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Bringing in a construction project at the least possible cost is the primary goal of every member of the construction team, albeit not necessarily for the same reasons. Owners are particularly concerned about overruns in their budget, especially when the viability of their entire enterprise may be jeopardized by such a cost overrun. Owners' attitude towards claims is, perhaps, one of the best examples of their pre-occupation with keeping costs under control. This attitude is one of the most important reasons for the recent flurry of activity surrounding dispute avoidance. In a previous Revay Report (Vol. 14, no. 2) I described the salient features of the New Engineering Contract (NEC) and stated that the NEC goes further towards dispute-free projects than any of the other standard forms in use today. I stated this because the NEC distributes risk and deals with disputes in a very equitable and enlightened manner. Accordingly, one may argue that the implementation of the NEC serves the interest of the owners. This is true, but is far from being the complete answer.

First of all, the least expensive project is not necessarily the most cost-effective project, particularly if one considers life cycle cost. Additionally, avoiding disputes, when looked upon as the ultimate goal, can be a very expensive pastime. For owners to receive the most value for their construction dollar, they must do more than simply concentrate on dispute avoidance. The lead article of this issue was written by Stephen O. Revay, Vice-President of Revay and Associates Limited, and George F. Jergeas, Ph.D., Assistant Professor with the Department of Civil Engineering, project management specialization, at the University of Calgary. It describes an integrated approach which at times may require some heretofore unrecognized front-end expenditures, but if implemented properly ought to assure the most cost-effective project.

VALUE FOR MONEY — AN INTEGRATED APPROACH

By Stephen O. Revay, V.P. RAL and Dr. George F. Jergeas, University of Calgary

Introduction

Owners are telling the construction industry that they are looking for a 30% reduction in overall project cost. This article suggests that this objective can only be achieved if one implements in one form or another the concepts discussed within this article. There is a plethora of articles recommending one or another concept that will ensure the project comes in on time, within budget, and without claims. No one concept, however, can address the variables, risk and uniqueness of any given project, let alone all projects.

This article does two things. First, it provides no guarantees, and second, it suggests that consideration must be given to an integrated approach that combines several key disciplines. A guarantee is not provided because that would be foolish, and the integrated approach to be discussed deals only with the front end of the project. Although it makes eminent sense to focus on the front end where impact is the greatest, it is equally foolhardy to assume that to do the right thing at project commencement will alone ensure success. Project success requires full team commitment to a number of different critical concepts from inception to completion, which does not happen by chance.

The integrated approach refers to combining four key concepts and the disciplines involved, specifically: partnering, value management, risk management, and constructability. Variations exist on all of these concepts, some not quite as good as others. This article shall first describe each concept and provide some comment on the variations which exist. Then, the article shall address how the four concepts can work in harmony, resulting in significant synergism and cost savings.

It should be understood that it is not the intent of this article to provide a comprehensive dissertation on the above four concepts. Sufficient background is provided so that the readers can form their own conclusions regarding the advantages of treating these four concepts as one. Additionally, it is noted that each concept has had different labels attached to it. We shall identify those labels and indicate why we prefer the one used here.

We are advocating a philosophy of working smarter not harder. We are suggesting that if an owner/developer wants to save money prudently, then it needs to invest in better ways of achieving the end result. There is a need to circumvent the view that costs can only be reduced by less spending (always taking the low price) or the view of deferring all expenditures until the last possible moment. These views only result in negating the opportunities that are available during the inception and initial design of the project.

Partnering

The first of the four concepts to be discussed is Partnering, (also known as Strategic Alliances) which is nothing more than, arguably, a refinement on how many buyers of construction services used to conduct themselves years ago with their favourite contractor. We have chosen to use the term Partnering because it is the more common of the two labels being used to describe the concept. The Associated General Contractors of America (AGC) defines partnering as follows:

"The Partnering process attempts to establish working relationships among the parties through a mutually developed formal strategy of commitment and communication. It attempts to create an environment where trust and teamwork prevent disputes, foster a cooperative bond to everyone's benefit, and facilitate the completion of a successful project."

Partnering is about creating a win-win situation. It requires commitment, trust, and cultural change. Normally adversarial parties must adjust to a culture of trust. If a level of trust can not be attained, the partnering concept simply will not work. There is also a need for accountability and incentives. Accountability is tied to "buy-in" and mutual respect. Incentives are based on the team winning. That team requires:

- commitment of all parties (including senior management) to the common goals;
- all stakeholder interests are considered;
- honest and open communication at all levels;
- no hidden agenda;
- continuous real time measurement and evaluation;
- timely responses; and,
- a process for issue resolution.

In practice, two broad variations exist in the implementation of this concept. Pursuant to Demming, the father of quality in Japan, the first variation consists of forming a long term arrangement that spans the life of more than one project. The second variation, which is more common with the public sector, is project-specific partnering arrangements. Whereas the latter approach has been successfully used, it is not as effective as the former. There are a number of owners and contractors who feel they have been "taken" as a result of this latter approach. Quite clearly the necessary level of trust is much more difficult to attain in a "one off" type of relationship; thus, the reason one sees more failed partnering attempts under a project-specific type of relationship.

It is the opinion of the authors that the highest degree of success will be achieved with the first variation – i.e., a long term arrangement based on a given volume of work over several years. If that approach is culturally, economically or politically not palatable, then the second approach can be used. In these cases, one should focus more energy on developing a level of trust as it will not come as naturally as it will with a long term arrangement. Additionally, one might consider if other enlightened approaches to contracting strategies would not be just as effective.

By enlightened approaches the authors are simply referring to fair contracts that apportion risk based on the ability to control/manage the risk. Trust is key. That will not occur if the risk is being unreasonably transferred to one who has no control over that risk.

Value Management

Value Management, the second of the four concepts, is a process used during the design phase to optimize project cost and functionality/performance. This concept has also been labelled Value Engineering and Value Analysis. We prefer the broader description as it appears (as explained below) that the other two labels have some negative connotations. AACE International, in its publication Skills and Knowledge of Cost Engineering, provides the following definition:

"Value engineering is a multi-discipline, systematic, and proactive function that is targeted at the design itself. The objective is to use value engineering to develop a facility or item design that will yield the least life-cycle cost or provide the greatest value while also meeting all functional, safety, quality, operability, maintainability, durability and other criteria established for it."

The principal approach in Value Management is to analyze functionality, focusing on the elimination or modification of any component of the facility that adds costs without contributing to functionality. Not only are initial costs to be considered, but also the later in-place costs of operation and maintenance. Value Management should not be regarded as cost-reduction based on reduction of quantities, use of cheaper materials, or lower performance standards, nor should it be confused with design review or quality control. Value Management requires:

- using professional effort to optimize the life cycle cost of a facility;
- allocating sufficient resources to support these efforts; and,
- documenting efforts including feedback mechanisms.

Accurate cost measurement is one of the most important requirements of a successful value management program. Any cost comparison must take into account capital expenditure and maintenance costs - i.e., life cycle cost. The value manager is trying to find out how much additional capital expenditure is warranted today to achieve future cost benefits over the life of the facility and what less expensive process or item can be substituted without compromising future costs and functionality.

In determining the various components as design begins to be developed, the following questions need to be asked:

- What is it?
- What does it do?
- What must it do?
- What does it cost?
- What is it worth?
- What else might do the job?
- What does the alternative cost?
- What will satisfy all of the owner's needs?
- What is needed to put the change into effect?

One would think that any process which advocates economy (the best "bang for the buck") would be readily adopted. This has not been the case with Value Management. There are several reasons why this occurs. For example, the general philosophy of many owners is that the architect or engineer who does not consider maximum economy and value engineering in the selection and use of construction materials and methods, within the limits dictated by the design, is simply not doing their job. According to that thinking, why should there be a need for separate Value Engineering effort if the architect or engineer is already providing competent professional services to the client? However, when design contracts are let on a competitive basis, within a tight time frame, competent professional services in reality do not include Value Management. This also explains why we prefer Value Management to Value Engineering. It is a separate process and not what one might assume occurs as a matter of course during the design phase.

The above philosophy of some owners is why Value Engineering is frequently limited to incentive clauses in the contract between the owner and the contractor wherein any savings are shared. [In truth, that process should more correctly be called constructability, which will be the next concept to be discussed]. However, the introduction of value-added changes will be limited if the process is restricted to when the contractor is brought on.

If one discounts the above variation to Value Management and utilizes the process early on in the design, it can be used in one of two ways.

The first method is to create an environment wherein the design team is allowed the opportunity to brainstorm and pursue alternatives. This requires a mind set that recognizes and accepts that some additional design time and cost is necessary to reduce the overall project cost. This concept will not work if the mind set is to award the design work to the low bidder and then advise that it is their "engineering responsibility" to produce the lowest cost. That approach does not create ingenuity or initiatives. It simply causes one to use safe and true means which may or may not have the least overall cost.

The second option is to bring in a second design team to review the work of the first. This process has worked well on occasion. More often than not, however, this approach has not been successful. The first design team feels a natural need to defend its original design from a competitor. The second design team has an inherent tendency to prove they can do better than its competitor. The end result is that the competitive nature of the two parties often interferes with the process.

Ironically, the advantage of the second process is that savings are easily ascertainable. Such is not the case with the first process, wherein doing it right the first time makes it difficult to identify savings. This irony needs to be highlighted, for with the right environment, the pitfalls of the second process can be avoided i.e., the additional cost of the second design team, the adversarial climate, and the potential delays in arriving at decisions. Sometimes these pitfalls are preferred to the perceived inability to measure the overall saving in time and cost of doing it right the first time. However, identifying savings with the first process is not an insurmountable problem. Estimates can be provided for different alternatives. Proper tracking of costs can separate the cost of design from the cost of Value Management. Order of magnitude techniques such as end-product units, scale-of-operations, and other various ratio or factor methods can be used for broad assessments of the savings which have been achieved.

As a comment on savings, some have suggested that the potential saving for Value Engineering implementation is between 5% and 20% of the overall budget.

It is the authors' opinion that the most successful implementation of value management will occur when the right environment is created and not when a second team is used to review and critique the work of the first team.

Constructability

As the skill and technology requirements of the design and construction phases of projects have increased over the years, the tendency has become to divide the two phases into distinct activities. The separation of the two phases is a natural extension of breaking projects into smaller components to facilitate management of each. However, the independent execution and management of these two project phases has caused additional costs to be incurred during construction due to the unnecessary difficulty in executing the design.

A high proportion of total project cost—perhaps as much as 70%—is determined at the completion of the early design phase. As design is developed, decisions are made that lock the design into a certain set of relationships. These relationships become so complex that any subsequent change is virtually impossible without significant cost impact. Therefore, to reduce design's impact on construction, it is prudent to encompass construction considerations or construction planning into design. If there is to be any benefit from construction planning, construction's contribution must be made from day one of the design process. Combining the effort among designers and builders at the initial stage of design in a cooperative manner will reduce problems encountered during the construction phase. Reducing problems during the construction phase minimizes the project's final completion cost and duration. This cooperative combining of skills and experience in a conscious effort to reduce potential construction problems is termed "constructability".

Constructability has been defined a number of ways. The Construction Industry Research and Information Association (CIRIA) in the U.K. defines constructability as:

"The extent to which the design of the building facilitates ease of construction, subject to the overall requirements for the completed building."

The Construction Industry Institute (CII) defines constructability in broader terms as:

"Constructability is the optimum use of construction knowledge and experience in planning, engineering, procurement and field operations to achieve overall objectives."

The premise for all constructability definitions is that the inclusion of construction knowledge and experience into the planning and design of a project is beneficial. Constructability is not Value Engineering, which tends to focus on functional analysis and life-cycle costs. Constructability is achieved by fully exploiting construction experience.

Project constructability is achievable only when a company has a definitive constructability program. There are two levels of a constructability program: a) the higher level, corporate policy-driven program, and b) the lower level, project-specific program. The lower level, project-specific program changes from project to project. This is due to the uniqueness of each project, such as size, type, critical success factors and others. The high level corporate program does not change from project to project. This high level program sets the baseline and corporate support to ensure constructability occurs in a consistent manner at the lower project specific level.

Each company's unique constructability program should be considered as a continuous improvement process where activities, effort and results are continuously evaluated, updated and improved. The constructability process includes self-assessment, bench marking against industry standards, identification of constructability implementation barriers, goal setting and constructability progress measurement.

It is worthy to note that the CII has identified several barriers that inhibit the effective implementation of a constructability program. These barriers are quite relevant to this article as they also apply to the other concepts and the implementation of the integrated approach. These barriers, relative to their significance, are:

1) complacency with status quo;
2) reluctance to invest additional money and effort in early project stages;
3) imitations of lump-sum competitive contracting;
4) lack of construction expertise in design organizations;
5) designer's perception that "we do it";
6) lack of mutual respect between designers and constructors;
7) construction input is requested too late to be of value;
8) belief that there are no proven benefits of constructability;
9) owner's lack of awareness and understanding of constructability concepts;
10) misdirected design objectives and designer performance measures;
11) owner's perception that "we do it";
12) lack of genuine commitment to constructability;
13) designer's lack of awareness and understanding of constructability concepts;
14) poor communication skills of constructors;
15) lack of documentation and retrieval of "lessons learned";
16) lack of team building or partnering;
17) poor timeliness of constructor input;
18) the right people were not or are not available.

The effort required to organize and execute a constructability program pays divi-

dends toward project success and optimization. These dividends manifest themselves by:

- lowering both design and construction costs as a result of increased focus on advantageous design alternatives and improved constructability;
- decreasing the project schedule by better integration and shortening of the design and construction schedules;
- improving external interfaces by making realistic commitments and incorporating them into design and construction plans;
- building a team whose members understand and are committed to meet project objectives by mutually agreed-upon plans;
- increasing construction's understanding of design intent and design's understanding of construction's problems in building certain designs and training the representatives from each discipline to do their job better by considering the needs of others;
- increasing innovation in both design and construction;
- gaining competitive advantage for the firm; and,
- improving the learning curve.

Risk Management

There are a number of different definitions of risk. The following, by Patrick Godfrey in his article *The Control of Risk*, is provided:

"Risk is the chance of an adverse event. More technically, risk is the combination of the probability or frequency of occurrence of a defined hazard and the magnitude of the consequence of that occurrence. Thus, risk is a measure of the likelihood of a specific unwanted event and its unwanted consequence or loss.

Likelihood x Consequence = Risk

or

Probability x Cost = Risk"

It should be noted that we are not advocating a complicated process of assessing probability or consequence. As this concept has been previously addressed in an earlier Revay Report (Volume 12 Number 1, July 1993), our comments here will be brief. Of the two more frequent labels for this concept (Risk Management and Risk Analysis), we prefer the broader description – i.e., risk management – the last of the concepts to be discussed.

Here and subsequently, we shall be quoting from Sir Michael Latham's report enti-

tled *Constructing The Team*. That report is a joint review of procurement and contractual arrangements in the United Kingdom construction industry. The forward of that Report states, in part:

"This Final Report makes recommendations to tackle the problems revealed in the consultation process. The Review has been about helping clients to obtain the high quality projects to which they aspire. That requires better performance, but with fairness to all involved. Above all it needs teamwork. Management jargon calls that 'seeking win-win solutions'. I prefer the immortal words of the Dodo in 'Alice's Adventures in Wonderland', 'Every body has won and all must have prizes'. The prize is enhanced performance in a healthier atmosphere. It will involve deeper satisfaction for clients. It will lead to a brighter image and better rewards for a greater industry."

Further in the above report, Sir Michael Latham has the following comment on risk: **"Risk is of course endemic in all forms of construction work. It can be managed, minimised, shared, transferred or accepted. It can not be ignored."** This article advocates, as does Sir Michael Latham, addressing risk in the early stages of project development.

Unfortunately, a common approach to dealing with risk is through the contract – i.e., by transferring the risk. For many, the solution has been to simply transfer all the risk onto the contractor. The intent was to minimize cost overruns and claims. That intent was typically not achieved. Claims were pursued, litigation was commenced, and overruns were experienced. More and more private and public owners are realizing through bitter experience that full transfer of risk onto the contractor does not work and they are changing their contracting strategy to a sharing of risk based on control, and the ability to manage that risk.

A sharing of risk obviously means that risk must be identified and managed. Simply throwing contingency at risk is not the answer. Risk has to be the responsibility of the party that can best manage or influence the probable adverse event.

Integrated Approach – Purpose

Before discussing implementation, one must first identify the expected objectives/purposes of using the above four concepts. The project team during the first phase (project inception to substantial completion) is primarily concerned with cost, time, quality, scope and safety. On completion, the client expects the project:

- to be fit for purpose;

- to have reasonable operating costs;
- to have satisfactory durability;
- to have no claims; and,
- to have market viability.

The goals of the project team and the owner are obviously not mutually exclusive, particularly as the owner is invariably part of the project team. The issue here is that all parties must appreciate it is the owner who invariably pays the bill. Consequently, it is the owner's interests which need to be served and those interests do not simply relate to the cost of the construction process. Time (financing costs) and operational costs are frequently more of a concern than the construction process. It is with that understanding one must adopt or implement the above four concepts.

Integrated Approach – Implementation

Sir Michael Latham, in his report *Constructing The Team*, states: **"Implementation begins with clients. Clients are at the core of the process and their needs must be met by the industry."**

Clients are demanding more for less. In Lemming-like fashion, the industry has responded by slashing costs and reducing margins. Consequently, the industry has responded by providing less with more resultant risk. The contracting industry now has the dubious distinction of having the highest rate of bankruptcy in Canada.

Our industry has two choices: (1) continue to fling ourselves off the cliff, or (2) commence to "work smarter – not harder".

Clients must understand that reduced bids/tenders do not mean better performance. Too frequently, it means greater cost and time. Clients have to appreciate that investment in the inception/design phase of the project can lead to a better project at completion – i.e., lower overall project cost and time. The best research on this matter is seen in the Aromex case study that was completed by the Construction Industry Institute.

From the above description of the four concepts, it becomes apparent that all four rely on a team concept and the development of the Scope of Work. Additionally, all four seek investment and foresight at the beginning so as to avoid downstream problems. We are simply suggesting an approach which focuses the Project Team on very clear objectives. Clearly, the more opportunity there is to get the Team working on common fronts and goals, the better the complete process is going to work.

What is being proposed is frequently referred to as "picking your brain". At key points in the design development process, the scope of work would be reviewed by various experts in constructability, value management and risk management in conjunction with the senior design staff. These experts bring with them certain disciplines, skills, experience, and mind sets that can be imparted to the design team. In essence, these experts would bring their know-how and awareness to the Project Team. With proper coordination of this team of experts, the right project environment and the commitment of the client it is herein suggested that the likelihood of a successful project (by whomever's definition) will be greatly enhanced.

WHAT'S HAPPENING:

In the last three months, **Al Morgan** and **Stephen O. Revay** have acted as arbitrators, while **Michael Wheeler** acted as a mediator.

Peter Maidment will be presenting at the PMI Symposium in May 1996 in Calgary.

Stephen O. Revay will be concluding his term as President of Construction Specifications Canada at their June 1996 National Conference in Quebec City.

RAL's Western Region will be putting on a two day seminar on Contract Administration and Damage Quantification on March 20 and 21, 1996 in Vancouver.

The Calgary office is preparing for its certification audit in the spring for its registration to ISO 9002.

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