e	6-f	6-g	6-h
T-test	Manegrial vs. Engineering	60.1%	75.7%	16.6%	34.6%	33.6%	6.3%	66.5%	62.9%
	Senior vs. Jr.	46.7%	51.0%	82.3%	12.7%	0.5%	7.2%	67.6%	50.5%
	Senior Manager vs. Supervisor	69.2%	36.9%	80.0%	59.1%	9.8%	33.8%	79.3%	57.1%
	Senior Manager vs. Senior Engineer	27.0%	65.1%	40.3%	49.6%	87.6%	48.5%	75.7%	94.5%
	Senior Manager vs. Engineer	66.6%	82.7%	30.6%	55.8%	13.3%	88.2%	52.1%	93.0%
	Supervisor vs. Senior Engineer	48.9%	59.0%	31.6%	14.0%	2.2%	3.3%	100.0%	47.6%
	Supervisor vs. Engineer	51.4%	38.9%	24.4%	83.0%	79.8%	20.8%	46.2%	74.8%
	Senior Engineer vs. Engineer	29.9%	75.1%	68.6%	26.6%	5.7%	53.1%	45.6%	95.7%
Mean Value	Senior Manager	2.57	2.14	3.57	3.00	3.29	3.57	4.14	3.43
	Supervisor	2.75	2.67	3.75	3.33	4.33	4.00	4.25	3.75
	Senior Engineer	3.08	2.38	4.15	2.58	3.38	3.25	4.25	3.46
	Engineer	2.25	2.25	4.33	3.50	4.25	3.50	3.50	3.50
	Senior	2.90	2.30	3.95	2.74	3.35	3.37	4.21	3.45
	Jr.	2.63	2.56	3.87	3.38	4.31	3.88	4.06	3.69
	Managiral Level	2.68	2.47	3.68	3.21	3.95	3.84	4.21	3.63
	Engineering Level	2.88	2.35	4.19	2.81	3.59	3.31	4.06	3.47
Gap	Managiral - Engineering	-0.20	0.12	-0.50	0.40	0.36	0.53	0.15	0.16

Appendix VIII Statistical Data: Different Types of Alliances

			1	company values in forming an alliance						
			1-a	1-b	1-c	1-d	1-e	1-f	1-g	1-h
T-Test	Leftover vs. Separate		49.6%				82.7%	13.5%	33.2%	7.4%
Gap	Leftover-Separate		-0.38				0.11	-0.89	-0.67	-1.36
T-Test	Leftover vs. Integrated		39.4%				51.4%	41.1%	30.6%	17.8%
Gap	Leftover-Integrated		-0.35				0.23	-0.30	-0.43	-0.82
T-Test	Separate vs. Integrate		96.4%				81.0%	26.4%	71.0%	34.6%
Gap	Separate-Integrated		0.02				0.12	0.59	0.24	0.54
Mean Value		Leftover	3.00				4.11	3.11	2.33	2.89
		Seperate	3.38				4.00	4.00	3.00	4.25
		Integrated	3.35				3.88	3.41	2.76	3.71

			2	key factors of success												
			2-a	2-b	2-c	2-d	2-e	2-f	2-g	2-h	2-I	2-j	2-k	2-l	2-m
T-Test	Leftover vs. Separate		77.6%	94.5%	5.8%	70.5%	66.0%	63.5%	70.5%	16.3%	24.5%	76.5%	31.4%	43.7%	57.9%
Gap	Leftover-Separate		-0.15	-0.03	1.07	0.21	0.24	0.33	0.21	0.83	0.78	-0.17	-0.54	0.47	0.40
T-Test	Leftover vs. Integrated		25.2%	7.2%	23.5%	88.3%	98.1%	54.9%	25.1%	28.7%	58.7%	84.2%	81.3%	20.8%	74.5%
Gap	Leftover-Integrated		-0.25	-0.37	0.27	0.04	-0.01	-0.14	0.33	0.33	0.25	-0.08	0.10	0.52	0.13
T-Test	Separate vs. Integrated		85.9%	40.5%	13.2%	74.1%	64.9%	50.4%	80.9%	37.5%	44.3%	87.1%	19.2%	93.6%	69.2%
Gap	Separate-Integrated		-0.10	-0.34	-0.80	-0.17	-0.24	-0.47	0.13	-0.50	-0.53	0.09	0.64	0.04	-0.27
Mean Value		Leftover	4.22	4.22	4.44	4.33	4.11	4.33	4.33	4.33	3.78	3.33	3.33	3.22	3.78
		Seperate	4.38	4.25	3.38	4.13	3.88	4.00	4.13	3.50	3.00	3.50	3.88	2.75	3.38
		Integrated	4.47	4.59	4.18	4.29	4.12	4.47	4.00	4.00	3.53	3.41	3.24	2.71	3.65

			3	Factors that impair alliance success												
			3-a	3-b	3-c	3-d	3-e	3-f	3-g	3-h	3-i	3-j	3-k	3-l	3-m	3-n
T-Test	Leftover vs. Separate		84.9%	79.6%	26.6%	66.1%	64.2%	11.9%	35.7%	98.1%	50.4%	16.9%	27.8%	36.8%	9.7%	83.8%
Gap	Leftover-Separate		0.07	0.10	0.67	0.21	0.19	0.81	-0.42	0.01	0.36	0.82	0.43	0.46	-0.64	-0.11
T-Test	Leftover vs. Integrated		68.1%	22.4%	1.1%	65.0%	36.5%	1.2%	4.7%	11.8%	0.5%	2.0%	7.0%	52.7%	32.2%	19.6%
Gap	Leftover-Integrated		0.15	0.46	0.90	0.16	0.27	0.97	0.71	0.65	1.17	0.92	0.73	0.27	0.35	0.48
T-Test	Separate vs. Integrated		83.2%	39.5%	70.4%	91.4%	86.8%	74.5%	2.3%	26.2%	14.9%	86.9%	48.2%	72.2%	0.9%	28.5%
Gap	Separate-Integrated		0.08	0.36	0.24	-0.05	0.07	0.16	1.13	0.64	0.81	0.10	0.30	-0.18	0.99	0.59
Mean Value		Leftover	4.44	4.22	4.67	4.33	4.44	4.56	3.33	3.89	4.11	4.44	4.56	4.33	4.11	3.89
		Seperate	4.38	4.13	4.00	4.13	4.25	3.75	3.75	3.88	3.75	3.63	4.13	3.88	4.75	4.00
		Integrated	4.29	3.76	3.76	4.18	4.18	3.59	2.63	3.24	2.94	3.53	3.82	4.06	3.76	3.41

			4	Disadvantage of the alliance							
			4-a	4-b	4-c	4-d	4-e	4-f	4-g	4-h	4-i
T-Test	Leftover vs. Separate		89.2%	12.7%	35.7%	53.4%	24.6%	29.9%	100.0%	56.1%	16.7%
Gap	Leftover-Separate		0.08	-1.01	0.50	-0.40	-0.65	-0.97	0.00	0.60	-1.00
T-Test	Leftover vs. Integrated		26.7%	41.5%	2.1%	46.6%	5.0%	60.3%	51.7%	14.9%	94.2%
Gap	Leftover-Integrated		0.45	-0.48	1.06	0.40	0.93	-0.42	0.48	0.98	0.05
T-Test	Separate vs. Integrated		54.7%	29.7%	35.4%	17.2%	0.5%	46.4%	55.6%	69.3%	1.7%
Gap	Separate-Integrated		0.37	0.54	0.56	0.80	1.58	0.55	0.48	0.38	1.05
Mean Value		Leftover	3.33	3.11	4.00	3.22	3.22	2.83	3.60	3.60	3.80
		Seperate	3.25	4.13	3.50	3.63	3.88	3.80	3.60	3.00	4.80
		Integrated	2.88	3.59	2.94	2.82	2.29	3.25	3.13	2.63	3.75

			5	Rate the alliance's capability to perform the following steps												
			5-a	5-b	5-c	5-d	5-e	5-f	5-g	5-h	5-i	5-j	5-k	5-l	5-m	5-n
T-Test	Leftover vs. Separate		19.5%	63.0%	13.2%	62.6%	31.2%	29.9%	13.9%	19.5%	6.2%	51.2%	48.7%	1.8%	41.3%	23.7%
Gap	Leftover-Separate		-0.56	-0.21	0.78	0.28	0.50	0.51	0.60	0.56	0.81	0.29	0.35	0.92	0.31	0.51
T-Test	Leftover vs. Integrated		1.4%	0.4%	11.6%	41.5%	25.4%	46.9%	11.4%	20.4%	2.3%	4.0%	3.0%	62.8%	0.5%	45.7%
Gap	Leftover-Integrated		-0.79	-0.92	-0.52	-0.34	-0.41	-0.29	-0.54	-0.39	-0.74	-0.75	-0.84	-0.16	-0.68	-0.23
T-Test	Separate vs. Integrated		52.3%	8.8%	2.0%	20.7%	5.5%	4.9%	0.3%	2.6%	0.1%	1.6%	2.4%	0.5%	1.6%	6.3%
Gap	Separate-Integrated		-0.24	-0.71	-1.29	-0.62	-0.91	-0.80	-1.14	-0.94	-1.54	-1.04	-1.18	-1.07	-0.99	-0.74
Mean Value		Leftover	2.44	2.67	2.78	2.78	3.00	2.89	2.22	2.56	2.56	2.67	2.22	2.67	2.56	2.89
		Seperate	3.00	2.88	2.00	2.50	2.50	2.38	1.63	2.00	1.75	2.38	1.88	1.75	2.25	2.38
		Integrated	3.24	3.59	3.29	3.12	3.41	3.18	2.76	2.94	3.29	3.41	3.06	2.82	3.24	3.12

			6	How much you agree with each of the following statements						
			6-a	6-b	6-c	6-d	6-e	6-f	6-g	6-h
T-Test	Leftover vs. Separate		61.7%	65.5%	40.5%	59.8%	30.2%	20.2%	57.9%	66.5%
Gap	Leftover-Separate		0.28	0.29	0.50	-0.31	0.61	-0.47	-0.33	-0.26
T-Test	Leftover vs. Integrated		66.6%	22.2%	74.8%	5.8%	23.0%	3.0%	10.7%	5.7%
Gap	Leftover-Integrated		-0.22	0.49	0.13	0.88	0.46	0.59	-0.77	-0.65
T-Test	Separate vs. Integrated		24.8%	75.6%	51.3%	4.4%	80.1%	1.4%	35.7%	50.7%
Gap	Separate-Integrated		-0.50	0.20	-0.38	1.19	-0.15	1.06	-0.44	-0.39
Mean Value		Leftover	2.78	2.67	4.13	3.44	4.11	3.78	3.67	3.11
		Seperate	2.50	2.38	3.63	3.75	3.50	4.25	4.00	3.38
		Integrated	3.00	2.18	4.00	2.56	3.65	3.19	4.44	3.76

Appendix IX Companies participated in the study

Operating Companies:

Esso Strathcona

Imperial Oil is one of the largest producers of crude oil in Canada and a major producer of natural gas. The company is the largest refiner and marketer of petroleum products -- sold primarily under the Esso brand -- and a major producer of petrochemicals. Strathcona refinery, with about 400 employees, located on the outskirts of Edmonton, in Strathcona County, Its daily capacity is 176,000 barrels of crude oil. (Information source: http://www.esso.com/index_flat.html, June 26, 2002).

Esoo Strathcona have an alliance relationship with Bantrel Co.

Shell Scotford Limited

Shell Canada Limited is one of the largest integrated petroleum companies in Canada. The company is a major producer of natural gas, natural gas liquids and bitumen, and the country's largest producer of sulphur. (Information resource: http://www.shell.ca/, June 25 2002)

Shell Scotford has an ongoing alliance relationship with Colt Engineering.

Suncor Energy Inc.

Suncor Energy Inc. is a Canadian-based integrated energy company with about $12 billion in assets. It has 3,000 employees. Business has been built on the growth of independent, integrated businesses, which now include oil sands, natural gas and renewable energy. (Information resource: http://www.suncor.com/bins /index.asp, June 26, 2002)

Suncor has an ongoing alliance relationship with Fluor Daniel.

Syncrude Canada Ltd.

Syncrude Canada Ltd. is the one of the largest producer of crude oil from oil sands and the largest single source producer in Canada. Syncrude is one of the largest private sector employers in Alberta, employing over 3,900 people directly and an average of 1,000 maintenance contractor employees. (Information resource: http://www.syncrude.com, June 26, 2002)

Syncrude Canada Ltd. has an ongoing alliance relationship with Colt Engineering Corporation. The joint office named “Cosyn Technology”.

Dow Chemical Canada Inc.

Dow Chemical Canada Inc. is a wholly owned subsidiary of The Dow Chemical Company, providing innovative chemical and plastic products and services to many essential consumer markets. Headquartered in Calgary, Alberta, Dow serves customers in a wide range of markets that are vital to human progress, including food, transportation, health and medicine, personal and home care, and building and construction, among others. (Information resource: http://www.dow.com/facilities/namerica/canada/index.htm, June 26, 2002)

Dow Chemical Canada has an ongoing alliance relationship with SNC Lavalin.

Engineering Companies

Bantrel Co.

Bantrel provides a range of high quality Engineering, Procurement and Construction/Construction Management (EPCM) Services across Canada. Its head office is located in Calgary, Alberta (AB), Canada, with branch offices in Edmonton (AB) and Toronto, Ontario, Canada. (Information source: http://www.bantrel.com/start.htm, June 26, 2002).

Bantrel Edmonton has an alliance relationship with Esso Strathcona.

Colt Engineering Corporation

Colt Engineering Corporation is a multi-discipline engineering contractor in the design of hydrocarbon process facilities in Canada, the USA and in many regions of the world.

Colt specializes in the design of conventional oil and gas production/ processing facilities, pipelines, refineries, petrochemical plants, electrical power generation and cogeneration facilities, heavy oil facilities and oil sands plants. Colt has over 2,000 staff in Canada, with offices in Calgary, Edmonton, Toronto, Sarnia, and Anchorage, Alaska. (Information resource: http://www.colteng.com, June 26, 2002)

Colt has an ongoing alliance relationship with both Shell Scotford and Syncrude. The joint office with Syncrude named Cosyn Techonology.

Fluor Daniel

Fluor Daniel is one of the world's largest engineering and construction services companies. Organized into four Strategice Business Units --- Energy & Chemicals, Infrastructure, Manufacturing & Life Sciences, and Mining --- Fluor Daniel is a global company with a reputation for being responsive to client needs, providing value-added services, executing complex captial projects on schedule with delivering safety performance that sets the industry standard. (Information resource: http://www.fluordanielcanada.com/about/canadian_operations.htm, June 26, 2002)

Fluor has an ongoing alliance relationship with Suncor Co.

Cosyn Technology

CoSyn Technology is a division of Colt Engineering Corporation and serves Syncrude's expanding oil sands operations. Colt's Edmonton office provides specialized, multi-disciplined EPCM services to the refinery, pipeline, petrochemical, oil and gas and industrial sectors across Canada. (Information resource: http://www.colteng.com/employ-CoSyn.html, June 26, 2002)

SNC Lavalin Group

SNC-Lavalin Group is one of the leading engineering and construction firms in the world, and a key player in the ownership and management of infrastructure. The group and its companies have offices across Canada and in 30 other countries; provide engineering, procurement, construction, project management and project financing services to a large number of sectors of the economy. (Information resource: http://www.snc-lavalin.com/e/e-index.asp, June 26, 2002)

SNC-Lavalin has an ongoing alliance relationship with Dow Chemical.

Appendix X Glossary

Sampling Error

Standard error for the mean is used to analyze sampling error in the survey. (See, for example, http://www.bls.gov/opub/hom/homch16_f.htm, January 2001 and http://www.eia.doe.gov.emeu, January 2001)

Frequency Distributions

Number of times an event occurs. (See, for example, http://forrest.psych.unc.edu/research, January 2001). Frequency distribution graphs picture the (grouped) frequency distribution of a variable at the interval or ratio level of measurement.

Measures of Central Tendency

Central tendency means an aggregate for the whole group, center of a distribution. The Mean or average is used as method of describing central tendency.

Variability of Dispersion

Dispersion refers to the spread of the values around the central tendency. There are two common measures of dispersion, the range and the standard deviation. The Standard Deviation is a more accurate and detailed estimate of dispersion because an outlier can greatly exaggerate the range. The Standard Deviation shows the relation that set of scores has to the mean of the sample. (See, for example, http://forrest.psych.unc.edu/research, January 2001)

Inferential Statistics: Statistical Difference

T-test assesses whether the means of two observed group are statistically different from each other. Consider the situation in Figure 0-1, variability can be different when difference between the means is the same, because the overlap between the two bell-shaped curves can be different. In a high variability case, the group difference appears less striking because the two bell-shaped distributions overlap so much. (See, for example, http://trochim.human.cornell.edu/kb/stat_t.htm, January 2001)

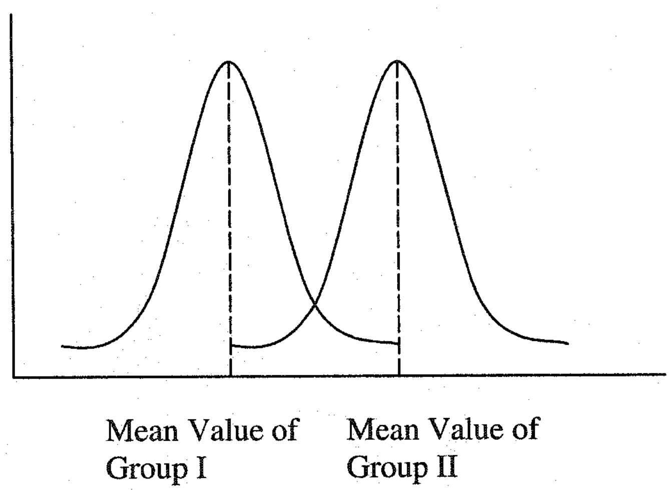


Figure 0-1 T-Test

The formula for the test is as following:

$$t\text{-value} = \frac{\text{Difference between group means}}{\text{Variability of groups}}$$

$$= \frac{\bar{X}_1 - \bar{X}_2}{SE(\bar{X}_1 - \bar{X}_2)}$$

$$= \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{var_1}{(n_1 - 1)} + \frac{var_2}{(n_2 - 1)}}}$$

Where, $\bar{X}_1, \bar{X}_2$ are the mean values of two groups; var_1, variation of each group; n_1, n_2, number of sampling of each group.

Correlation Statistics

Spearman's Rank Order Correlation: The spearman correlation coefficient is obtained by determining the Pearson correlation coefficient of the ranked data. The advantage of the Spearman correlation is that it measures association, direct or inverse and is not sensitive to non-linearity or to outliers.

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