

IMPACT OF VARIOUS CONSTRUCTION CONTRACT CLAUSES

By C. William Ibbs¹ and David B. Ashley,² A. M. ASCE

ABSTRACT: Construction contract types and general condition clauses have a major influence on the likelihood and degree of project success. A comprehensive empirical study was conducted for 36 very large capital construction projects completed within the past three years to assess such impacts. Two general contract types (cost reimbursable and fixed price) and 96 clauses were carefully analyzed for impacts on six measures of project performance: cost, schedule, quality, safety, and owner and contractor satisfaction. The clauses bearing most heavily on project performance are identified, and the key elements of those clauses that are most crucial to project success are discussed in detail. Other contract administration concepts such as risk allocation, respective views of owners and contractors, and incentive provisions are factually and thoroughly discussed.

INTRODUCTION

Construction contracts set forth the intentions and procedures to be employed in any building effort. Ideally, they should be an easily understandable, mutually agreed-upon document that provides the answer to every project contingency. More realistically, they often predominantly represent the owner's interests to which the business-hungry contractor agrees, with the hope that enough ambiguity resides in the document to permit multiple interpretations.

Believing that the contracts themselves and their administration are serious subjects for research, the Construction Industry Institute (CII) has established a contracts task force. The long-term goal of that task force is to improve construction cost-effectiveness through improved contracting. This paper presents the findings and recommendations of this group of owners, contractors, and university representatives and their first study on the impact of various construction contract types and clauses on capital construction project performance.

RESEARCH METHODOLOGY

With that broad charter as a guiding principle, the task force commissioned the University of Illinois and the University of Texas to research such impacts on a variety of performance criteria: cost, schedule, quality, safety, and owner and contractor satisfaction. The research methodology was to develop an extensive questionnaire seeking information about specific project practices and results. This survey was applied and responded to by 36 CII member companies for one individual project of their choosing. The 21 owners and 15 contractors in this study

¹Assoc. Prof., Dept. of Civ. Engrg., Univ. of Illinois, Urbana, IL 61801; and Assoc. Prof., Dept. of Civ. Engrg., Univ. of Calif., Berkeley, CA 94720.

²Assoc. Prof., Dept. of Civ. Engrg., Univ. of Texas, Austin, TX 78712.

Note.—Discussion open until February 1, 1988. To extend the closing date one month, a written request must be filed with the ASCE Manager of Journals. The manuscript for this paper was submitted for review and possible publication on May 27, 1986. This paper is part of the *Journal of Construction Engineering and Management*, Vol. 113, No. 3, September, 1987. ©ASCE, ISSN 0733-9364/87/0003-0501/\$01.00. Paper No. 21832.

submitted results from 16 lump sum, 4 guaranteed maximum, 11 cost plus fixed fee, 3 cost plus percent fee, and 2 target estimate contracts completed within the past three years.

The questionnaire response sessions were held in a variety of nationwide locations and drew senior-level representatives who were directly involved in the project's management. Upon completion of the questionnaire, a discussion period was convened which allowed for frank, in-depth discussions among this small group of owners and contractors (typically six in number). The university researcher in attendance presented the subject matter (i.e., change clauses or contract type selection rationale) and recorded the important points to supplement the raw data of the questionnaire. The contracts task force reviewed these data and comments and frequently added its own observations and recommendations. A copy of the questionnaire can be obtained from either of the writers.

The important performance measures of cost, schedule, quality, and safety were quantified by having these senior project representatives compare actual results to budgeted expectations. A semi-quantitative scale of "much worse than expected" (greater than 10% deviation); "worse than" (1-10%); "expected" ($\pm 1\%$); "better than" (1-10%); and "much greater than" ($>10\%$) categories was established. Owner and contractor satisfaction performance measures were much harder to standardize and were, in effect, discarded. The task force identified 96 clauses for study

TABLE 1.—Excerpt of Study Questionnaire Showing 14 Questions Asked of Every Clause

Questions (1)	Clauses					
	Work scope defini- tion (2)	Sup- porting/ included docu- ments (3)	Defini- tion of terms (4)	Inter- preta- tion (5)	Coordina- tion and coopera- tion (6)	Com- ments (7)
Is clause included in contract? If not, should it have been? Risk allocated to contractor, owner, or both? Limitations on risk exposure? Is responsibility defined in clause? Number of times clause used? (none, few, many) Impact of use (none, much, some) Strict or informal enforcement? Was clarification necessary? Is this a company standard clause? Is this clause necessary? Should clause be improved? Use comment column to expand Was it subject of dispute? If yes, was it major?						

and developed a list of 14 questions to be asked of each clause. These questions are contained in Table 1. An almost infinite number of data sorts were then conducted; the most interesting of these constitute the rest of this paper. The magnitude of this study was so comprehensive that this paper can only skim the surface of the total research program. The reader is therefore directed toward the total package of products emerging from this investigation: (1) this paper; (2) three university technical reports; and (3) a computer database on floppy disk of the questionnaire data (Ashley and Matthews 1985; Ashley and Workman 1985; Ibbs, et al. 1986; Matthew and Ashley 1985). These materials are available at nominal cost from CII or the individual writers.

A variety of statistical tests were used. The Chi-square test was used to test the dependency of two characteristics of a sample (e.g., the strict enforcement of a particular clause and its impact on project cost performance versus lax enforcement of that same clause). Student's *t*-tests were employed to test the means of two independent samples, i.e., the cost performance of fixed price versus cost reimbursable contracts. Another test, by means of the normal deviate *Z*, was used to test proportions of different populations. An example would be the proportion of times a contractor was assigned the risk of a clause in fixed price versus cost reimbursable cases. More discussion of both the statistical analysis procedures and data collection efforts can be found in the Illinois Technical Report (Ibbs, et al. 1986) and any general statistics text (Snedecor and Cochran 1971).

DATA ANALYSIS

The subsequent sections present results from a variety of analyses: individual clauses, clause families, contract types, and other management concepts. These tests use two types of criteria as a standard of comparison: (1) project performance as measured in terms of cost, schedule, quality and safety; and (2) criteria like "subject of dispute" and "clarification required." By and large, the conclusions and recommendations are supported directly by the data. Occasionally, some points are made which were drawn primarily from the discussions and deliberations of the project personnel and the 14 task force members.

It is to be noted that the analysis conglomerated the responses about clauses specific to a particular project for 36 jobs. To a small extent, this is an assumption because the same clause may be phrased differently for different projects. In retrospect, this tactic proved to be reasonably consistent and fair, since clauses tend to have an industry-wide standard connotation. Even more reassuring was the discovery that clauses usually serve as a proxy or pressure point to an issue and that their literal interpretation is of secondary concern.

Individual Clause Analysis

An early step of the analysis was to identify those contractual clauses that were tied to project performance. Table 2 lists all clauses reviewed in this study and shows which had a statistically significant correlation to any of the project performance measures. (The clause numbers are

TABLE 2.—Clauses Found to Have a Statistically Significant Effect on Project Performance

Clause number (1)	Clause description (2)	Performance Characteristic			
		Cost (3)	Schedule (4)	Quality (5)	Safety (6)
1	Work scope definition		NP (80%)		
2	Supporting/included documents		NN (90%)		
3	Definition of terms		U (80%)		NP (90%)
4	Interpretation				NP (80%)
5	Coordination and cooperation		NN (90%)		
6	Secrecy			UP (90%)	UP (80%)
7	Drawing ownership				UP (80%)
8	Patents and royalties				UP (80%)
9	Design changes				NP (80%)
10	Construction changes				NP (90%)
11	Quantity variations			UP (80%)	
12	Workmanship variations				
13	Inspection; quality control				NP (90%)
14	Quality assurance responsibility		U (90%)		U (80%)
15	Submittals and samples		U (90%)		
16	Performance test		U (80%)		
17	Mechanical completion			U (80%)	
18	Start-up		U (80%)		U (80%)
19	Beneficial occupancy				
20	Completion of construction				
21	Transfer of care, custody and control			UP (90%)	
22	Release of liens			U (80%)	
23	Owner termination and default				
24	Contractor termination and default				UP (80%)
25	Arbitration				
26	Official communication contacts			NP (80%)	
27	Audit rights		U (80%)		U (80%)
28	Governing law			UP (90%)	U (90%)
29	Maritime/admiralty law			UP (80%)	UP (90%)
30	Third party liabilities	UP (90%)	UP (80%)		UP (80%)
31	Liabilities; comprehensive	U (80%)			
32	Liability; builder's risk	U (80%)			
33	Liability for defects	U (80%)			
34	Delays; time extension				
35	Delays; damages	UP (80%)			
36	Schedule intervention		U (80%)		
37	Errors and omissions	UN (80%)			UP (80%)
38	As-built drawings			UP (90%)	
39	Correction of damage; other's work			UP (80%)	UP (90%)
40	Independent contractor				
41	Separate prime contractors				
42	Subcontracting				
43	Labor	UP (80%)		UP (90%)	
44	Personnel administration	UP (80%)			
45	Suppliers	UP (90%)	UP (80%)		
46	Key personnel	UN (80%)		UP (90%)	
47	Project manning				
48	Safety				NP (90%)
49	Security				
50	Care of materials		U (80%)	U (90%)	
51	Care of site		U (80%)		
52	Temporary utilities				
53	Temporary facilities				
54	Temporary protection; weather				UP (90%)
55	Temporary protection; safety				UP (80%)
56	Overtime				
57	"Or equal" standards			UP (80%)	UP (90%)
58	Permits and licenses				
59	Definition of costs				NP (90%)

TABLE 2.—Continued

(1)	(2)	(3)	(4)	(5)	(6)
60	Fees	U (80%)	UP (90%)	U (80%)	
61	Price	U (90%)			
62	Cost reporting and control	U (80%)			
63	Schedule reporting and control	NP (90%)			
64	Payments; progress	U (90%)			
65	Payments; substantial completion				
66	Payments; final completion				NP (90%)
67	Payments; retention	NP (90%)	NP (80%)		
68	Taxes; use and sales				
69	Accounting requirements		U (90%)		
70	Incentives; cost		UP (90%)		UP (90%)
71	Incentives; quality		UP (80%)		
72	Incentives; schedule		UP (80%)		UP (90%)
73	Incentives; other	UN (80%)			
74	Bonuses			UP (80%)	UP (90%)
75	Penalties				UP (90%)
76	Liquidated damages			UP (90%)	
77	Value engineering	UN (90%)			
78	Bonds; performance				
79	Bonds; labor and materials				
80	Indemnification (Hold harmless)				
81	Insurance; third-party	UP (90%)	UP (90%)		U (80%)
82	Insurance; comprehensive	U (90%)	U (80%)		
83	Insurance; builder's risk	UP (80%)			
84	Insurance; statutory (WC, etc.)	UP (90%)	UP (90%)		
85	Facility performance guarantee				
86	Design warranty				
87	Equipment/materials warranty				
88	Construction warranties				U (80%)
89	Consequential damages				UP (90%)
90	Subsurface investigation				
91	Force majeure			UP (90%)	
92	Unforeseen conditions				
93	Design rework			UP (80%)	
94	Equipment/material rework			U (80%)	
95	Construction rework				NP (90%)
96	Escalation				

Note: UN—Used few or many times with a negative effect on the performance characteristics. UP—Used few or many times with a positive effect upon the performance characteristics. NN—Not used (or present) with a negative effect upon the performance characteristics. NP—Not used (or present) with a positive effect upon the performance characteristics. U—Relationship identified but trend is uncertain. (80 or 90%)—Indicates level of confidence.

not a rank ordering, instead they are only for reference purposes.) Clearly, there are many findings, interpretations, and conclusions that can be drawn from this particular analysis—too many in fact to really discuss in a specific way here. The crucial point to be gleaned from this table is that individual clauses can be identified with project performance, both positively and negatively. Naturally, those clauses that were used and had a negative impact on a performance measure should be examined more carefully and possibly reworded.

Another way to examine individual contract clauses is to identify those which cause the most problems. The underlying assumption of this analysis is that a well-conceived contract strategy creates an environment for excellent overall project performance and does not contribute to situations of ambiguity or poorly defined responsibility. Successful contracts will limit the need for contract clarification. The task force's belief was

TABLE 3.—Nine Problem Clauses According to All Respondents and Contract Types (36)

Clause (number) (1)	Criteria (Statistically Greater than all Other Clauses)					
	Used many times (2)	Large impact of use (3)	Clarifi- cation neces- sary (4)	Improve- ment sug- gested (5)	Subject of dis- putes (6)	Subject of major dispute (7)
Work scope definition (1)	*	*	*	*	*	
Supporting/included documents (2)	*	*	*		*	
Design changes (9)	*	*	*		*	*
Construction changes (10)	*	*	*	*	*	*
Definition of costs (59)	*		*	*	*	
Price (61)		*	*			
Cost reporting and control (62)	*		*	*		
Schedule reporting and control (63)	*		*	*	*	*
Design rework (93)				*	*	

that well-prepared contracts would be relatively free of contract disputes.

To assist in the formulation of improved contractual arrangements, the study sought those contract clauses which required clarification and improvement more frequently than the average. Also identified were the clauses which were most frequently used, had large impact, and were the subject of disputes. These clauses are listed in Table 3, where all contract types and respondents are analyzed together.

From one point of view, the nine clauses listed in Table 3 were the most troublesome of the contracts investigated in this study. Further examination reveals that these problem clauses tend to fall into natural groupings or families that pertain to one of three categories: (1) Clauses which govern contract variations or adjustments (*a changes family*); (2) the physical work itself and its definitions (*a work scope definition family*); and (3) the control and reporting aspects (*a project control family*). Further analysis was conducted along these lines of inquiry.

CLAUSE FAMILY ANALYSIS

This research study defined and examined 18 different clause families. Failure to consider and respond to the importance of the three mentioned families in particular was seen to result inevitably in more project ambiguity and disputes with a corresponding decrease in cost effectiveness. Additionally, these families were found to be directly related to contract execution and often defined the procedural steps required to contend with unexpected occurrences. A summary of that analysis and a series of important recommendations for each of these three crucial clause families are presented below.

Change Clauses

"Change" brings to mind the worst images of a construction project. Cost overruns, mismanaged jobs, low productivity, unexpected subsurface conditions, and litigation are associated with change. Most construction professionals agree that change is an inevitable aspect of the

construction process and may even have beneficial effects if handled properly.

Change clauses deal with variations or omissions in design, construction, and management efforts. They provide a mechanism for facilitating corrections or modifications to the physical work, the contractual conditions, or the activity and management plans. The major objectives of change clauses are control and flexibility, which are achieved by providing a contractual method for dealing with an event that is not part of the original contract. By effectively reducing contractor risk, such clauses may reduce construction costs by minimizing contractor contingency. Quality variations in either the plant or resultant product can be accommodated and can protect the project owner from unnecessary loss. The flexibility provided through procedures that allow contract modification is an important element of a contract.

Analysis of the data indicates that change clauses continue to be a major problem in construction contracting. Clauses that caused significantly more disputes, required more clarification, or needed more improvement than average included several from the change family. An analysis of the "all respondents" category (owners and contractors aggregated together) shows that several members of the change-clause family listed in Table 4 were disputed, required clarification or needed improvement significantly more than average.

The responses to these questions were tabulated for all 96 clauses to establish a comparative ranking. High rankings (a value of one) were assigned to clauses with affirmative responses to each of the criteria in the columns of Appendix I; low rankings were assigned to clauses that were not cited as such. By using this analysis, it was determined that the following clauses represented the most important areas of study: (1) Work scope definition (clause 1); (2) design changes (9); (3) construction changes (10); (4) workmanship variations (12); and (5) design rework (93). This selection was made by identifying that 30% of the family's clauses that were the most troublesome.

Disputes involving these five change clauses seemed to affect project performance negatively. Cost, schedule, quality, and safety performance results were better on projects where these clauses were not disputed than where they were. Specific recommendations for this clause family and, in fact, all subsequent specific analyses will be detailed near the conclusion of this paper.

Work Scope Definition Clauses

For the purposes of this report, the work scope definition clause family was defined to serve the purpose of describing the following project parameters: (1) The physical work to be completed; (2) the minimum standards of acceptability; (3) the procedural guidelines for performing the work; and (4) the technical documents that depict the work (e.g., drawings and specifications).

Due to the apparent impact on project performance of work scope, a family of 17 clauses was defined from the total 96 clauses studied. They are listed in Appendix II. As can be seen, five stood out as particularly important. As with Appendix I, the numerical values indicate the relative frequency that a clause was cited as being in need of clarification or

improvement, on the subject of dispute or major dispute, with a value of 1 being most frequently cited.

The clauses which were troublesome in this sense, called the worst of the worst, can be summarized as: (1) Work scope definition (clause 1); (2) supporting and included documents (2); (3) design changes (9); (4) construction changes (10); and (5) workmanship variations (12).

Project Control Clauses

For this report, the project control clause family established and defined the following: (1) The systems, means, and personnel necessary to monitor and approve project performance; (2) methodologies to confirm compliance with the contract; and (3) methodologies to correct unacceptable variations from the contract. Using the same procedures and nomenclature employed for testing the previous two families, Appendix III was developed. The most troublesome clauses were: (1) Construction changes (clause 10); (2) workmanship variations (12); (3) definition of costs (59); (4) cost reporting and control (62); (5) schedule reporting and control (63); and (6) design rework (93).

CONTRACT TYPES ANALYSIS

Within the construction industry, it is recognized that the spectrum for contract strategy may range from a single contract (in its various forms) to many separate prime contracts for construction design or construction management. Generally, however, contracts are defined as some derivative of either cost-reimbursable or fixed price contracts. Each has distinct differences and produces very important effects on project performance. Selecting the optimal contract type and making the necessary project-specific modifications requires sensitivity and awareness to the impact of these decisions. It is very difficult to forecast the consequences of such actions, yet the contract form is, undeniably, a major determinant of project success or failure.

In this study, cost reimbursable contracts were defined to include all contract types characterized by financial arrangements which allow the contractor price adjustments relative to project costs and which do not require the stipulation of a final fixed sum. By contrast, fixed price contracts include all contract types characterized by financial terms which require the contractor to establish a stipulated sum for the completion or execution of a defined quantity of work.

The research discussed in this section is organized along two different lines. First, the task force identified a number of what are called conventional wisdoms and tested them for accuracy. These are commonly accepted truths that are so broad that neither this research nor any other single project could conclusively prove their applicability to all segments and projects in the construction industry. Still, there was enough supporting data derived from this research to lend some measure of support to the following conventional wisdoms.

1. Risk allocation is considered to be primarily directed toward the contractor in projects using fixed-price contracts. In this research, fixed price contracts did demonstrate a significantly larger allocation of risk to

the contractor independent of project scale or type.

2. The owner assumes a greater degree of risk-sharing with the contractor in cost reimbursable contracts. By examining the individual contract clauses in cost reimbursable contracts, it was seen that the owners did not assume more risk solely on their own part but moved to a position of greater risk-sharing with the builder.

3. More owner administrative time is required to implement a cost reimbursable contract as compared to a fixed price contract. Trends indicated greater numbers of owner personnel and time were required to administer reimbursable contracts than fixed price contracts.

4. Cost reimbursable contracts substantially reduce the adversarial relationship between the owner and the contractor compared to fixed price contracts. This point was substantiated in two ways. First, contractual disputes were significantly more frequent and severe in fixed price settings. Also, the individual clauses had to be used and clarified more often as well as enforced more strictly in fixed price contracts.

5. Significantly more effort is required for documentation of design with fixed-price contracts before initiating construction, especially to establish a clear definition of work scope and responsibility. The data used to substantiate this point included: (1) The costs expended; (2) the man-hours expended; and (3) the duration (in months) committed before construction began. The findings were supportive.

6. Cost-reimbursable contracts require less owner effort to enforce contractual quality provisions. This research supported this controversial point. Stricter interpretation and more frequent use and clarification of quality-related clauses were discovered on fixed price contracts. Higher dispute rates also were found.

7. Cost-reimbursable contracts provide flexibility to prescribe change in design or scope of work, while fixed price contracts are considered significantly less accommodating. For change clauses in fixed price contracts, the use and strict enforcement rates were substantially higher. Secondly, clarification was needed more frequently in fixed price environments. Finally, disputes of all kinds gravitated more readily to fixed

TABLE 4.—Problem Clauses in Fixed Price Contracts (20 Contracts)

Clauses (1)	Criteria (Significantly Different from Average)			
	Improvement was suggested (2)	Clarification was necessary (3)	Subject of a dispute (4)	Subject of a major dispute (5)
Cost reporting and control (62)	*	*	*	
Construction changes (10)		*	*	*
Bonuses (74)		*	*	
Schedule reporting and control (63)		*		*
Work scope definition (1)	*	*		
Design changes (9)		*		
Supporting/included documents (2)			*	
Schedule intervention (36)			*	
Workmanship variations (12)			*	
Quality assurance responsibility (14)			*	
"Or equal" standards (57)			*	
Incentives: schedule (72)	*			
Unforeseen conditions (92)	*			
Accounting requirements (69)		*		

TABLE 5.—Problem Clauses in Cost Reimbursable Contracts (16 Contracts)

Clauses (1)	Criteria (Significantly Different from Average)			
	Improvement was suggested (2)	Clarification was necessary (3)	Subject of a dispute (4)	Subject of a major dispute (5)
Construction changes (10)		*	*	
Definition of costs (59)		*	*	
Design changes (9)		*	*	
Design rework (93)			*	
Schedule reporting and control (63)	*	*		
Cost reporting and control (62)		*		
Supporting/included documents (2)			*	
Work scope definition (1)	*			

price contracts, especially for work scope family clauses.

8. Cost reimbursable contracts allow for easier phasing or fast-tracking of design and construction which provides for earlier completion of construction. Indeed, when the sum of design and construction period durations was divided by total project duration, more overlapping was clearly seen in cost reimbursable environments than in fixed price settings.

The second type of analysis conducted for these two contract types was to identify the most troublesome for each. Using the familiar criteria of suggested improvements, necessary clarification, the subject of dispute, and the subject of major disputes, Tables 4 and 5 were developed.

The selection of contract type is largely dependent on the owner's predetermined goals. Both fixed price and cost reimbursable contracts (and the individual contracts that comprise these groups) have their selective merits. After the owner identifies the project goals, the "best fit" should be selected and tailored to those specific needs.

OTHER SPECIFIC ANALYSES

Contractual Risk Management

Sophisticated construction participants recognize the importance of the risk management concept. Risk is interpreted to mean the possibility of gain or loss which may occur during the course of a project. One of the fundamental purposes of developing a legally defined relationship among participating parties in any construction process is to assign or allocate risk. Successful contract strategies will transfer risk accountability to enhance overall project objectives.

Each owner must determine rationally which risks his or her organization has the capability and experience to assume successfully. It is important not only to develop a contract strategy to match the primary objectives of the owner, but to design the contract documents so that the resource capabilities of the contractor are recognized. Disproportional contractual arrangements are responsible for many project disputes and difficulties. Unfair contract conditions obviously impact project performance in an adverse manner.

In determining a contract strategy, both parties should strive to understand and recognize each other's goals and capabilities. Neither party

will benefit from dictating preferential contract language. This serves as a catalyst for creating adversarial relationships and should be avoided. The construction process, however, inherently contains many risks which must be assigned in a manner that maximizes the probability of successful project completion. Helpful guidance is needed with respect to appropriate measures to allocate risk most effectively. Project performance will be greatly improved when risk allocation is assigned in a manner cognizant of the impacts of these decisions.

This study confirmed that the prevalent manner of allocating risk is one in which the owner uses the contract to minimize his risk exposure. Surprisingly, it appears that a number of clauses do not specifically assign risk to the contractor and, thus, may be defined as being an assignment to both parties. On an aggregate basis, the allocation of risk in the clauses reviewed was as follows: Owners were at risk 11% of the time; contractors were at risk 46% of the time; and both parties were at risk 43% of the time.

The study indicated that significant disagreements exist between owners and contractors with respect to the perception of risk assessment. In many instances, particular clauses were viewed quite differently by owners and contractors when asked to indicate their interpretation of the risk allocation. Among the more important of these are shown in Table 6.

The design rework clause 93 is particularly striking. While owners viewed the risk as being allocated to contractors 23% of the time, contractors felt they were assigned this responsibility 80% of the time. Although this example may seem extreme, the study consistently showed

TABLE 6.—Owners' and Contractors' Divergent Views of Risk for Several Interesting Cases

Clause (number) (1)	Frequency of Risk Allocation		
	Owner's view (2)	Contractor's view (3)	Allocated to (4)
Work scope (1)	31%	0%	Owner
	15%	67%	Contractor
	54%	33%	Both
Cost reporting and control (62)	30%	14%	Owner
	20%	57%	Contractor
	50%	29%	Both
Equipment/material warranty (87)	11%	23%	Owner
	61%	33%	Contractor
	28%	44%	Both
Subsurface investigation (90)	25%	43%	Owner
	42%	0%	Contractor
	33%	57%	Both
Force majeure (91)	17%	43%	Owner
	11%	0%	Contractor
	72%	57%	Both
Design rework (93)	23%	0%	Owner
	23%	80%	Contractor
	54%	20%	Both

that such disparities in interpretation exist. Such conditions create an environment for misunderstandings, disagreement, and, ultimately, dispute. Contractors on this task force felt that this was the most important finding of the entire research project!

Although owners and contractors agree that the majority of contracts assign much risk to the contractor, a significant percentage of contract clauses requires both parties to share risk. Such clauses may create problems if not clearly understood and carefully written. In the context of risk allocation, ambiguity will create difficult situations to resolve. The data, however, did not provide a clear view of such mutual risk sharing was precisely achieved.

In clauses where there was no limit on the risk exposure, the risk allocation pattern was as follows: (1) Owners were at risk 11% of the time; (2) contractors were at risk 45% of the time; and (3) both parties were at risk 44% of the time.

The study also showed that no-limit clauses were characterized by strict enforcement. This raises several concerns to the contracting parties. Do contractors recognize the intention of owners to strictly enforce no-limit clauses? Do contractors have sufficient resources to respond to such requirements should the situation arise? Has the no-limit clause been assigned to the party most capable of bearing this responsibility? Are project objectives best served by this contract strategy? The analysis performed for this study could not conclusively determine the answers to these questions. Each contract, however, should respond to these issues.

Owners and Contractors: Respective Views

Another important analysis was to separate owners and contractors. That is, when developing a successful contracting strategy, one must consider the fundamental views, motivations, and incentives of both the owner and the contractor(s). Are their views different? If so, why? Are there any common interests? If so, what are they? What impact do the differences have on the overall project performance? Although the specific viewpoint and project circumstances may vary, owners and contractors generally have objectives which conflict, at least to some degree.

This research sought to identify areas of disparity and agreement in clause importance. Such information would serve to enlighten both parties as to what the other sees as critically important in the context and language of the contract. Given this awareness, contractual arrangements can be shaped into documents which provide greater opportunity for improved project performance and significantly reduce the incidence of contract disputes.

In order to evaluate the most important clauses present in the current contract forms, the CII study's database was analyzed to determine those clauses that are significantly different from the average for each party. A list of the clauses identified by owners as being significantly different from the average in at least four criteria is shown in Table 7. Comparatively, a list of clauses identified by contractors as being significantly different from the average in at least four of the above criteria is shown in Table 8.

The study showed in other ways the wide differences in perspectives of owners and contractors. For instance, the following group of six clauses

TABLE 7.—Significant Clauses for Owners (21 Owners)

Clause (number) (1)	Criteria (Significantly Different from Average)									
	Unim- portant and not useful (2)	Import- tant and useful (3)	Im- prove- ment was sug- gested (4)	Subject of a dispute (5)	Subject of a major dispute (6)	Clarifi- cation was neces- sary (7)	Used many times (8)	Large impact of use (9)	Used and should be im- proved (10)	Dis- puted and should be im- proved (11)
Design change (9)			*	*	*	*	*	*		
Work scope def- inition (1)		*	*			*	*			
Construction changes (10)					*	*	*	*		
Schedule report- ing and con- trol (63)		*			*	*	*			
Incentives; qual- ity (71)	*		*					*	*	
Incentives; schedule (72)	*		*					*	*	
Incentives; other (73)	*		*					*	*	

was identified by the owners as being in significant need of improvement: (1) Incentives; Quality (clause 71); (2) Incentives; Other (73); (3) Incentives; Schedule (72); (4) Cost Reporting and Control (62); (5) Care of Site (51); and (6) Work Scope Definition (1). The owners' average frequency ranking for this set was five for the criterion "improvement needed." For these same six clauses, though, contractors rated them as an average of 42. These frequency ratings are scaled from 1 (most frequently cited) to 96 (least significant).

Under this same criterion of improvement needed, contractors identified another set of clauses as being significant: (1) Design rework (clause 93); (2) mechanical completion (17); (3) construction rework (95); (4) work

TABLE 8.—Significant Clauses for Contractors (15 Contractors)

Clause (number) (1)	Criteria (Significantly Different from Average)									
	Unim- portant and not useful (2)	Import- tant and useful (3)	Im- prove- ment sug- gested (4)	Subject of a dispute (5)	Subject of a major dispute (6)	Clarifi- cation neces- sary (7)	Used many times (8)	Large impact of use (9)	Used and should be im- proved (10)	Dis- puted and should be im- proved (11)
Construction changes (10)		*	*	*		*	*	*	*	*
Design changes (9)		*		*		*	*	*	*	*
Supporting/in- cluded docu- ments (2)		*	*	*		*	*			*
Work scope definition (1)		*	*			*	*			
Definition of costs (59)				*		*	*	*		

scope definition (1); (5) supporting/included documents (2); and (6) construction changes (10). The contractors frequency ranking for this second set was four. Owners, on the other hand, assigned this group a 34 on the average. This simple example dramatically reinforces the proposition that divergent goals on the part of the various project participants lead to considerable confusion and disagreement.

Incentives

A well-designed and fairly administered contract is a catalyst for good contractor performance; selection of contract type and risk allocation are basic to this contract design. Beyond these stimuli, additional incentives in the form of inducements, encouragements, or threats can be used to further motivate contractor performance. The contractor is encouraged, directly or indirectly, to adopt more closely the owner's project objectives.

Incentives are a tool used by owners in contract administration to impact or affect the contractor's compensation. Adjustment is made for variations in contractor performance from an established standard. The owner's expectations must, therefore, be outlined in the incentive program along with the measures of performance. Contractor performance is normally categorized into the areas of cost, schedule, or quality. Performance measures used in an incentive program should be perceived as valid measures, be flexible enough to meet changing conditions, and be easily administered.

Many owners believe that incentive programs are not easily administered and, in fact, are accompanied by additional administrative difficulties. The incentive program must be structured to maintain a harmonious relationship between the owner and contractor. For purposes of the study, contracts were classified as having positive incentives if they contained at least one of the following clauses: (1) Incentives, cost (clause 70); (2) incentives quality (71); (3) incentives, schedule (72); (4) incentives, other (73); and (5) bonuses (74). Negative incentive contracts were considered to be those that had no positive incentive clauses and at least one of the following two clauses: (1) penalties (clause 75); and/or (2) liquidated damages (76). The remainder of the contracts were designated as having no incentives. Enough contracts fell into each of the three categories so that assessments of related project performance could be made.

Superior project performance can be attained through judicious use of positive incentives. Schedule and safety performances are definitely improved by inclusion of positive incentive provisions; differences between positive and negative incentive contracts are even more marked than between positive and no incentive ones. Cost performance follows a similar trend, while quality levels are little affected by use of incentives. No evidence exists that negative incentives used by themselves enhance project objectives; in fact, except for perhaps public sector contracting, negative incentives may have no role in modern contracts.

Better project performance is counterbalanced by a need for more contract administration. Contracts with positive incentives need more clarification and are more strictly enforced than other contracts. The findings show that positive incentive clauses, with the exception of cost

incentives, are disputed quite frequently and need more improvement than negative-incentive clauses. Use of positive incentives appears to place more project risk on the contractor. Choosing an incentive contracting approach should thus be a deliberate decision that will enhance project performance by providing more probable contractor compensation, and at the same time recognize the potential for increased contract administration effort and contractor risk assumption.

Many industry professionals indicated high enthusiasm for incentive programs that go beyond the contract agreement. These unilateral bonus programs are designed to reward exceptional contractor project management with all or part of a substantial bonus; typically, bonus allocation is determined solely by the client or a client-contractor committee. Since these bonuses are not normally guaranteed in the contract, they generate little additional administration effort or adversarial attitudes. Although relatively new, this approach received strong endorsement from those individuals, both owner and contract personnel, who had participated in such programs.

CONCLUSIONS AND RECOMMENDATIONS

This study has successfully demonstrated the importance of thoughtful and meticulous contract preparation to achieve improved project performance. Owners and contractors alike will benefit by taking a more discerning approach to the contractual arrangements of their projects. Although the analysis has already provided many suggestions for contract improvement, it is important to note that nine specific clauses were consistently identified as being most troublesome and as having a statistically significant impact (at least to the 80% level) on project performance. These nine clauses are presented in Table 9 with respect to their

TABLE 9.—Summary of Most Troublesome Construction Clauses

Clause (number) (1)	TYPE OF TEST							
	Clause Family			Contract Type		Party		
	Changes (2)	W/S (3)	P/C (4)	Fixed price (5)	Cost reim- burse- ment (6)	Own- er (7)	Con- trac- tor (8)	Both (9)
Construction changes (10)	*	*	*	*	*	*	*	*
Design changes (9)	*	*		*	*	*	*	*
Design rework (93)	*		*		*			*
Supporting and included documents (2)		*		*	*		*	*
Workmanship variations (12)	*	*	*	*	*		*	*
Work scope definition (1)	*	*		*	*	*	*	*
Definition of costs (59)			*		*		*	*
Cost reporting and control (62)			*	*	*			*
Schedule reporting and con- trol (63)			*	*	*	*		*

relative importance as indicated by the various tests conducted in this research.

Note that Tables 3 and 9 are quite similar in that eight of the nine clauses in each are the same. The difference between these two tables is that the first is a summary of important clauses for all contract types and all parties aggregated together; Table 9, on the other hand, is a summary of the important clauses as identified by the separate, more specific tests discussed in this report. The similarity of these tables underscores these clauses as being all the more important since they are significant from such a wide variety of perspectives.

RECOMMENDATIONS

Fifty-three specific and practical recommendations pertaining to contract strategy preparation and individual clause drafting were generated by the people interviewed and the task force members as a result of this research. Space limitations do not allow enumeration of all; however, the most important may well be the following:

1. Clearly list and include, if possible, all documents that relate to work scope definition. Owners should spend extra time before the release of their documents to check for conflicts and omissions, and contractors should quickly and honestly report any such problems.
2. Recognize that adversarial relations are counter to the best interests of both owners and contractors. Contractors rarely are enriched by claims and change orders.
3. Cost effectiveness can be improved by artfully structuring the construction contract to reflect clearly the project objectives of both parties.
4. Incorporating project objectives into the contract will require evaluation by both parties to determine their respective interests.
5. Clear communications are enhanced by minimizing generalizations of these interests when wording contractual clauses. Lack of details or specifics will commonly result in differing interpretations and, at the least, require time-consuming clarifications.
6. Company standard clauses can be cost effective when they are tailored to the particular project and are viewed as part of a whole. A later part of this report underscores the importance of treating clauses in a collective or "family" fashion. Project clause-tailoring must be performed with this fact in mind.
7. Recognize that the clauses identified herein as troublesome are more symptomatic of problem areas than as being the root cause of the problem. It is strongly recommended that the pressure points be discussed and negotiated in advance of construction.

It should be noted that simply writing the best contract clauses is no panacea. Intelligent and fair administration of the clauses (i.e., the "people-side" of contracts and contracting) is just as crucial. A good starting point for achieving successful construction contracting is to adopt the principles derived from this research investigation and tested exhaustively in practice by the companies who participated in this study.

ACKNOWLEDGMENTS

This material is based upon work supported by CII and the National Science Foundation under grants MSM 84-51561 and MSM-86-52354, Presidential Young Investigator Awards. Additional support was provided by ARGONAUT AEC General Motors Corporation and the W. E. O'Neil Construction Company. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the writers and do not necessarily reflect the views of the sponsors.

The writers appreciate the contributions of research assistants W. E. Back, J. J. Kim, D. E. Wall, J. M. De La Garza, M. A. Hassanein, S. M. Schran, and R. K. Twardock at the University of Illinois, Champaign-Urbana, Ill., and J. J. Mathews and W. B. Workman at the University of Texas, Austin, Texas.

APPENDIX I.—FREQUENCY RANKING OF CHANGE CLAUSES

IDENTIFICATION OF PROBLEM CLAUSES "CHANGE" FAMILY								
Clause number	Clauses in family (description)	Ranking out of 96 Clauses (Criteria)				Worst of worst	Impact (much)	Use (many times)
		C	I	D	MD			
1	Work scope definition	1	1	5	5	*	+	+
9	Design changes	2	4	1	2	*	+	+
10	Construction changes	2	2	1	2	*	+	+
11	Quantity variations	73	85	52	16		+	
12	Workmanship variations	11	12	4	5	*		
36	Schedule intervention	27	18	8	5			
37	Errors and omissions	42	44	14	5			
38	As-built drawings	42	12	52	16			
39	Correction of damage	83	85	67	49			
90	Subsurface investigation	58	44	52	49			
91	Force majeure	83	69	35	49			
92	Unforeseen conditions	83	12	52	16			
93	Design rework	21	8	9	5	*		
94	Equipment/material rework	27	12	35	16			
95	Construction rework	17	9	9	16			
A) Average ranking of worst of worst		7.4	5.4	4.0	3.8	Avg = 27.4 Avg = 41.8 Δ = 14.4		
B) Average ranking of family minus worst of worst		53.6	39.0	37.6	23.9			
C) Average ranking of family		38.1	27.8	26.4	17.2			
D) Average ranking of non-family clauses		55.8	43.7	45.6	33.2			
Key C—Was clarification necessary? I—Should Clause be improved? D—Was this clause a subject of dispute? MD—Was this clause a subject of major dispute? *—"worst of worst" +—Clause had greater significance than the average for at least one of five groups; all respondents, cost reimbursable contracts, fixed price contracts, owners, and contractors. Δ—Average of row D minus that of row C.								
Definition of Family—Clauses concerning any design, construction, schedule or quantity changes. (Also deals with errors and omissions.)								

APPENDIX II.—FREQUENCY RANKING OF WORK SCOPE CLAUSES

IDENTIFICATION OF PROBLEM CLAUSES "WORK SCOPE DEFINITION" FAMILY								
Clause number	Clause description	Ranking out of 96 Clauses (Criteria)				Worst of worst	Impact (much)	Use (many times)
		C	I	D	MD			
1	Work scope definition	1	1	5	5	*	+	+
2	Supporting and included documents	5	4	1	5	*	+	+
3	Definition of terms	42	18	67	49			
4	Interpretation	21	18	21	4			
5	Coordination and cooperation	58	25	27	16			
9	Design changes	2	4	1	2	*	+	+
10	Construction changes	2	2	1	2	*	+	+
12	Workmanship variations	11	12	4	5	*		
14	Quality assurance responsibility	11	69	14	16			
16	Performance tests	73	69	27	16			
17	Mechanical completion	21	9	27	49		+	
18	Start-up	42	25	27	16		+	
20	Completion of construction	11	12	14	16			
41	Separate prime contractors	91	85	88	49			
52	Temporary utilities	42	25	52	49			
53	Temporary facilities	58	44	52	49			
61	Price	7	18	14	5		+	
A) Average ranking of worst of worst		4.2	4.6	2.4	3.8			
B) Average ranking of family minus worst of worst		39.8	34.8	35.8	27.8	Avg = 25.5		
C) Average ranking of family		29.3	25.9	26.0	20.8	Avg = 42.6		
D) Average ranking of non-family clauses		46.9	44.5	46.2	32.8	Δ = 17.1		
Key								
C—Was clarification necessary?								
I—Should the Clause be improved?								
D—Was this clause a subject of dispute?								
MD—Was this clause a subject of major dispute?								
*—"worst of worst"								
+—Clause had greater significance than the average clause for at least one of five groups; all respondents, cost reimbursable contracts, fixed price contracts, owners, and contractors.								
Δ —Average of row (D) minus that of row (C).								
Definition of Family—Clauses that define the physical work to be done, the standards to be adhered to, and how the work is to be completed.								

APPENDIX III.—FREQUENCY RANKING OF PROJECT CONTROL CLAUSES

IDENTIFICATION OF PROBLEM CLAUSES "PROJECT CONTROL" FAMILY								
Clause number	Clauses in family description	Ranking out of 96 Clauses (Criteria)				Worst of worst	Impact (much)	Use (many times)
		C	I	D	MD			
10	Construction changes	2	2	1	2	*	+	+
11	Quantity variations	73	85	52	16		+	
12	Workmanship variations	11	12	4	5	*		
13	Inspection quality control	10	44	14	16			
16	Performance tests	73	69	27	16			
26	Official communication contacts	42	25	35	16			+
34	Delays; time extension	27	44	9	49			
35	Delays: Damages	42	44	21	49			
36	Schedule intervention	27	18	8	5			
37	Errors and omissions	42	44	14	5			
44	Personnel administration	58	44	52	49			
46	Key personnel	73	44	35	16			
47	Project manning	58	44	14	5			
59	Definition of costs	7	4	7	5	*	+	+
62	Cost reporting and control	5	2	9	5	*		+
63	Schedule reporting and control	4	4	5	1	*		+
92	Unforeseen conditions	83	12	52	16			
93	Design rework	21	8	9	5	*		
94	Equipment/material rework	27	12	35	16			
95	Construction rework	17	9	9	16			
A) Average ranking of worst of worst		8.3	5.3	5.8	3.8			
B) Average ranking of family minus worst of worst		46.6	38.4	26.9	20.7	Avg = 25.0		
C) Average ranking of family		35.4	28.4	20.6	15.7	Avg = 43.4		
D) Average ranking of non-family clauses		46.1	44.5	48.4	34.6	$\Delta = 18.4$		

Key
 C—Was clarification necessary?
 I—Should the Clause be improved?
 D—Was this clause a subject of dispute?
 MD—Was this clause a subject of major dispute?
 *—"worst of worst"
 +—Clause had greater significance than the average clause for at least one of five groups; all respondents, cost reimbursable contracts, fixed price contracts, owners, and contractors.
 Δ —Average of row (D) minus that of row (C).

Definition of Family—Defines the systems, means, and personnel necessary to check the work, confirm its compliance, and correct variations.

APPENDIX IV.—REFERENCES

- Ashley, D. B., and Mathews, J. J. "Analysis of construction contract change clauses." *Technical Report No. UTCEPM-85-2*. Univ. of Texas, Austin, Tex., Dec., 1985.
- Ashley, D. B., and Workman, B. W. "Incentives in construction contracts." *Technical Report No. UTCEPM-85-3*, Univ. of Texas, Austin, Tex., Dec., 1985.
- Ibbs, C. W., et al. "Determining the impact of various construction contract types

and clauses on project performance." (1,2). *Technical Report No. 20*, Univ. of Illinois, Urbana, Ill., Feb., 1986.

Mathews, J. J. and Ashley, D. B. "Contract Clause Study Data." *Technical Report No. UTCEPM-85-1*, Univ. of Texas, Austin, Tex., Nov., 1985.

Snedecor, G. and Cochran, W. *Statistical methods*, ed. 6, Iowa State University Press, Iowa State Univ. of Sci. and Tech., Ames, Iowa, 1971.