



DPI - Disputes Potential Index
A Study into the Predictability of Contract Disputes

A Report to the Construction Industry Institute
The University of Texas at Austin

Under the Guidance of
The Dispute Prevention and Resolution Task Force

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Executive Summary

This report describes research conducted for the Dispute Prevention and Resolution Task Force of the Construction Industry Institute (CII). The research analyzes the effect of different project characteristics on the likelihood of project disputes and develops a computerized model to predict the likelihood of contract disputes. This report provides an explanation of the project characteristics that were evaluated, our data analysis techniques and the conclusions that we made about this work. This project is consistent with this emerging trend toward cooperative prevention and settlement of contract disputes. Fundamentally, this research attempts to develop a method to identify construction projects on which contract disputes are likely to occur, so the parties involved can take steps to reduce the likelihood of contract disputes. This research considered the impact of three categories of project characteristics on contract disputes. These characteristic classes are:

People: Issues involving people are extremely important when considering the number of organizations, relationships, roles, responsibilities, and the many different expectations that affect these people.

Process: Process issues, or the manner in which the contract and building process is carried out, include 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: 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.

The findings of this work are based on a statistical analysis of data on the frequency and severity of disputes on various construction projects. A logistic regression model, the Disputes Potential Index (DPI), is created. The DPI model is based on responses from 159 individual 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. Secondly, background 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 DPI model includes 21 project variable questions, combined into eight hybrid input variables:

1. Variable 1 (V_1):Owner's Management and Organization
2. Variable 2 (V_2):Contractor Management and Organization
3. Variable 3 (V_3):Project Complexity
4. Variable 4 (V_4):Project Size
5. Variable 5 (V_5):Financial Planning
6. Variable 6 (V_6): Project Scope Definition
7. Variable 7 (V_7):Risk Allocation
8. Variable 8 (V_8):Contract Obligations

These variables are described in detail in the report. DPI is delivered as a Microsoft Excel® spreadsheet. Its output classifies projects into one of five categories relative to the projects predilection for experiencing contract disputes.

The fundamental conclusions from the data analysis phase of the project are the following:

1. People do not always *cause* disputes, but the quality of people invariably affects the disputes performance more than any other project characteristic. People either greatly help or greatly hinder the process of settling disputes.
2. Of the "People" on the project, the Contractor's personnel have the greatest opportunity to make an impact on the disputes climate of a project.
3. 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 the likelihood of contract disputes. In essence, disagreements on Projects issues will be settled by people.
4. The impact of Process falls between the impact of Project and People. Pre-construction planning and contractual relationships can help or hinder a project more than Project issues can.

The other work by this task force urges project players 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 "stay right" if the project participants use it periodically to measure changes in the dispute climate of the project. DPI might serve a useful communication function if it were used as part of a partnering meeting.

The most important follow-on work for this project would be to fund a longitudinal study of the accuracy of the DPI. All of our analyses were accomplished retrospectively. A longitudinal study would allow for a DPI prediction and sufficient time to follow up on the prediction. Additionally, the views and insights of the participants in the longitudinal study regarding DPI's impact on disputes avoidance and resolution would be invaluable.

We are encouraged by the results that we obtained from this research. However, none of this would be possible without the cooperation and support of the CII Disputes Avoidance and Resolution Task Force.

Chapter 1: Introduction

1.A Purpose of the Report

This report describes research conducted for the Dispute Prevention and Resolution Task Force of the Construction Industry Institute (CII). The research analyzes the effect of different project characteristics on the likelihood of project disputes and develops a computerized model to predict the likelihood of contract disputes. This report provides an explanation of the project characteristics that were evaluated, our data analysis techniques and the conclusions that we made about this work.

1.B Research Objectives

Goals of this research were as follows:

- 1) To gain a better understanding of the predictors of construction contract disputes.
- 2) To identify the important predictors of contract disputes and categorize them into simple groupings.
- 3) To construct a dispute performance prediction tool which can be used before a project begins, to assess the likelihood of contract disputes.
- 4) To deliver the prediction tool in a simple computerized form, including a method of interpreting the results.
- 5) To develop recommendations and conclusions about the study, the predictive tool and their limitations.

1.C Research Methodology

The research was conducted in several stages under the guidance of the Disputes Prevention and Resolution Task Force. The primary steps in the project were:

- 1) A literature review was accomplished to determine the predictors of disputes on construction projects, i.e., the factors that are necessary for project success.
- 2) A review of accepted procedures for formulation of questionnaires and surveys was performed to provide a sound basis for needed data collection survey.
- 3) The task force participated in several "brainstorming" meetings to develop a preliminary list of predictors of disputes based on the literature and the task forces members' collective experience..
- 4) A hierarchy of dispute predictor variables was created as a basis of the data collection survey.
- 5) A data collection survey was developed to gather the raw data for this analysis.
- 6) Survey data was collected on past projects of both CII and non-CII member companies.
- 7) The survey data was evaluated to determine the relationship between project characteristics and the propensity to contract disputes.
- 8) The Dispute Potential Index (DPI) was developed and a computerized DPI tool was developed and tested.

1.D Outline of the Report

The remaining chapters of this report are organized as follows:

Chapter 2: Provides background on the problem of disputes in today's construction industry.

Chapter 3: Discusses the concept of a prediction tool for dispute performance. This chapter also discusses the design of a survey that was needed to gather data for the study.

Chapter 4: Describes the statistical analysis employed to develop a prediction model. Numerous statistical analysis methods are described, while the method used for the "DPI" is explained.

Chapter 5: Explains the variables included in the model, the relative importance of these variables, the scoring methodology used for prediction, and sensitivity of the model to certain variables.

Chapter 6: Discusses the recommended usage of the "DPI." These discussions include the testing and accuracy of the model and questions regarding usage of the model. Conclusions are also presented regarding limitations of the research and areas of future study.

Chapter 2: Current State of the Construction Industry

Historically, the construction industry has devastated itself with excessive numbers of costly, time-consuming legal disputes. Recently there has been a significant increase in the attention given to improving working relationships within the construction industry. The seriousness of this dispute problem can be measured by the proliferation of industry groups that are aimed at improving the quality of industry interactions.

2.A The "Old" vs. "New" Industry Attitudes

The behavior of the construction industry has changed dramatically in the last 30 years. An industry that once operated on trust and a handshake now experiences an unprecedented degree of legal actions. People in the industry were once considered partners and colleagues; they knew one another from previous projects or from their involvement in the local industry. Because of these bonds, people trusted each other and communicated openly; this created a teamwork atmosphere where cooperation was the standard. When problems did come up, they were either settled by negotiating at the job site or by an architect/engineer's decision. Problems were settled as they arose, "and lawyers usually weren't involved." Today, it is common for problems to linger on, unresolved, for months or years, and to occur all too often. Today's construction industry tends to be less cooperative and less teamwork-oriented. "Traditional, cooperative relationships have been replaced by adversarial, antagonistic 'win-lose' attitudes." [Groton 1991].

2.B The Problem of Disputes, Claims, and Litigation

The environment of today's construction industry causes business problems for contractors, design professionals, and owners in the form of legal costs. "Legal expenses for the ordinary contractor and architect are an uncontrollable budget item, and therefore threaten the life of the firm" [Doyle 1989]. The problems of litigation and their related costs are enormous.

"We are seeing the demise of the small business, the family-owned business, the entrepreneur upon which America's great strength was built, the selling and liquidation of businesses that were handed down from generation to generation, all primarily because of the litigation/liability crisis and the unpredictable nature of the risk associated with operating a business today" [Doyle 1989].

Litigation is becoming so popular that "most proposals for construction management seek candidates who are skilled in the analysis related to disputes and claims preparation" [Henderson 1991]. Disputes and litigation are so prevalent, the courts have become backlogged. It is not uncommon for large cases to take many years to settle in the courts. It can take more time to settle disputes than it took to actually build the project. In economic terms, litigation costs outweigh the benefits, and this often makes litigation a "no win" situation.

In the construction industry, one must coordinate the resources, time, and communications of all organizations involved. Coordinating the resources includes: financing and management from both the contractor and the owner, manpower, and countless suppliers and subcontractors. The construction project is a complicated process involving many variables which must be pulled together to complete the desired work in a given time frame under constantly changing conditions.

"It is ironic that the one industry in the country which more than all others depends upon coordination, cooperation, and teamwork among multiple participants, should be the country's most adversarial industry" [Groton 1991].

2.C Efforts to Improve the Picture

The industry has recognized the growing problem of litigation and has recently made substantial efforts to improve the situation. A number of new ideas have surfaced in recent years to try and reduce legal disputes, and in effect return to the old business climate. One of these ideas is Team Building, or Partnering, where a relationship of trust is started at the outset of the project, and where the participants analyze the benefits of the project for all parties if

cooperation is practiced. Another of these ideas has been the standing neutral, where the parties select a number of neutral parties to serve as a standing board during construction, where disputes can be taken if desired. Using this method, disputes are settled during the project, so construction can be minimally affected. The Disputes Prevention and Resolution Task Force recently completed a comprehensive report on DRBs with special emphasis on their use on private sector projects [Vorster 1993].

This research is consistent with this emerging trend toward cooperative and early settlement of 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. This study considered the impact of three categories of project characteristics on the likelihood of contract disputes. These characteristic classes are:

People:

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?

"A construction project, even a modest-sized one, involves a tremendous number of people. Organizing their efforts would be complex even if they all worked for the same parent corporation or within a purely centralized command structure such as the military" [Howell 1990].

The well-being of the project depends heavily upon the organizations' approach to problems and upon what their relationship is based. Efforts have been made to return to the old attitudes in the industry in which trust and cooperation prevailed. Combining organizational efforts and working together as a team has been an industry focus to solve problems efficiently. Howell's CII Project Organization Task Force defined **team** as "a group of people who could get more done working together than working alone." In an effort to form better project teams, the

idea of "partnering" has recently flourished. "The goal is to mold a new synergistic bond between contracting parties in the industry in order to prevent disputes before they surface."
[Howell 1990]

Howell also identified four factors for project success involving the people of the organizations. People issues have been a common focus in attempting to improve the overall construction methodology. The combination of obtaining qualified people to manage the project and a teamwork approach has been a proven method of improving the success rate of construction projects.

Process:

Process issues, or the manner in which the contract and building process is carried out, include 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. "Managing the contract process can significantly reduce the occurrence of claims" [Henderson 1991].

The process starts with the initial planning of the project, including scope definition.

"Some construction industry officials consider lack of scope definition to be the most serious problem on construction projects. Regardless of the reason, when there is poor scope definition, final project costs can be expected to be higher because of the inevitable changes which disrupt the project rhythm, cause rework, increase project time, and lower the productivity and morale of the work force" [O'Connor, Vickory 1986].

The next critical step is the quality of the design. The design documents, that tell the contractor how to build the project and what it should look like when completed, are critical for the well-being of the project. The CII report, *Evaluation of Design Effectiveness*, defined several evaluation criteria, including accuracy of documents, usefulness of documents, and fitness for

construction, to rate a design's pertinence to the project. "The accuracy of design documents can be related to the amount of document revisions and extra work due to these revisions" [Scarlett, Tucker 1986].

Contractual wording is also extremely important because of the risk allocation which it defines. Another study by CII identified risk allocation as influential in the success of the project [Ashley 1988]. Some contractual language in the past has led to unrealistic risk allocation to certain parties, thereby leading to more disputes.

"In order to try to protect themselves against the unexpected, many owners and their lawyers have drafted contracts shifting to contractors, risks over which these entities have little or no control, including 'No damages for delay,' 'Differing Conditions,' 'Indemnification of Owner' " [Groton 1991].

Risk allocation, along with risk identification, is critical in the overall construction process. There are many methods and contractual types to allocate risks properly, all of which have been heavily researched in recent years.

Another part of construction is the dispute resolution process used by the parties involved. If the contract does not specify a dispute resolution process, the typical path of disputes is common. If on-site negotiations or disputes for time and money are not settled, the only recourse is the courtroom. On the other hand, the use of Alternative Dispute Resolution (ADR) techniques has recently boomed. ADR includes methods such as Mediation, Dispute Review Boards, Arbitration, and many other techniques to settle disputes before they reach court. "ADR provides a vehicle to keep parties involved in the process and to reach favorable settlement with less cost and in a shorter time than litigation" [Henderson 1991]. New methods have become more common, with different techniques for different circumstances. The objective is less litigation, more success with projects.

Project:

Project: 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 cannot be substantially changed. Thus, the project characteristics provide fewer opportunities to improve disputes performance. These characteristics, however, do indicate project risks and, therefore, the need for special dispute prevention/resolution efforts.

Chapter 3: A Tool to Predict the Likelihood of Legal Disputes

A substantial amount of research has investigated the causes of contract modifications and disputes. This research attempts to go one step further and predict the "likely" dispute experience of a project based on its people, process and project characteristics. A prediction tool can give the project team a measure of how the project is expected to perform. Since this information can be provided before construction begins, it gives the people involved an opportunity to make necessary changes in the project characteristics to improve the project's anticipated performance *before* construction begins.

3.A Usefulness of a Prediction Tool

Suppose a researcher polled construction professionals for the "causes" of disputes on their projects and then compiled and analyzed this information. For example, suppose a study shows that disputes occur more often due to additional work than due to bad weather conditions. How is this information useful to the manager of a very simple project to be built in a geographic region with severe weather conditions and with a contract that does not address weather delays? Chances of change orders for this simple project are minimal, while weather problems are probable. It would be more useful if the project manager had a predictive tool that analyzes the *unique* features of the specific project. If a predictive tool alerts the manager to a high likelihood of disputes before construction begins, he/she may want to hire more qualified personnel, hold a partnering session, or set up a Dispute Review Board (DRB). In a worst case scenario, the project manager may choose not to enter into the contract because of a prediction of a high likelihood of disputes caused by variables that the project manager does not have the power to change.

Each construction project is unique and reasons for disputes are varied. Accordingly, our goal was to design an audit tool to analyze individual characteristics of a project *before* problems arise and give the participants a chance to change project characteristics to help them

avoid problems. This research is directed at providing a predictive tool for project managers. We call this tool the Disputes Potential Index - "DPI."

3.B Using a Survey - "DPI"

One common analogy for the "DPI" we envision is the compatibility test found in popular magazines. Couples can assess information about one another before they marry, enabling them to make decisions or change variables to increase their level of compatibility. The information is unique to each couple and may help them to avoid future problems. This is comparable to our predictive tool, since every project is also unique, and the information is beneficial when gained beforehand. Therefore, the idea of a "DPI" was initiated to help a project manager answer questions regarding the unique characteristics of the project and the project's susceptibility to disputes. This "DPI" is self-standing like a compatibility test. It includes directions and explains to the project manager why he or she may want to use such a tool. It explains the benefits of such a tool if the answers to the questions are accurate, and it explains the subjectivity of the results. Compatibility tests do not give "yes/no" answers, (i.e., this relationship will last for 2.5 years, and then it is doomed.); the results are more subjective. They alert the test takers of communication problems or other such troubles. The DPI, likewise, gives relative, subjective results that anticipate the relative likelihood of disputes occurring on the project.

3.C A "Cause" vs. "Correlation"

Predicting disputes susceptibility on a construction project is a complicated process. Analyzing a project after it is completed and determining why a dispute had occurred can be equally complicated. Individuals may not agree on the reasons why a dispute resulted. One may say unreasonable personnel sat on the other side of the negotiating table, while another may say it results from extra work delaying the project. Are these two causes or one cause? There was one dispute, should there not be one cause? Can people truly cause disputes or simply hinder

settlement? Since disputes are more prevalent on larger, more complex projects, could this be a cause of the dispute? Obviously, no simple answers exist to these questions. We go to court to settle disputes because the causes are not crystal clear, even *after* construction. Is it possible then, to predict a project's vulnerability to disputes?

"Surveys cannot usually show a causal connection, only indicate associations and correlations" [Oppenheim 1966]. Therefore, to predict whether a project will be prone to disputes, a survey should focus on the variables and factors relating to a construction project that are *related* to or *associated* with disputes, those which can be found to correlate with claim performance, or predictors. In other words, the survey should focus on inherent project variables which tend to bring about more/less disputes; people variables which help/hinder settlement, project variables which increase/decrease the complexity of construction, and process variables which give methods to heighten/lessen disputes. Strictly speaking, the survey will not deal with *causes* of disputes, but with *predictor* variables.

3.D Data Collection vs. "DPI"

The best method to conduct this study would be to perform studies on as many projects as possible. A set of questions would be answered for each project before construction begins and before problems arise. When those projects are over, a measurement of dispute/claim experience would be taken. A correlation can be made between the answers given before construction and how well the project actually performed. Since this test would represent the true prediction sequence on a final DPI, this would be the most sound test. However, the delay in receiving this data would be too long because it could literally take years to wait until some disputes were finally resolved in court.

Since this type of data gathering approach was not feasible, we obtained data retrospectively from completed projects. A questionnaire was developed to gather data about project characteristics that are believed to be correlated to claim susceptibility. This information

was then analyzed for a correlation to project performance, thus determining what questions are of importance when predicting disputes performance. Subsequently, only these questions deemed important by the analysis are included in the final DPI.

Therefore, two instruments must be considered. The first is a survey for data collection to provide a way to find the relationships between project variables and disputes performance. The second is the actual DPI, which will be a subset of the data collection questions together with a scoring system to allow project managers to predict how their projects may perform. In constructing the data collection survey, the project characteristics must be measurable, must be answered consistently, and must obtain enough information in order to analyze the correlation between these project variables and disputes performance.

3.E Statistical Approach vs. Multi-Attribute Approach

Two primary methods of survey design and data analysis methodology are applicable to this problem. The first is called the statistical approach. This method is applied to surveys in which sampling of the respondents is the paramount issue. Usually, the most common purpose of such a survey is to sample and group the respondents by attitudes or opinions, such as in the census or in marketing studies. The second method of surveying is a multi-attribute approach. Multi-attribute analysis is common where multiple objectives are weighted to compare risks or decisions which have more than one factor, or attribute.

Statistical Approach:

The statistical approach is easily applied to our survey design. The procedure is to collect information on as many measurable variables about completed construction projects as possible. A correlation between project variables (input) and disputes performance (output) would depend solely on statistical analysis. Each question (input variable) would have a correlation coefficient calculated with respect to the performance (output). The relative

importance of one variable with respect to another would depend on this correlation coefficient. Numerous variables would be analyzed at one time to measure the correlation with the output. The purpose would be to find interdependencies of input variables and how they affect the output [Judd 1992].

We can apply this method to a construction project. Assume we are interested in measuring the effect of "people" in construction disputes. If we consider only four people, two people each from the contractor and owner organizations, and each are asked 1) their number of years of experience, and 2) whether they have ever worked on a similar project, we have eight answers to consider. If each answer is binary, there are eight binary input (two inputs for each person). Therefore, 2^8 , or 256, independent combinations are needed to fully understand interdependencies of variables. Of course, more than two variables are needed to perform a realistic analysis of a project. Numerous issues and project variables must be considered, business relationships, size and complexity of the project, contract documents, risk allocation, and scope of the work all come into play. Statistical analysis becomes unrealistic because a survey that asks hundreds of questions is unreasonable. In addition a huge number of background projects are needed to analyze correlations and interdependencies properly.

Multi-Attribute Approach:

Multi-attribute analysis deals with problems that the statistical approach cannot, such as analyzing subjective and imprecise information and the interdependency of variables, and has been used extensively in multi-attribute decision analysis. It has been used this way because of its ability to deal with more than one objective or factor. Multi-attribute decision analysis attempts to combine different attributes for different decision alternatives into a single score for comparison. A decision then can be made based on the single score.

Obviously, the DPI could use the multi-attribute approach. The DPI's scoring methodology could attempt to compare project variable settings which comprise multiple

objectives, i.e., good people, a good process, etc. These different objectives, or variables, then need to be combined into a single measure. This single measure then indicates how the different project variable settings compare as a whole, and thus what the different settings indicate for claim susceptibility.

Our procedure will be a combination of multi-attribute decision analysis and statistical analysis. The former will be used to organize our project characteristic as to the predictors of contract disputes, while the latter will be used to develop a scoring/weighting system for prediction. J.R. Miller pioneered multi-attribute decision analysis in 1966 while developing methods to evaluate transportation route alternatives. Miller outlines five major steps for using multi-attribute decision analysis:

- 1) List performance objectives
- 2) Develop hierarchical structure of performance criteria
- 3) Select performance measures
- 4) Determine relative importance of criteria
- 5) Eliminate worth interdependence of criteria

Listing Performance Criteria:

The first step in developing the DPI is to list the objectives of the decision to be made. This involves listing all the project variables which are thought to cause disputes or inhibit occurrence of disputes. This process includes enlarging the concepts of the problem and identifying relevant issues. All relevant issues would originally be included, no matter how trivial others may think them to be [Ferris, Sage 1975]. Points to remember [Miller, 1970] include:

- 1) List should be complete and exhaustive
- 2) Criteria should be mutually exclusive
- 3) Criteria should be considered highly important
- 4) Criteria need to be independent

Developing a Hierarchy:

The hierarchy is the formal ranking of the listed criteria. The hierarchy is a value tree, a structure which breaks down the objectives into measurable criteria [Ferris, Sage, 1975]. The purpose of the hierarchy, or value tree, is broad. The hierarchy will be used for comparison purposes, and eases the development of relative importance, or weighting, which is critical to the scoring of alternatives. This structure helps the user to "cover the bases," or to include *all* the variables that may affect the performance of the project [Edwards, Newman, Snapper, Seaver 1982]. The development of a hierarchy is a straightforward process. Each of the main features, such as people and process, are divided into subcriteria. If subcriteria are not measurable and have subcriteria themselves, they are again broken down. This breakdown continues until the subcriteria are all measurable [Miller, 1970]. It must be remembered, however, that there is little premium for a large number of measures [Edwards, Newman, Snapper, Seaver 1982]. The criteria should be kept to a minimum since relative importance is more efficient with less criteria. Also, with less criteria it is easier to keep subcriteria mutually exclusive.

Selecting Performance Measures:

If the subcriteria are all broken down into measurables, this step is simply to apply methods of measurement to these subcriteria. The definitions of the subcriteria and the hierarchy give an indication how to measure them.

Determining the Relative Importance (Weight):

In decision analysis, weight is a subjective personal bias. The decision maker assigns weight to the measurable criteria depending on how important it is judged to be. Weight is the basis of the comparison scoring system. In the DPI the "weight" is determined by the statistical analysis of the survey data.

Eliminating Worth Interdependence:

Both the statistical and the multi-attribute approach requires that the criteria by which the alternatives are being compared are independent. [Farmer 1989].

3.F Construction of Multi-Attribute Hierarchy

Based on input from the CII Dispute Avoidance and Resolution Task Force, a hierarchy of contract dispute predictors was constructed. Three main criteria were recognized and were considered main factors in construction disputes. These criteria are categorized as the "Three P's":

- *People*: This includes individuals of the organization, organizational relationships, and abilities which affect the possibility of disputes.
- *Project*: The inherent variables of a project which may cause problems to arise.
- *Process*: The procedures, practices and contracts used by the *people* to complete the *project*.

These main criteria were broken down by the task force until they were measurable and the subcriteria were thought to be independent from one another. The hierarchy for each of these main criteria are discussed in the following paragraphs.

The first main objective, or criterion, is People, as shown in Figure 1. People were considered by the task force to be the most important sets of variables associated with the success of any project.