ARE CONTRACT DISPUTES PREDICTABLE?

By James E. Diekmann[1] and Matthew J. Girard[2]

ABSTRACT: Are some construction projects more prone to contract disputes than others? If so, can these projects be identified before construction begins? This paper describes research conducted with the CII Dispute Prevention and Resolution Task Force to answer these questions. This research analyzed the effect of different project characteristics on the occurrence of contract disputes. This paper explains the project characteristics that were evaluated, our data analysis techniques, and the conclusions that we made from this analysis. Three categories of project characteristics were considered: people aspects, process aspects and project aspects. The findings of this work are based on statistical analysis of data on the frequency and severity of disputes on 159 construction projects. A logistic regression model named Disputes Potential Index was created from this data set that predicts those projects that have a high likelihood of experiencing contract disputes. People, process, and project issues all play a role in predicting the likelihood of contract disputes. However, the fundamental conclusion from this research is that "people" hold the key to avoiding contract disputes.

INTRODUCTION

The Dispute Prevention and Resolution Task Force of the Construction Industry Institute (CII) has adopted a two-pronged approach to contract dispute prevention and resolution. This approach proposes that the contracting parties "start right" and "stay right." "Start right" requires that the contracting parties start with suitable contract language and with appropriate alternative dispute resolution (ADR) procedures. "Stay right" requires that the parties solve emerging disputes quickly, before they develop into complex legal problems. The work described in this paper is intended to help contracting parties start right by helping them identify construction projects that have a high likelihood of experiencing contract disputes.

Fundamentally, the research attempts to develop a method to identify dispute-prone projects so the parties involved can take steps to reduce the likelihood of contract disputes. For the purposes of this research we define contract dispute as, "any contract question or controversy that must be settled beyond the jobsite management staff." By this definition, a construction project can experience a large number of non-contentious changes and contract modifications that are not considered disputes. This study seeks to determine whether construction projects with certain characteristics are more likely to experience contract disputes.

A TOOL TO PREDICT THE LIKELIHOOD OF LEGAL DISPUTES

This paper describes what can be likened to a "cholesterol test" for project disputes. A cholesterol test may indicate a propensity toward heart disease; however, a high cholesterol value does not guarantee a heart attack, neither does a low cholesterol value preclude the possibility of a heart attack. This "cholesterol test," which is called the disputes potential index (DPI), is developed to provide the project team with foreknowledge of a high propensity toward contract disputes. Such foreknowledge can give the project team the ability to make necessary changes in the project, its delivery system or its personnel to avoid or reduce likelihood of disputes.

[1]Prof. of Civ. Engrg., Dept. of Civ., Envir. and Arch. Engrg., Univ. of Colorado–Boulder, Boulder, CO 80309.

[2]Field Engr., Flatirons Structures Co., Longmont, CO 80504.

Note. Discussion open until May 1, 1996. 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 September 28, 1994. This paper is part of the ***Journal of Construction Engineering and Management***, Vol. 121, No. 4, December, 1995. ©ASCE, ISSN 0733-9364/95/0004-0355–0363/$2.00 + $.25 per page. Paper. No. 9344.

Predicting dispute susceptibility on a construction project is a very complicated process. Many things may *indicate* the likelihood of disputes just as a sedentary lifestyle or a high-fat diet may *indicate* the likelihood of heart disease. What might be the analogous potential indicators of disputes on a construction project? To find out, we developed a questionnaire to gather data on project characteristics that we believe have a high likelihood of being correlated to a high incidence of disputes on a construction project. (The complete text of the data-collection survey is found in Appendix I.) The essence of this research is to investigate whether any or all of these characteristics serve as a predictor of disputes. Three classes of characteristics were defined for this research: people, process, and project characteristics.

Issues involving people are extremely important when considering the number of organizations, relationships, roles, responsibilities, and the many different expectations that affect these people. Do the organizations involved have the personnel resources to manage the process adequately and do they work in a cooperative manner?

Process issues, or the manner in which the contract and building process is carried out, includes planning of the project; financial and scope definition; contractual obligations, contractual risk allocation, and contract administration procedures; quality of the construction documents used; and the use of dispute mitigation techniques.

Project issues are those characteristics that define the technical nature of the work, such as the type and complexity of a project, the limitations of the site and the environment in which it is being proposed. Once the project is defined by the owner, these project characteristics are inherent and can not be substantially changed. Therefore, the project characteristics provide lesser opportunities to improve dispute performance; however, these characteristics do indicate project risks and therefore, the need for special dispute prevention or resolution efforts.

In cooperation with the CII Dispute Prevention and Resolution Task Force, a hierarchy of contract-dispute predictors was constructed around the main categories of people, project, and process. The hierarchy of predictors for the people criterion is shown in Fig. 1. People are the foundation of every construction project: They must deal with ever changing conditions, must manage the process, and most importantly must negotiate and deal with disagreements and disputes that are bound to arise. As shown in Fig. 1, People criteria are arranged into three branches: the owner, the contractor, and the business relationship that exists between the two. The subcriteria for each of these branches are described in the following paragraphs:

J. Constr. Eng. Manage., 1995, 121(4): 355-363

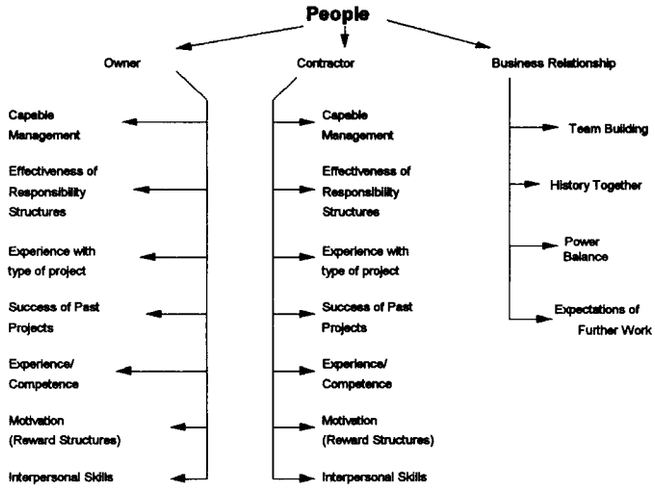

FIG. 1. People Branch of Hierarchy

- Capable management. This considers the respective organization, owner or contractor, and the skill and ability of the upper management. Upper management is considered to be those people responsible for the overall success of the project at a home-office or corporate level. Their responsibility stretches beyond "the contract" to include long-term business and customer satisfaction objectives.
- Effectiveness of responsibility structures. This subcriterion considers the organization's internal responsibility structure, which is ideally well defined when people are allowed to make decisions on matters within their control.
- Experience with type of project. This considers the organization's level of experience with type of project undertaken. It does not deal with individuals, but with the organization as a whole.
- Success of past projects. This category considers whether the organization was considered "successful" and "reputable" with previous projects. Success can be measured by any combination of schedules, budget, quality, minimal disputes, and so on.
- Experience/competence. This branch is the first of three that considers the individuals of the organization, those individuals that are responsible for the management of the actual construction. These individuals include project managers, project engineers, superintendents.
- Motivation. This category considers if the individuals of the organization are motivated by direct, tangible, and/or personal incentives to avoid or resolve disputes. Motivation may come from the company as a bonus or of advancement or may be on a personal level—a measure of satisfaction that disputes be avoided.
- Interpersonal skills. Because personalities of individuals can play such a large role in construction projects, inherent interpersonal skills, good experiences with these skills, or training of these skills is desired.
- Team building. This subcriterion is the first of four under the business relationship branch. This category deals with the existing effort of the two organizations to use a team approach. Various methods exist, but the most common one is "partnering," in which a relationship is built on trust, dedication to common goals, and understanding of each other's expectations and values for the benefit of the project.
- History together. This branch considers the historic working relationship of the two organizations and how it can affect the current project. Organizations with a poor history together may have a difficult time making the current project a success.
- Power balance. Situations occur in which a stronger company (financially, experientially, technically) may have the advantage when it comes time to settle disputes. This tends to alienate one or more parties and does not help to solve disagreements.
- Expectations of further work. When a project is under construction either or both organizations may have expectations of future work with the other; this can affect the way some disputes are approached. If the possibility of future work together rests on "successful" completion of the current project, this can aid in making disputes more diplomatic.

The project criterion, as shown in Fig. 2, is divided into two subcriteria, internal variables and external variables. Internal variables are inherent to the project, whereas external variables are associated with the environment where the project is being constructed. The subcriteria for each of these branches are defined as

- Environmental issues. These measure the relative importance of environmental regulations and their relation to the particular project.
- Public interference. This considers if and how the public will be directly affected by the construction and completion of the project. Problems can arise when large numbers of the general public are minimally affected by construction or when small numbers of the public are greatly affected by a high-profile project.
- Site limitations. This category measures the limits of the actual project site. Some items considered are storage, access, and staging for setup.
- Remoteness. This subcriterion considers the location and whether or not materials and technical expertise are locally available and adequate.
- Availability of capable craftsmen and subcontractors. This subcriterion considers the ability of the local workers (carpenters, ironworkers, etc.) and the ability and expertise of the subcontractors. Limited availability of such essentials negatively impacts the success of the project.
- Pioneer project. This category measures the precedence of this "type" of project. Items relevant here are the types of technology being used and are considered pioneering if they have never been constructed or used before.
- Design complexity. This category considers how complex, not innovative, the design process is. Nuclear-power

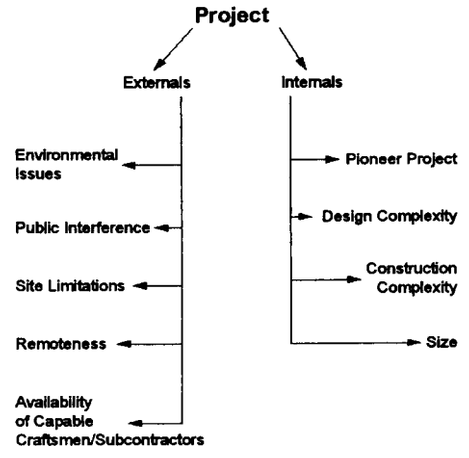

FIG. 2. Project Branch of Hierarchy

plants have a high level of design complexity but are not necessarily pioneer projects.
- Construction complexity. This branch considers inherent complexity of the process.
- Size. Since large-scale projects may have an increased possibility of disputes, this category considers the size in terms of the estimated contract amount.

The final major criterion, the process hierarchy is shown in Fig. 3. This criterion is subdivided into "preconstruction planning," or those activities that are required before the contractor and owner make an agreement and sign a contract and "construction contract," which defines the agreement between them. These subcriteria in the process hierarchy are described here:

- Input from all groups involved. This is the information from planning activities that must be shared among parties. These activities may include construction potential and value engineering studies.
- Financial planning. This branch considers another planning activity associated with sound financial backing and planning. In consideration of the project's size and existing economic situation, financial planning should be able to anticipate cost growth, change orders, and contingency.
- Permits and regulations. This is an analysis of how well the permit process was conducted.
- Scope definition. This is a measure of how well the owner has defined and documented the scope of the project. Inappropriately defined project scope may increase the number of disagreements and disputes during the project.
- Realistic obligations. The contract imposes obligations on both parties. For example, the contract explains obligations such as quality of work, schedule, and financial obligations. This criterion judges whether these obligations are reasonable assignments of responsibility.
- Risk identification/allocation. This measures whether the project organizations have identified the risks associated with the project and allocated them to whomever is best able to manage the risk.
- Adequacy of technical plans/specifications. This branch measures the quality of the plans and specifications. These documents should be subject to a complete review and be complete and clear.
- Formal dispute resolution process. This subcriterion considers how well the contract describes a dispute-resolution process. Such resolution processes include, but are not limited to dispute resolution bounds (DRBs), rapid response teams, minitrials, mediation, and negotiation. These resolution processes may foster jobsite dispute resolution.
- Operating procedures. This considers the contract and whether the contract administration operating procedures are reasonable and well defined. These typical processes include schedule submittals and updates, the submittal process, and meeting and communication procedures. Well-defined, reasonable procedures yield better planning and management during the construction process.

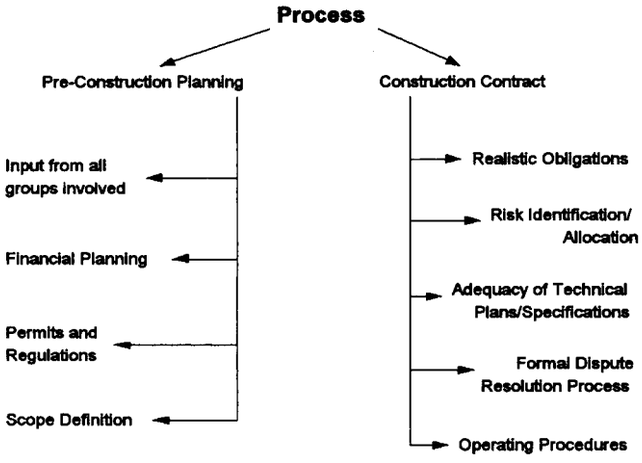

FIG. 3. Process Branch of Hierarchy

In addition to defining variables to predict disputes, we also needed to design metrics to distinguish good project-dispute performance from poor project-dispute performance. We gathered survey data to measure dispute performance using four metrics:

- The frequency of disputes (subjective measure)
- The relative severity of the largest dispute (subjective measure)
- The dollar amount of disputes settled beyond the field level
- The number of disputes settled beyond the field level

The first two measures are subjective judgments of the frequency and severity of disputes, whereas the last two are objective measures of contract dispute.

In all, we identified 38 potential indicators of project disputes and four measures of contract disputes. Data on the 38 factors and the four dispute metrics were collected from 159 projects. Data gathering was accomplished in two ways, first the CII Dispute Prevention and Resolution Task Force members distributed the data-collection survey to project managers in their respective companies. Additional data were also obtained from such large organizations as the Associated General Contractors, local contracting organizational groups, and large owner groups such as public works and state transportation departments. The following illustrations give a general breakdown of the 159 responses used to develop the prediction tool. In general, the respondents represented a wide variety of project participants, project sizes and types, and contract mechanisms (Fig. 4). However, nontraditional project delivery systems are not well represented by the survey data.

Several analysis approaches were tried on the 159 project data set. Linear regression, neural networks and nonlinear regression models were developed. The best results were obtained from a form of discrete choice modeling called logistic regression. Discrete-choice models identify the probability of an outcome being in one of several discrete categories. Discrete-choice analysis has been used extensively in many fields and is gaining popularity in the construction industry, for example, Jaselskis and Russell (1992) used it in predicting contractor failure. Logistic regression is similar to linear or nonlinear regression in a number of ways. Primarily, it calculates coefficients to minimize the differences between actual values and predicted values. The form of the equation is

$$Z = C_0 + C_1(X_1) + C_2(X_2) + \cdots + C_n(X_n) \qquad (1)$$

where Z = value of the discriminant function; C_n = regression coefficient of independent variable n; and X_n = measured value of independent variable n for project. In regression analysis, Z is the dependent value, in a logistic model Z represents the value of the discriminant function. The prob-

J. Constr. Eng. Manage., 1995, 121(4): 355-363

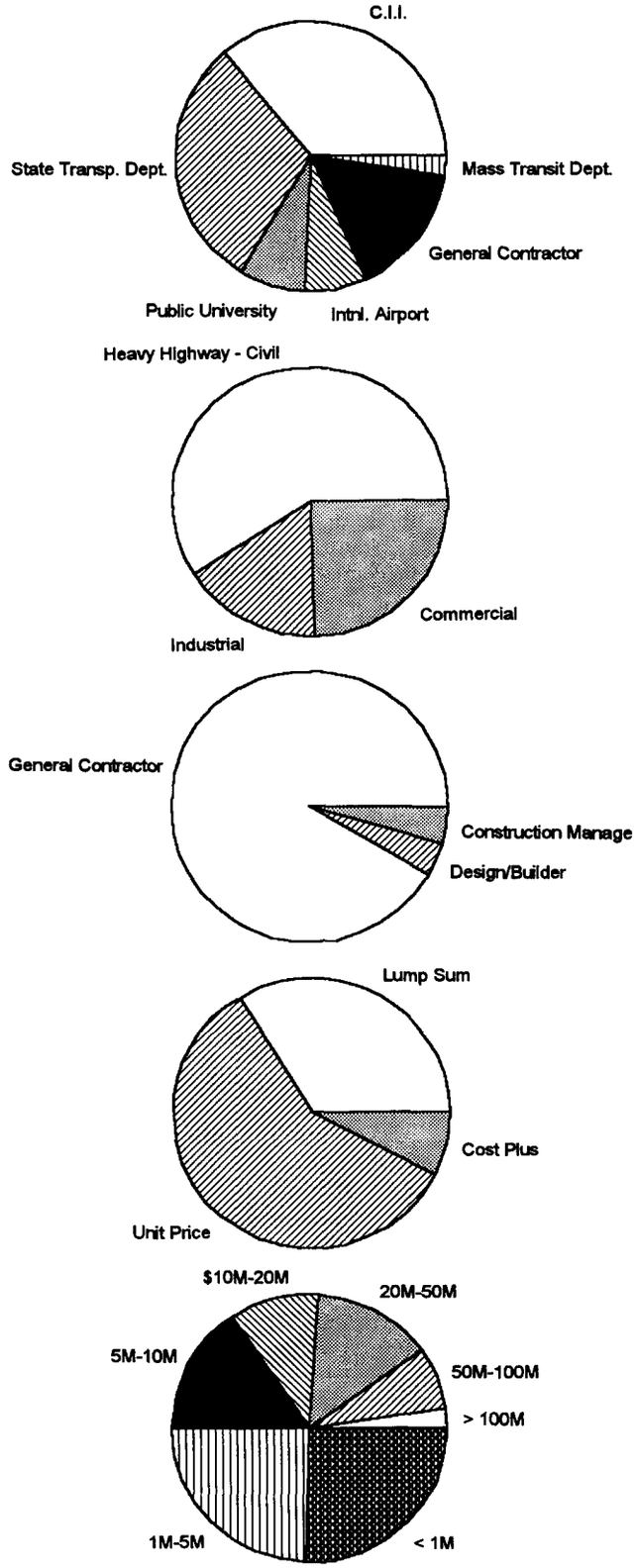

FIG. 4. Breakdown by: (a) Organization; (b) Type of Project; (c) Type of Contractor; (d) Contract Payment Method; (e) Dollar Size of Contract

ability of being in a certain category of only two discrete categories is

$$P = e^z/(1 + e^z) \quad (2)$$

A significant problem with the data set is that certain project variables tend to be correlated to one another. For example, if a contractor earns a good score in one of the people variables, the contractor tends to earn high scores in the remaining people questions. To avoid this autocorrelation problem, we fashioned hybrid variables from the set of 38 predictor variables. The final model incorporated 21 of the original 38 predictor variables. These 21 variables were combined into eight hybrid variables; the eight hybrid variables are:

- Variable 1 (X_1): owner's management and organization. The first variable is a combination of all the owner questions that were used in the model (question numbers refer to the data-collection survey in Appendix I):
  - 1c. Were previous contractual parties satisfied with the owner's upper management?
  - 2a. Was the owner's responsibility structure effective?
  - 4a. Would the owner's organization be considered successful based on past projects?
  - 7a. How would you classify the owner's individuals' interpersonal skills?
- Variable 2 (X_2): contractor management and organization. Similar to variable 1, variable 2 is a combination of contractor questions that were useful to the prediction model and associated with the contractor. Once again, these variables were found to be correlated and, therefore, combined into a hybrid variable. Variable 2 contains the following project variables:
  - 1d. Were previous contractual parties satisfied with contractor's upper management?
  - 2b. Was the contractor's responsibility structure effective?
  - 3b. Has the contractor's organization ever had experience with this type of project?
  - 4b. Would the contractor's organization be considered successful based on past projects?
  - 5b. What was the experience and competence level of the contractor's project individuals?
  - 7b. How would you classify the contractor's individuals' interpersonal skills?
  - 9. How would the history of the owner and contractor together on previous projects rate?
- Variable 3 (X_3): project complexity. Variable 3 is simply a combination of two project variables. Also, this is the first of two hybrid variables that are evolved from the project section of the survey. The project variables included in variable 3 are as follows:
  - 18. What was the level of design complexity for the project?
  - 19. What was the level of construction complexity for the project?
- Variable 4 (X_4): project size. Variable 4 is not a combination of project variables:
  - 20. Was the project considered to be unusually large?
- Variable 5 (X_5): financial planning. Variable 5 is also a single project variable. This is the first of three hybrid variables that evolve from process project variables:
  - 22. What was the level of experience and effort of the financial planners, and what was the adequacy of the financial plan?
- Variable 6 (X_6): project scope definition. Variable 6 is the combination of three process variables. These three variables are as follows:
  - 24. Regarding the type of project and contract used, was the scope well defined?
  - 27. How did the adequacy of the technical plans/specifications rate?
  - 29. To what extent were the operating procedures spelled out and reasonable?

- Variable 7 (X_7): risk allocation. Variable 7 is also a combination of variables, which include the following:
  21. To what extent was quality input shared during the preconstruction phase?
  26. How well were risks identified and properly allocated in the contract?
- Variable 8 (X_8): contract obligations. Variable 8 is one project variable:
  25. Were the contractual obligations considered to be realistic by both parties?

In summary, eleven of the original people variables were combined to form two hybrid variables, one for the owner and one for the contractor. Three project variables were combined to form two hybrid variables; and seven process variables were combined to form three hybrid variables. We used this model to regress on five different dependent variables. The dependent variables used in the regression analysis were the four dispute metrics that were included in the questionnaire and the one hybrid metric that was the product of the two subjective measures, frequency of disputes and severity of disputes. Since the frequency variable and the severity variable were both defined on a scale of 1–6, the hybrid variable was defined on a scale of 1–36. The hybrid (frequency × severity) score was best predicted by the logistic model that categorized disputes performance into three categories:

- Good dispute performance—scores from 20 to 36
- Average dispute performance—scores from 7 to 19
- Poor dispute performance—scores from 1 to 6

The final form of the logistic regression equation is shown here

$$Z = -16.7123 + (0.4198 \cdot V_1) + (1.6984 \cdot V_2) + (0.1848 \cdot V_3) + (0.4229 \cdot V_4) + (0.0839 \cdot V_5) + (0.5296 \cdot V_6) + (0.7527 \cdot V_7) + (0.0303 \cdot V_8) \quad (3)$$

To evaluate a project's susceptibility to disputes, one would first record a project specific score for each of the 21 predictor variables and combine the scores to form the required eight hybrid variables. Next, one would calculate the value of the discriminate using (3). The model gives a prediction of good dispute performance, this being calculated from (2).

It is this score P that is analogous to the cholesterol score. This score is a robust predictor of dispute performance. The higher the value of P the less likely are contract disputes. Considering the 159 projects in our database, projects whose P-value is >80 have a 70% chance of experiencing good dispute performance. On the other hand, projects whose P-value is <20 have only a 6% chance of experiencing good dispute performance. The relationship between P and project dispute is shown in Fig. 5.

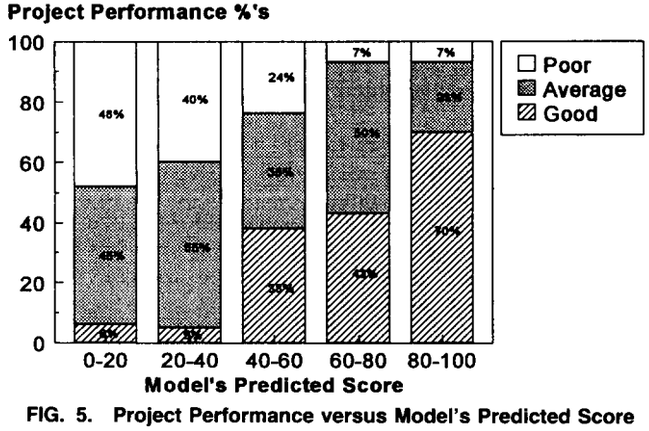

FIG. 5. Project Performance versus Model's Predicted Score

We conducted several sensitivity studies to investigate the importance of project variables in terms of people, project, and process questions. Eleven people, three project, and seven process questions are used in the prediction model. All else being equal, the people group of questions affect the prediction the most, followed by process and then project. This testifies to the importance of people in avoiding project contract disputes. On the other hand, if project and process factors were evaluated as well above average, the people scores still cause the P-value to vary over the entire range from 0 to 100. People can, therefore, make or break a project, even a simple project, with a good contract administration process. Overall, project questions affect the predicted score the least and process questions had a moderate impact.

Before developing the regression model into the final DPI tool, its predictions were tested for accuracy. This test was carried out by applying the logistic regression scoring system to 25 new projects. The results of the tests were judged with regard to the base case frequency of the data set. The results of this comparison are shown in Table 1.

Comparing these results to those anticipated from the base case frequency of the data set, the 25 test projects generally confirm the logistic regression model. The original model shows that if a project scored between 0 and 20, it had a 48% chance of performing poorly. Seventy-five percent of the test projects performed poorly in this circumstance. At the other

TABLE 1. Comparison of Test Results

Projects scoring (1)	No. of projects (2)	Actual Performance		
		No. good (3)	No. average (4)	No. bad (5)
80–100	4	3	0	1
60–80	6	1	3	2
40–60	5	1	3	1
20–40	2	0	1	1
0–20	8	0	2	6

Computer output screen - Model score 60-80]

Your project received a score of *{a score between 60-80}*

The experience on which the DPI is based shows that projects that receive scores between 60 - 80 have a 43% chance of "good" project, a 50% chance of an "average" project and a 7% chances of a "poor" project relative to the frequency and severity of contract disputes. Your overall score is based on individual scores for eight factors. These individual scores and scores from other projects with "good" experience relative to contract disputes are presented below:

Individual Evaluation Factor	Your Project's Score	Good Project Score
Owner Management and Organization	*factor score 1*	4.8
Contractor Management and Organization	*factor score 2*	5.0
Project Complexity	*factor score 3*	3.9
Project Size	*factor score 4*	4.4
Financial Planning	*factor score 5*	4.3
Project Scope Definition	*factor score 6*	5.0
Risk Allocation	*factor score 7*	4.6
Contract Obligations	*factor score 8*	5.0

Use the scores in this table to identify factors that can be improved on your project, so that you can reduce the likelihood of contract disputes on your project. If you can improve your project's score so that it falls in the range 80-100, the chance of a "good" project increases to 70%. Alternatively, if the situation deteriorates and your score falls to between 40-60, the likelihood of having a "poor" project increases to 24%.

FIG. 6. Typical DPI Output Screen

end of the spectrum, the original model shows that if the project scored between 80 and 100, it had a 70% chance of performing well. Seventy-five percent of the test projects performed well if the score was between 80 and 100. The DPI calculations are quite tedious. Therefore, we converted DPI into a Visual Basic application for Microsoft Windows. Once the program is loaded, the user need only answer the 21 questions, and the program performs the calculations and presents the results to the user in a textual and graphical forms. An example of one of the screens is presented in Fig. 6. The program presents five different text output screens depending on the model score that is calculated. We also field tested the computer program with industry practitioners using completed projects. In all eight field trials, DPI produced appropriate answers, and the users thought that the process of completing the DPI survey gave them insights into the nature and risks of the project. Most practitioners said that the results served to confirm their "gut feeling" about the project and they found the DPI documentation a useful aid when discussing the dispute potential of the project with their management or project partner.

CONCLUSIONS

Previously we indicated the need for project participants to "start right" and "stay right" as regards contract disputes. The DPI can be used to both "start right" as part of a contract readiness review and it can be used to "stay right" if the project participants use it periodically to measure chances in the dispute climate of the project. DPI might serve a useful communication function if it were used as part of a partnering meeting.

Several keen insights about the nature of contract disputes emanated from the data analysis portions of this project. People do not *cause* disputes, but the quality of people can affect the project disputes performance more than any other type of project variable. People either greatly help or hinder the process of settling disputes. Of the people on the project, the contractor's personnel have the greatest opportunity to impact the disputes climate of a project. The project variables do not affect the project disputes performance to a great extent. Generally speaking, inherently tougher or more complex projects do not make much of an impact on disputes performance. In essence, disagreements on projects issues are settled by people. The impact of process falls between the impact of project and people. Preconstruction planning and contractual relationships can help or hinder a project more than project issues can.

Certain limitations to the research need to be considered when assessing the usefulness of the DPI. The development of DPI used data from 184 (159 data points, 25 test cases) construction projects. This number can hardly be considered a large percentage of all construction projects, especially on which to base a prediction model. On the other hand, this is a substantial amount of data considering the proprietary nature of the data and the amount of time that was invested in completing the data surveys. More background data should be collected from the various types of project delivery systems and combined with the data already collected for this work. This would overcome the bias in our data sample toward the general contracting project delivery system.

In the early phases of a project, some of these questions are impossible to answer accurately. Therefore, disputes performance cannot be accurately predicted at extremely early phases of a project. The DPI can nevertheless provide answers, early enough in the project life to allow the responsible parties to make changes to obtain a better disputes performance.

In closing we are very encouraged by the quality of the results we obtained in developing DPI. If this work avoids only one adversarial, litigious project, the efforts we expended are justified.

ACKNOWLEDGMENTS

We would like to acknowledge the financial support of the Construction Industry Institute in funding this research. Moreover, we would like to acknowledge the insightful and generous assistance of the CII Disputes Prevention and Resolution task force. Finally, thanks to all those who contributed to this research by responding to our data-collection survey.

APPENDIX I. DATA-COLLECTION SURVEY

CLAIM SUSCEPTIBILITY for Construction Projects

Directions

The following questions survey construction projects for sensitivity to disputes. The purpose of the survey is to find a correlation between project variables and project-dispute susceptibility. This information will help predict susceptibility for future projects.

Please complete a separate packet for each project to be surveyed. Projects should be completed and have no outstanding disputes. Each packet should take approximately 30 minutes to answer. The survey contains 37 questions and is divided into four parts:

- People—organization and individuals of the major contractual parties
- Project—project information and variables
- Process—preconstruction planning and contract information
- Performance review—severity of disputes on the completed project

The first three sections refer to project environment variables, and the last section rates the effectiveness of the project relative to disputes. The survey also requests some background information on the project.

Each of the questions has a separate scale to which respondents rate their particular project. The scale ranges from 1 (worst) to 6 (best) for all questions.

People

Questions 1–7 refer to the owner and contractor of the project. Each question must be answered twice—first for the owner, then the contractor. An owner is the organization managing the construction for whomever will own it. The contractor is the organization responsible for the project's design *and* construction or may be the general contractor only responsible for the overall construction.

1. Capable management. Consider the owner/contractor's organization and level of skill of the upper management. Upper management are those people at a home-office or corporate level responsible for the overall success of the project. Their responsibility stretches beyond "the contract" to include long-term business concerns and customer satisfaction objectives.

1a. Was the *owner's* upper management heavily involved in the overall management of the project?
(No–Yes) 1 2 3 4 5 6

1b. Was the *contractor's* upper management heavily involved in the overall management of the project?
(No–Yes) 1 2 3 4 5 6

1c. Were previous contractual parties satisfied with the *owner's* upper managerial support and responses?
(No–Yes) 1 2 3 4 5 6

1d. Were previous contractual parties satisfied with the *contractor's* upper managerial support and responses?
(No–Yes) 1 2 3 4 5 6

2. Effectiveness of responsibility structures. If the owner/contractor's responsibilities within the organization are clear and if the people are allowed to make decisions on matters within their control, the responsibility structure is effective.

2a. Was the *owner's* responsibility structure effective?
(No–Yes) 1 2 3 4 5 6

2b. Was the *contractor's* responsibility structure effective?
(No–Yes) 1 2 3 4 5 6

3. Organization's experience with this type of project. This deals with the experience of the owner/contractor's organization as a whole and not with the individuals.

3a. Did the *owner's* organization have experience with this type of project?
(None–Alot) 1 2 3 4 5 6

3b. Did the *contractor's* organization have experience with this type of project?
(None–Alot) 1 2 3 4 5 6

4. Success of past projects. A company may be deemed successful and reputable if previous projects have performed well with regard to schedule, budget, and minimal disputes.

4a. Would the *owner's* organization be considered "successful" based on its history before this project?
(No–Yes) 1 2 3 4 5 6

4b. Would the *contractor's* organization be considered "successful" based on its history before this project?
(No–Yes) 1 2 3 4 5 6

5. Individuals' experience/competence. The owner/contractor's individuals responsible for construction and management are project managers, project engineers, superintendents, etc.

5a. What was the experience and competence level of the *owner's* project individuals?
(Low–High) 1 2 3 4 5 6

5b. What was the experience and competence level of the *contractor's* project individuals?
(Low–High) 1 2 3 4 5 6

6. Individuals' motivation (reward structures). Individuals' motivation may be a result of the organization's goals or the way in which employees are compensated.

6a. Did the *owner's* individuals have direct, tangible, personal incentives to avoid or resolve disputes?
(No–Yes) 1 2 3 4 5 6

6b. Did the *contractor's* individuals have direct, tangible, personal incentives to avoid or resolve disputes?
(No–Yes) 1 2 3 4 5 6

7. Interpersonal skills. A high level of interpersonal skills may be inherent or a result of experience or training for these skills.

7a. How would you classify the *owner's* individuals' interpersonal skills?
(Low–High) 1 2 3 4 5 6

7b. How would you classify the *contractor's* individuals' interpersonal skills?
(Low–High) 1 2 3 4 5 6

8. Team building. Team building, or "partnering," is considered to be a commitment between the organizations for the purpose of achieving specific business objectives for the length of the project. The relationship is based upon trust, dedication to common goals, and understanding of each other's individual expectations and values. Was a formal "Team Building" approach honestly carried out before the project began?
(No–Yes) 1 2 3 4 5 6

9. History together. A history between the owner and contractor on past projects may affect the current project. No experience together has a neutral rating. How would the history of the owner and contractor together on previous projects rate? (If no prior history, mark 4).
(Poor–Good) 1 2 3 4 5 6

10. Uneven power balance. A stronger company may have an advantage in settling disputes, due to its financial, experiential, or technical levels. Disagreements between parties may be difficult to solve when one feels threatened. Did the owner and contractor have equivalent abilities and resources in order to absorb costs associated with disputes?
(No–Yes) 1 2 3 4 5 6

11. Expectations of further work. While a project is under way, organizations may have expectations of work together on future projects. These expectations can affect how diplomatically disputes are handled. To what extent did the success of this project affect the possibility of work together on future projects?
(Low–High) 1 2 3 4 5 6

Project

12. Environmental issues. This category considers the natural or physical environment in which the project was constructed. Was the project considered to be environmentally sensitive?
(Yes–No) 1 2 3 4 5 6

13. Public interference. Problems can arise when construction projects conflict with the public's prerogative for comfort and safety. Traffic interference may occur or a high-profile project, such as a hazardous-waste incinerator, may cause local discontent. What was the probability and intensity of public interference for this project?
(High–Low) 1 2 3 4 5 6

14. Site limitations. Project site limitations include, but are not limited to, storage and access for staging and setup. How did the project rate in terms of site limitations and demand for space?
(Poor–Good) 1 2 3 4 5 6

15. Remoteness. Was the project located in an area where materials and technical expertise were locally available *and* adequate?
(No–Yes) 1 2 3 4 5 6

16. Availability of capable craftsmen/subs. What was the availability of skilled workers and subcontractors for successful completion of this project?
(Low–High) 1 2 3 4 5 6

17. Pioneer projects. A "pioneer" project includes aspects such as new technology, which have never been constructed or used before. To what extent was this a "pioneer" project?
(High–Low) 1 2 3 4 5 6

18. Design complexity. This entails the complexity of the design, not innovation, of the project. A nuclear-power plant is not a "pioneer" project, but does have a complex design. What was the level of design complexity for this project?
(High–Low) 1 2 3 4 5 6

19. Construction complexity. What was the level of construction complexity and innovation needed for this project?
(High–Low) 1 2 3 4 5 6

20. Size. Large-scale projects increase the possibility of disputes. Was the project considered to be unusually large?
(Yes–No) 1 2 3 4 5 6

Process

21. Input from all groups involved. Preconstruction planning includes potential for construction and value engineering studies, in which information is shared among parties. To what extent was quality input shared during this phase of preconstruction?
(Low–High) 1 2 3 4 5 6

22. Financial planning. The quality of financial planning is sometimes dependent on the size of the project, the current economic situation, and the possibility of changes or additions to the contract. What was the level of experience and effort of the financial planners, and what was the adequacy of the financial plan?
(Low–High) 1 2 3 4 5 6

23. Permits and regulations. Were the regulatory requirements, such as building permits and environmental impact studies, identified and completed in a timely manner before construction?
(No–Yes) 1 2 3 4 5 6

24. Scope definition. The scope defines what work is included in the project. Regarding the type of project and contract used, was the scope appropriately defined?
(No–Yes) 1 2 3 4 5 6

25. Realistic obligations. Contractual obligations, such as scheduling, budget, and quality of work, need to be practical to avoid disputes. Were the contractual obligations considered to be realistic by both parties before construction began?
(No–Yes) 1 2 3 4 5 6

26. Risk identification/allocation. Organizations involved in a construction project should identify relevant risks associated with the project and allocate risk liability to the project participants appropriately by means of the contract. Proper allocation ensures assignment to the party with the best ability to deal with the risk. Methods of proper allocation are good contractual language or use of the appropriate contract (turnkey, design/build, general contractor, etc.) How well were risks identified and properly allocated?
(Poor–Good) 1 2 3 4 5 6

27. Adequacy of technical plans/specifications. Adequacy of technical plans/specs include development and review, completeness, clarity, and organization of the bid documents. How did the adequacy of technical plans/specs rate?
(Poor–Good) 1 2 3 4 5 6

28. Formal dispute resolution process. Formal dispute-resolution processes are helpful in keeping disputes from becoming claims. Such processes include, but are not limited to, many ADR methods: DRB, rapid response teams, minitrials, mediations, negotiation. How well did the contract spell out such a formal dispute resolution process?
(Poor–Good) 1 2 3 4 5 6

29. Operating procedures. Such procedures include payment procedures, schedule-updating procedures and requirements, submittal methods, and meeting and communication procedures. To what extent were these procedures spelled out and reasonable?
(Low–High) 1 2 3 4 5 6

Performance

30. What was the type of project for which this survey was completed? (heavy highway-civil, industrial, commercial, etc.)

31. What role did the "contractor" of this project play? (general contractor, design/builder, construction manager)

32. What was the general payment method used by this contract? (lump sum, cost plus, unit price)

33. What was the original estimated dollar amount for this project?

34. How would you rate the frequency of disputes which arose at the field level?
(High–Low) 1 2 3 4 5 6

35. How would you rate the severity of the largest dispute/claim that arose on your project?
(High–Low) 1 2 3 4 5 6

36. What is the estimated number of disputes that were settled beyond the field level?

37. What was the final dollar amount of these disputes that were settled beyond the field level?

APPENDIX II. BIBLIOGRAPHY

Ashley, D. B. (1988). "Contract risk allocation and cost effectiveness." *CII Publ. 5-3*, Nov., Constr. Industry Inst., Univ. of Texas, Austin.

Doyle, P. (1989). "The litigation/liability crisis." *CONSTRUCTOR*, Sept., 18–20.

Groton, J. (1991). *Preventing and Resolving Construction Disputes*, CPR Legal Program Construction Disputes Committee, Center For Public Resources, New York, N.Y.

Henderson, T. (1991). "Analysis of construction disputes and strategies for cost minimization." *Cost Engrg.*, 33(11), 17–21.

Howell, G. (1990). "How owners and contractors organize project teams." *CII Publ. SD-53*, June, Constr. Industry Inst., Univ. of Texas, Austin.

Kamenetzky, R. (1982). "The relationship between the analytical hierarchy process and the additive value function." *Decision Sci.*, 13, 702–713.

Miller, J. (1970). *Professional decision making*. Praeger Publishers, New York, N.Y.

Nelson, M., and Illingworth, W. (1991). *A practical guide to neural networks*. Addison-Wesley Publishing, Reading, Mass.

NeuroShell 2 user's manual. (1993). Ward Systems Group, Inc., Frederick, Md.

Norusis, M. (1990). *SPSS user's manual*, SPSS, Inc., Chicago, Ill.

O'Connor, V. (1986). "Scope definition and control." *CII Publ. 6-2*, July, Const. Industry Inst., Univ. of Texas, Austin.

Oppenheim, A. N. (1966). "Questionnaire design and attitude measurement." Basic Books, Inc., New York, N.Y.

Scarlett, T. (1986). "Evaluation of design effectiveness." *CII Publ. 8-1*, July, Const. Industry Inst., Univ. of Texas, Austin.

Vorster, M. C. (1993). "Dispute prevention and resolution: alternative dispute resolution in construction with emphasis on dispute review boards." *CII Source Document*, July, Const. Industry Inst., Univ. of Texas, Austin.

Yoo, K., and Kim, G. (1989). "Multiple attribute decision analysis with imprecise information." *IIE Trans.*, 21(1), 21–25.

APPENDIX III. REFERENCE

Jaselkis, E. J., and Russell, J. S. (1992). "Predicting construction contractor failure prior to contract award." *J. Constr. Engrg. and Mgmt.*, ASCE, 118(4), 791–811.

J. Constr. Eng. Manage., 1995, 121(4): 355-363