

## Best Practices for Managing Construction Projects in Good Times and Bad

*Revay has pondered how best its clients can minimize the impact of the current economic turmoil. This special edition of the Revay Report encapsulates some of that thinking and lays out a number of useful pointers for the reader. To Revay, the economic health of its clients is paramount – we gratefully acknowledge that your business enables us to proudly state that we have been serving the needs of the construction industry for almost 40 years.*

*This edition of the Revay report contains contributions from all our five offices and is intended to provide actions, which – if taken – will improve the situation of the readers immediately and in the long term.*

The perennial contradictions created by the aspirations of owners, designers and contractors have gone “mission critical” in the current economic climate. Pressure is mounting on owners to save cost and time in all aspects of construction; whereas designers are struggling to keep utilization rates at satisfactory levels and contractors are scrambling to maintain a healthy order book and cashflow.

The typical owner has always expected an expeditious, quality build with maximum functionality for the least capital cost. From the designer, the owner invariably wants sound design at minimal cost and often in an overly optimistic timescale. These aspirations have never dovetailed with the immediate objectives of contractors and designers. Presently, with so many of them going into survival mode, this mismatch has never been more detrimental to the potential success of our clients.

Of the many issues currently facing participants in the construction process, in Revay’s opinion, the most pressing are:

- cashflow;
- changes;
- the culture shift involved in moving away from cost reimbursable contracts will be applicable in the Prairie provinces;
- value for money;
- coping with uncertainty;
- communications;
- scheduling;
- performance monitoring;
- effective, fast and inexpensive dispute resolution; and
- how best to use any down time.

These issues are the focus of this report.

### Cashflow

The contractor’s business model depends upon cashflow. Despite this fact, subcontractors commonly sign up to “pay when paid” contract provisions that severely hamper their cashflow.

From the court cases there seem to be two lines of argument concerning these types of provisions:

- in Ontario and Alberta, “pay when paid” clauses divest the risk of non-payment to the subcontractor unless and until the GC is paid; whereas
- in Manitoba, Saskatchewan and British Columbia the courts have interpreted “pay when paid” clauses to restrict only the timing of payment and have deemed the subcontractor to be entitled to payment within a reasonable time after it completes its work, irrespective as to whether the GC has been paid.

Either way, a “pay when paid” clause has the potential to detrimentally affect cashflow. In the current market place, GCs are more inclined to strictly enforce these provisions, thereby increasing the subcontractor’s risk exposure. Subcontractors would be well advised to reflect these risks in their bids.

For designers and contractors who are anxious to maintain a minimum cashflow the temptation to low-ball bids is obvious. Before making this decision, designers and contractors must ensure that they are properly informed as to:

- the risk profile of the project as it affects them;
- their liabilities – open ended liability and indemnities should always be avoided. If the owner’s schedule is unrealistic the contractor should make appropriate allowance

in its bid for the cost of extended contract time or penalties;

- any provisions cascaded from other contracts – commonly subcontractors are bound to provisions in the prime contract, in which case it is essential that subcontractors actually read and understand the prime contract provisions that will affect them;
- the payment terms – designer and contractors should familiarize themselves with the degree of discretion the contract affords the owner to withhold payment, the reasons for doing so and the owner’s set off rights; in addition the parties’ rights to recover consequential damages should be excluded;
- securities required – in a recession, owners are less likely to waive their requirements for securities, conversely, they may insist on on-demand bonds. The consequences of providing on-demand bonds must be understood by the principal;
- notice periods for claims – a number of Revay’s clients are now regularly enforcing conditions precedent and rejecting late claims;
- the warranties provided – by way of example, often overlooked are the warranties concerning the skills and competencies of the workers the contractor is to provide. This is pertinent because most contracts permit termination and enable the owner to resort to the contractor’s bonding company on the basis of the contractor’s failure to provide a properly qualified and skilled workforce;
- the ramifications on the mindset of staff – the perception that the ship is sinking will be palpably counterproductive. Rather, particularly in the current market, every success should be celebrated.

To avoid the contractor being preoccupied with money worries the owner must offer improved payment terms and pay promptly. As a result, contractors will likely offer better prices. To the contrary, the practice whereby owners give service providers and contractors the run around when it comes to *bona fides* invoices is becoming quite prevalent. In so doing, owners are unnecessarily jeopardising the survival of service providers and contractors alike. Revay believes that ultimately owners will regret the lack of choice and competition that will inevitably stem from their current actions.

Owners interested in differentiating themselves should look to best practices in their own and other parts of the world. The Construction Clients' Group in the UK runs a scheme that enables a third party administrator to benchmark against their peers the performance of clients according to the manner in which they treat their service providers and contractors.<sup>1</sup> The scheme has been operating since fourth quarter of 2001 and boasts the enrolment of over 400 clients. Good clients achieve "Client Charter Status" and are permitted to publicise their status, thereby differentiating themselves.

Inevitably some firms will be struggling to meet payment schedules. In this situation, the firm should seek to renegotiate payment terms at the earliest possible opportunity. Needless to say, a successful conclusion will be more likely if the firm approaches the negotiations armed with a well rehearsed and realistic plan for repayment that reimburses the creditor for its opportunity cost.

### Change Orders in the Face of Recession

In Revay's experience, changes and extras are a constant source of friction between the owner and contractor. Customarily, the owner sees itself as being gouged while the Contractor views the compensation as insufficient. Coupled with the almost inevitable battles over the changes' impact on schedule and our current economic climate the resulting mix is potentially explosive.

Clearly, the solution lies in having a complete design package available prior to the start of construction and refraining from post award scope changes. But this solution is rarely seen.

An incomplete design invariably leads to frequent changes which commonly impact the contractor's productivity on contract work. This topic has been the subject of considerable research over many years, some of which has been discussed in earlier Revay Reports. Readers interested in learning more will find our reports on our website at <http://www.revay.com>.<sup>2</sup>

All of these studies have shown that numerous changes adversely affect the cost of completing contract work but no consensus has been reached on the magnitude of the effect. This lack of consensus serves to agitate the existing friction.

In our current economic climate, contractors will be less inclined to proceed on changes without some assurance of sensible compensation. A change in attitude on both sides will be necessary to effect this.

Before commenting further, Revay would like to warn the readers that its comments must be applied in conjunction with the specific contract language or the particulars of the project. Equally, notice provisions and their significant potential impact on the ability to pursue a claim for additional cost must be taken into account.

Of course, the contractor needs to address the potential impact of changes on its productivity. The owner must understand that it is often impossible for a contractor to quantify this productivity impact on an ongoing basis for each change. That is why contractors qualify their change orders i.e. they reserve their rights to negotiate the productivity impact when it becomes quantifiable and also to create the right to compensation for the cumulative impact of changes on productivity, should it occur. An example of such a qualifier is:

"The price quoted is only for the direct cost of the change. We reserve the right to seek compensation for the impact on contract work and/or the cumulative effect of changes when these costs (if any) can be quantified."

Some owners take exception to such a qualifier, apparently assuming that it is possible to ascertain the full price of the change at the time of issue. Contract provisions that actually preclude the contractor from reserving its rights are not uncommon. In fact, many professional advisors seem to endorse this particular prohibition. In so doing, they intensify the friction which already exists in the change management process.

The owner can be assured that merely adding a qualifier to the change order does not promise the contractor payment for the productivity impact. The contractor still must demonstrate its entitlement to additional compensation in addition to quantifying the impact.

Practically, owners have several options. They can:

- control the frequency and magnitude of change by ensuring that the engineering is near completion before construction starts;
- accept the qualification and be prepared to discuss the cumulative impact of changes at the end of the project or at interim stages of the project; and/or
- pay for the impact of changes on each individual change – in which case, the contractor is left no option but inflate the amount to cover.

Because the owner ultimately controls the amount of front end work it undertakes prior to the start of construction, logically, it should also bear the consequences of the choices it makes in this regard.

If owners can bring themselves to accept this

reality, friction on construction projects will be greatly reduced. In this same vein, contractors can considerably help their cause by providing proper detailed pricing submissions for review, as opposed to inflated lump sum amounts with little or no detail, which seems to be the norm.

As a postscript, Revay would like to bring the reader's attention to a US case wherein the court recognized a contractor's claim for cumulative impact of changes despite seemingly unequivocal release language in the contract. A synopsis of the case may be found in the Volume 25 of *Construction Law Letter*.<sup>3</sup>

### The Shift Away from Cost Reimbursable Contracts

In many instances, particularly in the Prairie provinces, owners and contractors who have been working with reimbursable contracts now find themselves working in a firm price environment. This change in contracting strategy necessitates a change in *modus operandi*. Owners must recognize that, under a firm price arrangement, contractors are wholly responsible for the means and methods of executing the work. As such, save for instances when safety and/or the environment are at stake, owners are not empowered to direct the work. To do so would be tantamount to interference.

On the other hand, contractors must carefully adhere to the change management process dictated by their contracts. Both parties will need an understanding of scope that is crystal clear. Requesting payment for out of scope work after the work is completed is not a particularly sound or successful strategy.

### Creating Value for Money

The need to create value for money in the current climate is self-evident. While there are many vehicles that create value for money, in this report, Revay will concentrate on three – namely work face planning, constructability reviews and performance motivation.

### Work Face Planning

Two week and three week look-ahead schedules are becoming more commonplace. In Alberta, the Construction Owners Association has developed a tool similar in concept to look ahead schedules called Work Face Planning. This tool has been quite effective in improving productivity on a number of construction sites. The success has been sufficiently significant to prompt several major Albertan owners to make Work Face Planning a contractual requirement on its contractors. Interested readers can find more information on this tool at <http://www.workfaceplan.com/>.

### Constructability Reviews

According to the Construction Industry Institute<sup>4</sup> constructability is the:

"[O]ptimum use of construction knowledge and experience in planning, design, and procurement and field operations to achieve overall project objectives".<sup>5</sup>

Constructability is realized through an input process that supports the traditional communication between construction managers and designers during the pre-construction phase of the project and is enhanced with feedback from the on-site construction management personnel during the construction phase of the project.

Savings are created because:

- the design is checked for practicality for the spatial, staging and schedule constraints of the project. This minimizes the need to re-design during construction;
- recommendations are championed for design changes that take advantage of less expensive and more effective construction materials, methods and staging;
- unnecessarily complicated design details are identified for alteration, as are those that are incompatible with standard construction practices;
- lessons learned from previous reviews and construction projects are considered in order to initiate design improvements and avoid repeating costly mistakes; and
- elements of the design likely to be perceived as “high risk” components by the bidders are analyzed and reduced.

Constructability reviews and feedback are most useful before the documentation is 30% complete; reviews conducted past this stage tend not to be as effective because changes at a later stage usually involve additional design costs.

### Performance Motivation

The current market conditions will substantially enable owners to call the shots when it comes to contracting strategy. Stipulated price is the most potent motivator of performance and the reason why Revay has seen resurgence in stipulated price and design-build delivery strategies of late.

Design-build increases the likelihood of construction within the owner’s budget, chiefly because contractors are best placed to provide prices and information regarding construction methods and design-build affords the contractor the opportunity to conduct value engineering and constructability analysis from project inception. But design-build is only suitable for owners who have sufficient nerve to refrain from meticulous supervision and for projects wherein change will be limited.

The Construction Industry Institute has collated data regarding the incidence of change in design-build contracts for industrial, residential and commercial sectors and concludes that, on average, the additional cost attributable to change equates to 9% of the original price.<sup>6</sup> This is, perhaps, still too high to realize the full potential of the design-build strategy.

Nevertheless, design-build has proved to be a quick and cost effective mode of project delivery and is appropriate for organized and trusting clients provided a comprehensive

project brief is available at the outset. Data gathered by the Design-Build Institute of America indicates that this delivery approach is gaining in popularity; in 1993 the contribution of design-build on American non-residential construction was negligible; today it accounts for some 40% of American non-residential construction.<sup>7</sup>

In the absence of a stipulated price, owners must look to other mechanisms to motivate performance. A well-worn, but often ill thought out, example of this is target cost contracting. Many owners in the Prairie Provinces are still clinging to target cost contracting, even in the face of a “buyer’s market”, while others remain saddled with target cost contracts that were negotiated in a “seller’s market”. Target cost contracts are intended to motivate performance by enabling the contractor to share in any cost savings measured as the delta between actual cost and the target. They also serve to encourage timely performance by allocating to it liability for a share in any cost over runs. The potential to share in savings (or conversely the potential to shoulder some of the cost over run) is realized through a mechanism, known as the “pain:gain share”. The pain:gain share makes for relatively strong motivation only when certain conditions are met. However, in certain circumstances a target cost contract does not, of itself, provide any incentive to minimize cost, rather it does the exact opposite – if the gain share is low, the contractor’s strategy will be to maximize fee rather than benefit from any potential gain share. This issue is important because owners tend to adopt the policy of awarding to the bidder who provides the lowest target.

The typical compensation components in a target cost contract are:

- Actual costs – these are reimbursed on a monthly basis as work proceeds;
- Fee – which can be either a lump sum or a percentage of the aggregate actual costs; the fee may be payable on the basis of milestones or at monthly intervals; and
- Payout or deduction on the basis of the pain:gain share – generally the amount is calculated on the basis of a percentage split that remains constant irrespective of the magnitude of saving or cost over run, although schemes involving a complex graduated scale of percentages determined by the magnitude of saving or cost over run are not uncommon.

Under all fee arrangements, if the contractor reduces the target while increasing the fee, for any pain:gain share percentage, the price payable will increase, irrespective of the aggregate actual costs. If the contractor’s share of the potential savings is low, it will be motivated to increase the fee at the expense of the target. The corollary is: owners choosing between competing bids where target and fees are comparable should opt for the bidder who provides the lowest fee. Alternatively and more typically, the owner will be faced with competing bids in which targets and fees differ wildly. In such a situa-

tion, the price differential method should be employed to evaluate the competing bids.<sup>8</sup>

Target cost contracting focuses on one particular outcome factor i.e. final cost. This serves to distract all parties from non-cost objectives. As such, target cost contracts are susceptible to driving behaviours that are detrimental to the project. Success is more likely if the contractor is constrained to adopt the behaviours that coincide with successful projects.

This may be done by means of an incentive scheme predicated on a mix of key performance indicators (“KPIs”) embracing outcome factors and critical input factors. Input factors are those that relate to intermediate processes, procedures, actions or techniques. Table 1 identifies some examples of useful input factors that concern cost and schedule. There are, of course, many others that concern safety and quality.

In a cost reimbursable arrangement, the motivation comes by way of tying compensation to performance as measured against the KPIs. The reason for doing so is twofold – KPIs respond to our psychological imperatives and they provide a practicable management tool. The knack is to distill from nebulous ideals performance indicators that are measurable and effective and to administrate the scheme appropriately. Incentive schemes of this ilk are currently being used in several provinces in Canada for designers and contractors alike and with considerable success.

For stipulated price contracts of all guises, the owner’s KPIs will centre on matters other than cost. Of particular use to the owner will be liquidated damages, particularly when applied to interim milestones.

However, Revay would like to warn against liquidated damage overkill. Liquidated damages are extraordinarily strong motivators and should be used sparingly, otherwise the contractor will focus on LD avoidance to the detriment of all else.

### Pricing Uncertainty

The present slump has heightened our awareness of risk. Nevertheless, in the face of a volatile market, some businesses and project teams have made no attempt at pricing uncertainty. They presuppose that construction risk is unfathomable and/or that any data produced quickly becomes obsolete, thereby rendering the pricing exercise worthless. Absent appropriate allowances for uncertainty, decisions are, at best, made on analyses of partial data; in the worst case, no decision is made at all.

Revay does not agree that construction risk is incalculable. In Revay’s role as claims expert, its investigations follow the path of root cause. In its risk practice, Revay<sup>9</sup> follows a parallel path, utilizing comprehensive cause analysis to identify any multiple pathways. The responsible risk owner is identified as the entity within the team most able to manage the risk, regardless of liability or exposure (see Figure 1).



- greater understanding of the project; and
- improved project control.

Fifty three percent of contractor respondents confirmed that CPM scheduling brings increased control over risk and uncertainty.

Regarding disputes, 67% of the total number of respondents verified that CPM scheduling minimizes disputes.

Given the palpable benefits of CPM schedules, the slow uptake by owners is baffling. The prudent owner will go against the trend by including an independent bid item for scheduling in its tender documents and giving this discipline the deference it deserves in the contract.

The contractor should be contractually obliged as soon as possible after contract award to develop a fully detailed and realistic, resource loaded construction schedule using quality scheduling software. An effective schedule:

- incorporates input and has “buy in” of the subtrades and major suppliers;
- shows all owner responsible activities;
- plans and monitors construction activity, manpower and cash flow; and
- includes all changes and additions that affect the schedule activities and impact the project completion date and is capable of producing look-ahead schedules.

Revay is frequently asked to comment on a contractor’s position, only to discover that the contractor has failed to save every update as a separate file. Needless to say, without a record of the interim schedules, the contractor is pretty much hamstrung. More commonly, scheduling is ineffectual because either activities required to complete the work are absent from the schedule, it contains logic errors, overly optimistic duration estimates have been used, or detailed and timely schedule monitoring is lacking. Even if these particular issues are remedied as work proceeds, the difficulty of determining schedule performance with any degree of accuracy persists.

Schedules, if developed and monitored appropriately, become invaluable if it becomes necessary to prepare a claim.

### Project Performance Monitoring

Project performance monitoring can reveal potential problems before a project is impacted. Its usefulness when budgets are tight is plain. However, Revay has found shortcomings in the typical monitoring process:

- cost monitoring is performed against preset cost codes which do not correspond to the project activities or project work breakdown structure (“WBS”);
- costs are too often only reported at a summarized level and the “current” cost data is usually too old to facilitate advance warning;
- quality monitoring is limited to the quality assessment of too few key “products” or

deliverables produced by the work;

- change monitoring is limited to the running total amount of approved and pending changes to the work.

Fundamental to an effective performance monitoring system is a properly defined WBS which allows the performance of individual work activities to be integrated upwards to yield the overall performance. The health of a project or contract can be effectively assessed for each component of the work, using the WBS as a basis, by consistently measuring the following:

- earned value measures including cost and schedule variances as well as projected final cost and duration, which require an accurate determination of the percent complete for each element of work;
- labour productivity index;
- change variance with respect to the work performed;
- budget contingency variances;
- unanticipated change variance with respect to the approved contingency amounts;
- the variance between the projected man-hours required to those available.

The above assessments can be made only on the basis of available data.

By using the WBS and gathering the data at all levels of the work, the ability to focus on a specific area causing a problem is greatly facilitated, thereby giving management the information to take timely remedial action to correct a problem before it has a negative impact on the overall work performance.

### Efficient Dispute Resolution

In the economic circumstances preoccupying us all, our sensitivity to money is heightened and Revay anticipates more frequent disputes as a consequence.

“The success of the contractual relationship depends less upon what has been agreed than how the parties will agree to handle events in the future.”<sup>13</sup>

Most contracts now make provision for some type of dispute resolution process prior to resorting to litigation or arbitration and specify procedures for various types of ADR.

One of the fundamental obstacles to the effective resolution of disputes at the project level is that often the same individuals who caused the problem in the first place are charged with providing findings on the issue. Positions harden, emotions frequently get in the way and the process quickly reaches a stalemate. For these reasons the intervention of a third party is often the catalyst required to break the impasse and move the parties to a settlement.

If parties are to reach an amicable settlement without external help:

- ground rules must be established and agreed to by both parties before proceed-

ing to any form of settlement procedure;

- each party should take an informed position, born of a dispassionate business decision;
- individuals prone to personal attacks or emotional outbursts must be excluded from the negotiations;
- unless the parties intend to torpedo their working relationships, threats of forcing the dispute to litigation should be avoided.

Obviously negotiation should always be the initial step – it costs very little and often a mutually acceptable commercial solution is reached.

Alternately, negotiations can be formalized and given more credence by resorting to mediation or a dispute resolution board. The major benefit of using a mediator or dispute resolution board is the structure and direction that it entails. Experienced mediators and dispute resolution board members will be able to spot parties who are “going through the motions” and will halt the negotiations.

The caliber of these external aides is paramount. Amongst other things, they must be able to mitigate any unrest and be prepared to offer opinions to the parties on the strengths and weaknesses of their case.

Increasingly Revay has been privy to the mechanism described as ‘Third Party Neutral’ or ‘Project Neutral’ wherein an independent construction professional assists the resolution process by offering independent forensic analysis for both parties. Typically, the referral to the neutral is voluntary and the decision is non-binding.

The neutral submits a written opinion to the participating parties and, although non-binding, it tends to promote an amicable settlement of the issue.

A similar approach is resolution by independent claims expert – this was the approach taken by the Greater Toronto Airports Authority during its recent \$4.4 billion development of Lester B. Pearson Airport.

In the event of an intractable disagreement, a claim is inevitable. Revay recommends that a claim always be prepared as if it was being litigated. Claims should be easily readable, properly substantiated and pragmatic. In today’s market place the emphasis must be on making a claim in a timely fashion, if only because budgets are tight and staff who can recall the facts may be more transient.

When considering whether to prepare a claim, the following steps must be taken:

- determine the merits of the case;
- determine the relationship between cause of action and damages suffered;
- decide whether the information needed to prepare a claim is or will become available;
- determine whether the action is time barred or will be before the claim can be realistically completed;
- allocate a budget and deliverables.

A preliminary review of the issues in dispute, based upon the evaluation of a few key documents will provide an indication of the merits of a case, as well as the wherewithal to prepare a document that will either facilitate the settlement of an issue or serve to proceed to litigation. Following this type of preliminary review, a budget estimate for the preparation of a suitable document can be estimated.

Claim preparation generally comprises the following stages.

- Review and compose – the salient events are extracted from the contract and project documentation and a clear concise narrative describing the issues in dispute is composed. The review determines if the party has complied with the contractual notice provisions and/or requirements essential to establishing entitlement.
- Analysis – project schedule and schedule updates, labour and cost records are analyzed to determine cause and effect of disruptions and delays, to quantify the delays, evaluate resource productivity and determine labour losses.
- Presentation for senior managers and the opposition – Revay has found that presenting the essence of the results of the research and analysis as a clear and concise narrative accompanied by simple explanatory diagrams and charts to be a most effective manner of communication. Carefully prepared and clear graphical representations that set out the facts and findings are essential aids to understanding the issues and invaluable at negotiations for settling disputes.

A contractor's claim for additional compensation will only be as good as the information used to prepare it, hence the need for proper contemporaneous record keeping throughout the execution of the work, fundamental to all those responsible for any type of construction activity.

### Down Time

To any reader in the unenviable position of having time to spare, Revay would argue that the time could be beneficially used to create "Cheat Sheets" (explained below), update operations manuals and/or compile databases of normalized costs from historical projects to improve estimating capabilities.

"Cheat Sheets" are self-help tools for use by project personnel that collate and distill the commercial obligations, duties and rights into a few pages of easily accessible rules and guidance in plain language. The sheets should be embedded by means of training sessions featuring real life scenarios with which the project teams can identify.

An operations manual that clearly defines the intentions and common actions of the firm is one way that companies can ensure sound business and construction practices are clearly laid out for the current and future work generation.

Far from being a firm's keystone document that guides their principal movements in all things operations manuals, almost invariably, are:

- an excess of outmoded policies;
- substantially left on the shelf, thereby leaving room for inconsistency;
- not championed by senior management, so permitting mavericks to operate freely and the blind to lead the blind;
- poorly constructed, with no flow of information; and/or
- authored without taking into account the complete spectrum of operational, business and commercial issues.

By revamping operations manuals:

- bad habits that have, over time, crept into the company can be quickly identified and dealt with;
- new hires can gain access to an understandable and functioning document that will quickly assist them in achieving a high level of productivity;
- the organization gains a tool that promulgates the common objectives, procedures, and rules that support the firm's work.

### Conclusion – The Road Ahead

At this juncture, Revay urges you to take the opportunity to take stock and make any necessary course corrections in the way you do business. In particular, the recession presents opportunity to prune from your ranks the individuals who have habitually made mistakes, those pre-occupied with winning prestige for themselves at a project's expense, the disaf-

ected and those disinclined to help others succeed. By doing so, contractors may be able to regain the trust of owners, many of whom were short changed during the boom.

Now is the time for all participants in the construction process to seize the occasion and inform and educate themselves on all the available technologies, best practices and innovations to improve the overall performance of the construction process.

In this report, Revay has presented food for thought, which – we hope – will improve your situation immediately and in the long term.

For the past 39 years it has been Revay's privilege to serve the needs of the construction industry and we will continue to do so whenever the need arises.

<sup>1</sup> See <http://www.clientsuccess.org>

<sup>2</sup> Our most recent report on this topic is: McEniry, G., *The Cumulative Effect of Change Orders on Labour Productivity – the Leonard Study "Reloaded"*, 26-1 Revay Report (May 2007) <<http://www.revay.com/English/Reports/vol26no1en.pdf>>

<sup>3</sup> Madigan, T., *U.S. Court Recognizes Contractor's Claim*, 25-4 Construction Law Letter (March/April 2009).

<sup>4</sup> A consortium of owner, engineering-contractor, and supplier firms, based at The University of Texas at Austin.

<sup>5</sup> [https://www.construction-institute.org/scriptcontent/more/sd5\\_more.cfm](https://www.construction-institute.org/scriptcontent/more/sd5_more.cfm)

<sup>6</sup> See Oyetunji, A. and Anderson, S., *Project Delivery and Contract Strategy*, 165-12 (Austin, TX: Construction Industry Institute Research Report, 2001); Sanvido, V. and Konchar, M., *Project Delivery Systems: CM at Risk, Design-Build, Design-Bid-Build*, 133-11 (Austin, TX: Construction Industry Institute Research Report, 1998); Wardani, M., Messner, J. and Horman, M., *Comparing Procurement Methods for Design-Build Projects*, 132-3 J. Constr. Engrg. and Mgmt., pp. 230-238 (March 2006).

<sup>7</sup> See <http://www.dbia.org/about/designbuild/>

<sup>8</sup> Any reader who would like a copy of the analysis that supports these contentions and/or an explanation of the price differential method is encouraged to contact Sue England at [sengland@revay.com](mailto:sengland@revay.com).

<sup>9</sup> The reader will have noted that, although not mathematically correct, as is usual in risk management texts the terms uncertainty and risk are herein considered as synonymous.

<sup>10</sup> Hartman, F., *Don't Park your Brain Outside: a practical guide to improving shareholder value with SMART project management* (1st ed.) (Upper Darby, Pennsylvania: Project Management Institute, 2000).

<sup>11</sup> Scott, R., *For IT projects silence can be deadly*, Computer World, 5 February, 2007 <http://www.computerworld.com/action/article.do?command=viewArticleBasic&articleId=279450>.

<sup>12</sup> Galloway, P., *CPM Scheduling and How the Industry Views Its Use*, Cost Engineering: The AACE International Journal of Cost Estimation, Cost / Schedule Control, and Project Management (January 2006).

<sup>13</sup> McInnis, A., *Relational Contracting Under the New Engineering Contract: a model, framework and analysis*, (London, England: Society of Construction Law, September 2003). Arthur McInnis, PhD is a consultant with international law firm, Clifford Chance, in Hong Kong.

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