DISSERTATION

HOW DIFFERENCES IN HEAVY CIVIL PROJECT SET-UP PRACTICES IMPACT PERFORMANCE

Submitted by

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WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY WILLIAM S. YEARSLEY ENTITLED HOW DIFFERENCES IN HEAVY CIVIL PROJECT SET-UP PRACTICES IMPACT PROJECT SUCCESS BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

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ABSTRACT OF DISSERTATION

HOW DIFFERENCES IN HEAVY CIVIL PROJECT SET-UP PRACTICES IMPACT PERFORMANCE

The life cycle of a construction project traditionally involves five phases: procurement, pre-construction planning, execution, closeout, and maintenance. The second phase, pre-construction planning is broad in nature yet vital to achieving a successful project. This study is unique in its focus on the contractors' perspective of pre-construction planning in the heavy civil sector.

Data utilized was derived from a national survey developed specifically for this research. A mailed questionnaire was sent to 1,334 senior executives nationally, of whom 121 responded. Participants were asked to respond to questions about the individual characteristics of their companies including financial performance. They then responded to a series questions asking them to rate how often they practiced specific project set-up activities. Project set-up activities were categorized into groups from which composite variables were developed. These composite variables were utilized to study the relationships between how often certain project set-up activities were practiced and their contribution to over-all company performance expressed as profit margin (earnings before interest and tax or EBIT). Multiple-regression, factor analysis and

frequency analysis were used for evaluating this data. The descriptive responses were utilized to evaluate differences in patterns of variance based on individual company characteristics. Hierarchical cluster analysis was utilized to assess these relationships.

Only a partial relationship was found between how often certain project set-up activities were practiced and over-all performance. Project set-up activities concerning the identification of risk and opportunities accounted for the majority of the relationships found. Individual company characteristics did not significantly correlate to patterns of variance in performance and which activities were practiced. Supplementary analysis contrasting mean scores from high margin companies with lesser performing peers yielded differences in how often project set-up activities are practiced.

This research provides insights as to which project set-up activities are most often practiced by top performing construction companies. These insights provide a guide for construction contractors to consider as they look toward planning future projects. While only partial correlations to over-all performance were found in this research the door has been opened for further study.

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CHAPTER 1 – INTRODUCTION

Over the course of a 30-year career in the heavy civil sector of construction I have managed hundreds of projects across the United States and Europe. Like most construction contractors I would like to be able to say all of our projects were a success, but this would be a lie. In reality most contractors would have to admit that some portion of their projects, for various reasons, did not perform to expectations. Many peers in the industry, including myself, have spent endless hours helping project teams turn an underperforming project around and, more importantly, think deeply about actions to keep the next project on track to meet performance goals. Time and again observations have led me to believe some of the problems encountered during the physical construction of a project could have been mitigated by more diligent pre-construction planning efforts. Equally as eye opening is when observed projects that went well, admittedly for multiple reasons, demonstrated a diligent pre-construction planning effort.

Call it a passion for planning, but this belief in the importance of construction contractors committing time, resources and effort to plan projects is the impetus for this study. This is not any easy topic to research given the many factors that can impact project success. This study is seen as a first step in a long road to better understanding the importance and impact construction contractors' planning efforts can have on performance. This study and follow-up research can hold great value, not only for helping construction companies enhance their performance, but also for the higher

education system where the next generations of construction managers are being prepared to enter the workforce.

Study Context and Scope

Top construction companies have evolved methods they routinely employ during each phase of a project that increase opportunities for project success. Despite success some construction companies have achieved, an alarming industry trend has emerged. National statistics indicate performance by construction contractors has declined in recent years. This trend is documented both by the Surety Association of America (2003) and Fails Management Institute (2004), the largest professional consulting firm servicing the construction sector. Recently some heavy civil contractors have elected to exit the traditional design/bid/build market due to poor performance (T. Ferruccio, Washington Group, personal communication, September, 2005). Declining performance suggests a need for research as to how construction companies can work to improve performance.

Recognizing this broad topic area, this study seeks to investigate one phase of the construction project cycle, the pre-construction phase (see Figure 1.1). In this study the term project set-up instead of project planning has been chosen. The reason for the choice of project set-up is that the term project planning is often interpreted more broadly as demonstrated in the studies cited later in this chapter. Often project planning encompasses many activities that may not involve the construction contractor, such as pre-planning meetings between the designer and project owner to establish the preliminary scope and purpose of the project. Project set-up, however, for purposes of this study is intended to focus solely on construction contractors' activities during the planning phase of construction projects.

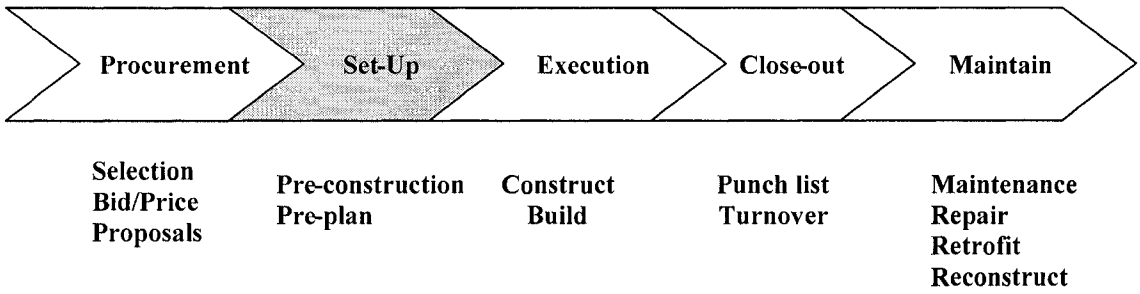

Figure 1.1. *Construction Phases*

The goal of the study is to identify which activities have the greatest impact on performance, not to identify project set-up activities. There is ample literature identifying the most common practices deployed by contractors during the pre-construction phase of the project. In this regard, the study attempts to further the work of other researchers. It is believed the findings will help construction companies better identify which project management practices can be deployed during the project set-up phase to improve project performance.

While the project set-up phase is but one of five common phases of a construction project (see Figure 1.1), this phase offers great opportunity to help contribute to better project performance. Contractors often find planning the most difficult part of the construction process (Fisk, 2003). Hugh Rice, a Board Director and Chairman of Fails Management Institute (FMI), recognizes that optimizing the project set-up phase is too often an opportunity not fully capitalized on by contractors (H. Rice, Chairman, FMI, personal communication, December 10, 2004).

The theoretical perspective for studying the correlation between project set-up practices and performance stems from the belief that top performing heavy civil construction companies approach projects in a materially different manner. While studies

have looked at both the importance of project planning and some of the activities that should take place during this phase, no studies were located that approached the topic from the performance perspective. Project management theory has been approached largely from a broad base perspective, often giving consideration to the combined viewpoints of the owner, designer and construction contractor. Seldom is the focus limited to the perspective of the construction contractor. Few studies narrow their focus to the set-up phase of a project (see Figure 1.1). It is surprising that past empirical research has largely ignored the perspective of the construction contractor during the pre-construction phase. Appendix A provides a catalog of relevant project management literature highlighting the author's approach and focus. The catalog helps to demonstrate that the study approach has not been previously explored.

Project management theory, where it has been applied to the project set-up phase, has historically sought to address the following areas.

1. Development of planning guidelines and checklists for project planning (Jaselskis, 1988; Parfitt & Sanvido, 1993);
2. Impact of external factors and, in particular, the changing environment many projects must operate in today (Morris, 1988; Tuman, 1988);
3. Allocation of project management resources for repetition of project success (Jaseliski, 1991); and
4. Different project stakeholders have varying views on what constitutes project success (Belassi & Tukel, 1996).

These studies and others have gone far in identifying some of the best practice theory in project management set-up.

The underlying logic for conducting the study can then be summarized by the following hypothesis:

1. Top performing heavy civil construction companies approach the project set-up phase differently than their lesser performing peers; and
2. There are similarities that can be identified among top performing construction companies that can predict project success.

Data was collected for this study concerning differences in project set-up activities with the intent to help construction companies improve overall performance.

The project set-up phase is also commonly referred to as the pre-construction and/or pre-planning phase of a project and is considered one of the most important phases in the life of a project (Ashley, Lurie & Jaselskis, 1987; Belassi & Tukel, 1996; Gidado, 2002; Jaselskis, 1988, 1991; Tortora, 1993). While project complexity has increased at a rapid rate, pre-construction planning is deemed not tot have kept up with the pace of change (Gidado, 2002). While there can be occasions when phases in the life cycle of a project overlap, this study primarily focuses on the activities that take place before construction gets fully underway.

There are a variety of stakeholders common to most construction projects that can impact the ultimate success or failure of a project. Three stakeholders in particular standout as key in most construction projects: the project owner, the designer, and the construction contractor. As discussed earlier, this study considered the perspective of the construction contractor in terms of project set-up practices.

In considering project set-up practices, it is important to have a fundamental understanding of what defines a successful project. Project success is characterized most

often by three criteria, as supported by the catalog of "Defining Project Success" in Appendix B.

1. On time completion or maintaining/exceeding schedule expectations;
2. Technical performance or quality; and
3. Delivering the project within or below budget.

Given this study considered the contractor's perspective, delivering a project within or below budget means a project was completed at or below the contractor's internal cost budget; thereby, yielding or exceeding the expected level of profit for a particular project. While it is acknowledged quality and schedule are important criteria in defining a successful project, these criteria are difficult to measure uniformly across a cross-section of companies (see discussion in Chapter 2, performance section). As a result, quality and schedule will not be considered as measures of success. Financial measures are for the most part, uniformly measured both at the individual project level and for construction companies as a whole.

Purpose Statement

The purpose of this associational study is to examine the relationship of project set-up activities to construction company performance delimited by:

1. The heavy civil construction sector;
2. Factors from the construction contractor's perspective;
3. Construction companies with annual sales under $200 million; and
4. Construction companies that predominately acquire work via the design/bid/build approach.

Predictor variables are defined as project set-up activities a contractor can implement before construction starts to position a project for success. The sole dependent variable is construction company performance, operationalized as earnings before interest and tax (EBIT). This financial measure is uniformly applied across the United States in conformance with Generally Accepted Accounting Practice (GAAP).

Individual company characteristics were considered important, in that they help to better understand how project set-up factors vary based on company background (i.e., company size, longevity of the business, work mix, experience). This study sought to help a specific sector of the construction industry better understand which project set-up factors have the most impact on performance, based on individual company characteristics.

Statement of Research Problem

The value of project set-up practices from a general perspective is largely known. As stated earlier, there is considerable literature that identifies project set-up practices. Empirical studies have focused on construction planning from a broad stakeholder perspective often including the construction owner, designer, contractor and at times other parties associated with a project. However, individual perspectives of contractors are missing from the theory base. Further complicating this problem is the fact that few studies have attempted to correlate project set-up factors to a consistent industry performance measure. The combination of these issues creates a problem in understanding what actions a contractor specifically can take to improve performance.

Empirical research has also done little to investigate whether project set-up factors differ depending on the characteristics of the construction company.

Understanding no two construction companies are the same in terms of size, work mix, geographical scope, and other characteristics that may define an individual company, one can theorize that project set-up practices deployed may vary from company to company.

Research Questions

From the above interpretation of gaps in literature two research questions emerge to guide the study:

1. How do the various components of Project Set-up contribute differentially to over-all performance?
2. How do these patterns of variance differ based on construction company characteristics?

Definition of Terms

American General Contractors Association (AGC): An industry association serving the construction sector.

Contractor: A construction company that accomplishes a particular task of a construction project. General contractors may have responsibility for the construction of an entire project while subcontractors have responsibility only for a specialized portion of the project (Clough, Sears, & Sears, 2000).

Design/bid/build approach: Traditional approach for a contractor to procure a construction project where the contractor submits a competitive bid for construction of a project. Commonly under this approach the contractor would have no involvement in the

design of the project. The successful low bidder would typically be awarded the project to construct.

Heavy Civil Construction: Comprised of engineering projects such as dams, roadways, bridges, and similar engineering projects (NAICS Definitions, 2003).

Liquidated Damages: A financial penalty commonly assessed by the owner of the project for late completion as a breach of contract. Typically the liquidated damage amount, usually stated as a dollar amount per day, is stated in the project contract documents (Gould & Joyce, 2003).

Preconstruction Phase: Pre-construction phase is generally the period of time between contract award and physical start of construction. Generally, the means and methods to build the project are discussed by key project stakeholders (Gould & Joyce, 2003).

Procurement Phase: Procurement is commonly defined as the necessary activities required to obtain materials and equipment to build the project (Ritz, 1994). For purposes of this study, the procurement phase will be considered as the process a contractor undertakes to acquire a project for construction. Often this activity requires submittal of a bid proposal.

Project: Any undertaking with a defined starting point and objectives by which completion is identified (Yates & Eskander, 2002).

Project Closeout Phase: The project closeout phase typically begins when the contractor achieves substantial completion of the project (Gould & Joyce, 2003).

Project Density: The ratio of total number of precedent relationships to total number of construction activities (Belassi & Tukel, 1996).

Project Management (PM): Application of knowledge, skills, tools, and techniques to project activities to meet or exceed project stakeholders' needs and expectations (Kwak & Ibbs, 2000).

Schedule: Primary role of the schedule is to represent the construction firm's original understanding of the scope of work and clearly communicate the intentions for completing the work (Clough, et al., 2000).

Set-up Phase: In context of this study, project set-up is the period of time from when a construction contractor is low bid and/or awarded a construction contract to when construction physically starts on the project site.

Surety: A private organization that provides a financial guarantee to the project owner that the project will be completed per the requirements of the contract on behalf of the construction contractor.

Surety Bond: A three party agreement between surety, contractor, and the owner. The surety bond is the written financial instrument that guarantees the completion of the project (Surety Information Office, 2004).

Delimitations

The introduction to this chapter described some of the delimitations of this study. The following list summarizes all the delimitations.

1. Only activities inherent to the project set-up phase will be considered.
2. Only the contractor's perspective will be investigated. The project owner's and designer's perspectives, while important, will not be considered.

3. Target audience will be civil construction companies with less than $200 million in annual sales.
4. Only the civil construction sector will be considered.

Figure 1.1 identifies the typical phases of a construction project. This study confines its investigation solely to the project set-up phase. Project set-up is considered the planning phase of the project and is arguably one of the more important project phases (Ashley, et al., 1987; Belassi & Tukel, 1996; Gidado, 2002; Jaselskis, 1988, 1991; Tortora, 1993). Identifying opportunities, risks, and potential problems that may be encountered prior to the start of a project allows the project team to develop an action plan with the intent to mitigate identified risks, solve problems before they become serious, and maximize opportunities.

While there is considerable literature on the subject of project success, including the drivers of project success, much of the literature is biased to the project owner's perspective in defining success. This commonly resulted from the sampling frame. Some literature takes a mixed approach in exploring factors that impact project success, combining responses from all major project stakeholders commonly including design professionals, owners, and construction contractors. Only the construction contractor's perspective will be considered in this study. Each key project stakeholder, while sharing many of the same motivations, also possesses singular motivations. It is important to understand clearly the activities that contractors recognize as key to successful project set-up.

The construction sector is a highly fragmented industry. It is a goal of this study to focus on contractors with annual revenues under $200 million. This group of contractors represents the majority of the industry.

Finally, there are multiple types of construction contracts available to the industry. This study narrows its focus to the most traditional contract approach (i.e., design/bid/build). While some of the project set-up best practices would likely have broad application to any contract method, some practices that will be identified in this study are better suited to traditional contracting methods.

Limitations

. This study is susceptible to some of the more common risks that could be equated as weaknesses in the design, which include:

1. Survey response rates are often lower when mailed questionnaires are utilized versus other forms of surveys, such as face to face surveys.
2. Limitation of inferring causality from the predictor variables creates the possibility that other extraneous variables could account for a portion of the relationship between predictor and dependent variables.

Significance of Study

In 2003, the construction industry experienced $1.25 billion in surety bond losses (Surety Association of America, 2003). Direct surety losses as a percentage of premiums written have increased from 21% in 1991 to 54% in 2003 (Surety Association of America, 2003). These surety industry results suggest a downward trend in project

performance over this 12 year period. The surety industry data are further supported by trends in contractor profit before tax. During the four years 1999 through 2002, contractors' profit before tax as a percentage of revenues dropped for most major construction industry sectors by approximately two percentage points (Fails Management Institute, 2004). Weaker profits mean less financial reserves for contractors to weather future industry downturns and to fund growth. Interestingly, during this same four-year period the construction industry grew in lockstep with the national Gross Domestic Product (GDP), increasing from $766 to $871 billion of construction put in place (U.S. Census Bureau, 2003), yet profitability eroded. With tightening surety conditions, one would expect less contractor capacity (i.e., supply of services) thus increasing profitability given increasing demand for services (i.e., more dollars of work available). However, this did not happen, leading one to ponder whether the efficiency of delivering work was the culprit for eroding profitability. Based on this observation, and considering the construction industry represents $915 billion (8.3%) of 2003 GDP dollars (U.S. Census Bureau, 2003), increasing the likelihood of project success has to be a core issue for the construction industry.

The foregoing factors indicate that the construction industry must look to improve performance. Project set-up is arguably one of the most important phases of the project life cycle and key to increasing potential for a successful project (Broadkorb & McCoy 1986; Gidado, 2002; Jaselskis, 1988; McCoy, 1986). Improving project set-up methods can be looked at as an effective way to materially impact construction project performance. By examining differences in how very successful construction companies approach project set-up versus their lesser performing peers, the opportunity exists in this

study to make a significant contribution to the heavy civil construction sector. No studies were found that explored differences between how top performing companies implement project set-up versus their lesser performing peers. It is believed that these differences may hold part of the key to enhancing project success.

Identifying existing industry educational gaps is also a central theme and essential for this study to making a material contribution to the industry. How better to ensure the construction industry benefits from the findings of this study, not to mention future studies on the topic, than to identify the industry's existing educational needs.

Researcher Perspective

One of the largest challenges is to not allow the experiences of a 30-year career in the private sector to materially influence the outcomes of this study. Over this long career in heavy civil construction, I have held almost every position common in a general contracting company including field engineer, estimator, field superintendent, project manager, VP/operations manager, division president, CEO, chairman, and board director. Three construction companies have provided all of my working experience. I have viewed the industry from the perspective of a small, midsize, and large construction company as each of the three employers I have worked for falls into one of these size categories. Therefore, I have the benefit of first hand understanding when investigating and interpreting the approaches of different size construction companies in this study. Career experience, coupled with my past and current educational training, provides a unique foundation to draw from in completing this study successfully.

Currently I function as Non-Executive Chairman for American Civil Constructors, Inc., along with being one of the founding partners of this $200 million revenue heavy civil construction company. As a result of many years of managing projects and operations, I have observed both successful and unsuccessful projects. As stated, it has been my experience that some of the problems or failures encountered on projects can be directly attributed to poor project planning during the project set-up phase. Therefore, I must acknowledge my personal bias that strong pre-project planning is essential to the successful outcome of a project. Some might argue my experience would bias the study. But participatory action research is common in the educational community and provides the opportunity for the researcher to study his or her own experiences (Creswell, 2002). In this regard, there is certainly an important place for the researcher's experience to guide and inform a research study. While it is arguably impossible to completely eliminate bias from any study, managed correctly, my experience can add value to this study.

Acknowledging that in certain portions of the industry sector my name and experience are well known, there was an argument to not associate my name with survey instruments so as not to influence participation by potential respondents. Therefore the decision was made not to include my name as a researcher on communications to survey participants.

In summary, the study has the potential to provide a meaningful contribution to the construction industry. To do so the study must not only be completed in accordance with good research practice, but the results must reach the target industry audience. To accomplish this, two goals were strived for. First, upon completion the results will be

translated into a language the industry understands. Publication in industry journals and/or periodicals versus just academic journals is a must. Second, development of industry educational program(s) based on the results will provide an additional avenue to reach this audience and make a contribution

CHAPTER 2 - LITERATURE REVIEW

The practice of project management is a broad discipline that can have application in almost any type of industry or organization undertaking a project. For this reason, parameters have been established to narrow the focus to specific applications within the construction sector.

This study sought to investigate whether there are correlations between certain project set-up practices and over-all construction performance. Within the investigation variance patterns based on construction company characteristics, such as company size, construction type, project size, and profit margin were considered. The primary purpose of the literature review is to support the theoretical framework of the study. To do so the following areas are addressed:

1. Need for study;
2. Project life cycle phases;
3. Importance of the project set-up phase in the project life cycle;
4. Document project success measures;
5. Project Set-up Practices; and
6. Establish an appropriate measure of business performance in the heavy civil construction sector.

Identifying the Need for Study

This study is intended to further the understanding of techniques a construction contractor can implement to improve project performance by building on previous studies. After reviewing a broad spectrum of literature related to the topic, it is evident there is a gap in literature. One study, by Gidado (2002), was found that addresses the project set-up or pre-planning phase of a project solely from the construction contractor's perspective. Additionally, most studies do not report financial performance of construction contractors and/or projects included in their samples in an effort to identify level of performance. Arguably financial performance is the most reliable measure of company and/or project performance from a construction contractor's perspective (see later discussion of business performance).

Ashley, et al. (1987) make the case that exploration of the drivers of construction success is an area deserving of further study. Identifying factors that contribute to outstanding performance is seen by these researchers as an opportunity to make a real contribution to the construction sector. More objective data tied to less subjective measures are the key to advancing this cause. In particular many studies, including the study cited above, tend to utilize success criteria such as owner satisfaction, functionality, level of follow-on work. These types of outcome variables are subjective by nature, and often subject to great variability depending on the experience of the respondents. As discussed later, Collins (2001) in his best selling book, *Good to Great,* addressed the issue of how to define outstanding performance. In the end Collins turned to a simple financial measure, earnings per share. Learning from Collins' experience, this study employs operating profit as a widely accepted quantitative measure of construction

business success. This approach removes much of the subjectivity found in other studies, thereby increasing content validity.

Project Life Cycle Phases

Much of the literature addressing project life cycle is focused broadly, beyond the scope of this study. However, an understanding of the different views of project life cycles is deemed to be important to help set the context.

Recognizing the practice of project management is a broad topic area, project life cycle is often interpreted by many authors from this perspective. Pinto and Prescott (1998) equate project life cycle to four phases:

1. Conceptualization -- Project mission established, including preliminary goals and project feasibility.
2. Planning -- Formalization of the plan takes place, including human resource and budgetary requirements.
3. Execution -- Tactical stage where the actual project work takes place.
4. Termination -- Occurs upon completion of the project, and provides for the project to be turned over to the intended user with reassignment of project personnel.

Kwak and Ibbs (2000) break the life cycle functions down further to six tactical phases that include: initiate, design and organize, plan, track and manage, closeout, and project-driven organizational environment. The first five phases identified are straightforward and need little definition. It appears the authors' intent regarding the last

phase was to measure the organizational environment in terms of supporting the project after completion. This phase is often equated to project maintenance.

Clough, et al. (2000) divide the project life cycle into three categories:

1. Planning and Definition – Project owner conceptualizes the project identifying preliminary budget parameters, needs, and special requirements.
2. Design – Design of the project by engineers and/or architects.
3. Procurement and Construction – Construction is planned, materials and equipment are ordered and the construction physically takes place.

There seems to be endless literature that can be cited on project life cycle. The three studies cited present a cross-section of perspectives from general industry to the construction sector. It did not seem productive to progress into an exhaustive review of perspectives on project life cycles, as there is no one answer. It seems better to accept that in the life of each project there is a defined starting point where the project is conceptualized and a defined completion of the effort. Some authors then address maintaining the project over its useful life.

Figure 1.1, repeated here from the Introduction, displays the five phases that define the life cycle of a construction project in the Design/Bid/Build environment. In this environment, the construction contractor does not have involvement in the conceptualization and design of a project. Typically, the contractor enters the scene after a complete set of contract documents are completed. These commonly include plans, technical and general specifications, and contract and bid instructions. Many standard specifications, such as the U.S. Department of Transportation FP-96 (1996), document the contractor's first involvement typically at the bid proposal stage.

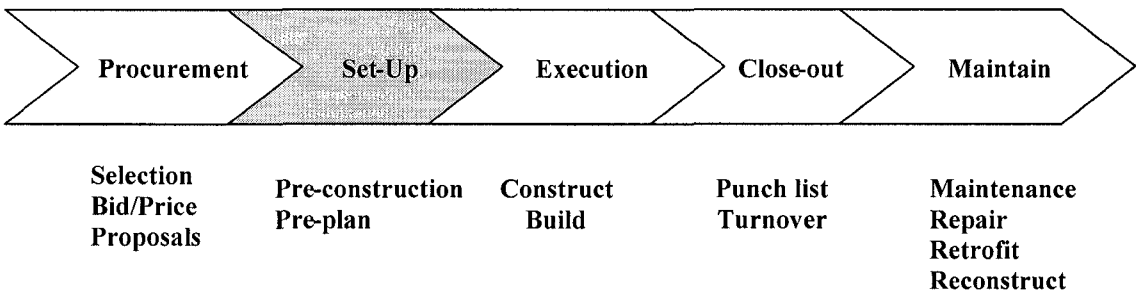

Figure 1.1. *Construction Phases*

Assuming a successful bid (procurement of the project) preconstruction planning or project set-up follows next (Gidado, 2002). Physical construction and closeout of the project are obvious phases in the progression. Limited literature was found that directly supports the last phase, Maintain, in Figure 1.1. Tortora (1993) is one of the few authors who identify this last phase, relating to it as operating the facility. The researcher has included this phase based on professional experience in industry. Most heavy civil construction projects require routine maintenance during operation. Kwak and Ibbs (2000), as mentioned in the previous section, emphasized the importance of establishing an operational environment to support the project after completion. This makes sense in those projects that require a major capital outlay by the owner to construct. To not protect the investment by supporting or providing routine maintenance puts the investment at risk. In recent years, some projects have required that the construction contractor include a price to maintain the project in their proposal. On other projects, the owner may elect to pursue a separate contract for maintenance services separate from the primary construction contract and/or perform these services with in-house personnel.

While including maintenance services, as part of the prime construction contract, is a newer trend in the industry, it appears to be gaining popularity with some owners and, thus, warrants consideration in the life cycle of a project.

Importance of Project Set-up as a Phase in the Project Life Cycle

As Gidado (2002) importantly notes:

> The changes the construction industry is experiencing in recent years have spirally increased the complexity of construction processes and thus make preconstruction planning at the right amount of detail and at the right time as an essential ingredient for successful delivery of projects. (p. 88)

Construction takes place outside and, as a result, is susceptible to many variables such as weather, traffic, etc. Construction is also a custom oriented manufacturing process that does not lend itself to mass production techniques common in most other manufacturing sectors. Each project is unique and has its own set of challenges and opportunities (Gould & Joyce, 2003). Given the uncertainties at the beginning of the project, many contractors find planning the project the hardest part of the construction process (Clough, et al., 2000). However, Ashley, et al. (1987), researchers at the University of Texas who have conducted extensive research into the drivers of project success, believe the quality and amount of project planning may be the most important factors impacting project success. While their work looks at the importance of planning from the broad stakeholders' perspective (i.e., owner, designer and contractor), it is clear that the construction contractor plays a key role in the planning process. Both the complexity and uniqueness of today's construction projects demonstrates the need for and the challenge and importance of the project phase for managers tasked with project set-up.

Three Most Common Project Success Measures

The project is the product that the construction company manufactures. Understanding this, for the company to be successful, the product must be manufactured or built successfully. As a result, it is important to identify what best defines project success. A considerable amount of literature was reviewed, often for a specific purpose. In the process of reviewing each document, a point was made to determine if the author(s) had a view or measure of project success, which in most cases was present. These views were tabulated and are summarized in Appendix B. As shown, the overwhelming views support quality, schedule, and cost as the best measures of project success.

Project Set-up Practices

In Chapter 1, multiple delimitations were defined to focus this study. Some of these delimitations presented challenges in identifying project set-up activities, given much of the literature approaches the topic from a broad perspective. For example Ashely, Lurie and Jaselskis (1987) have written extensively, together and individually, on drivers of construction success. Much of these authors' work took place at the University of Texas at Austin in the Department of Civil Engineering, a leader in this field of research. They are one of the few groups of researchers who have worked to differentiate practices that result in average performance versus outstanding performance. Some of their results present the obvious, but they also have demonstrated the importance of studying drivers of project success. While their study went far in demonstrating the importance of this topic, there were still multiple challenges faced in identifying factors

from their research for this study. First, their factors are not directly tied to a particular phase of a project. Second, they consider the perspectives of other key project stakeholders beyond the construction contractor. Third, it appears that their sample, both in the 1987 paper and in other research, trend suggests a continuum toward large projects only. Finally, their sample included projects across multiple sectors of construction, where this study seeks to look at heavy civil construction.

Belassi and Tukel (1996), as another example of some of the challenges faced, approach the problem from a completely different perspective. They categorize their success factors in a four dimensional framework that has no relationship to the common phases of a project. Their framework includes factors relating to the project itself, the project team, the organization, and the external environment. One of the challenges with this paper was determining how some of the above factors are put into action on the construction project. While this approach was interesting, in application one still needs to know when in the project life cycle each practice is best implemented to maximize the effect. In other words, to be successful both what to do and when to do it are important.

Norrie and Walker (2004) were interested in what drives project success from the perspective of the project team. These researchers approached the topic from a general business perspective. Though the quantitative results of their study are suspect given the small sample and the reliability of the sample, the qualitative insight obtained seemed of value. The authors acknowledged the weaknesses in their results in this pilot study and suggest further study is needed before drawing more definitive conclusions. Because the project team is essential to the project set-up phase, factors specifically relating to this group should be considered. Norrie and Walker (2004) made the point first and foremost

that the project team must have a firm understanding of the strategy along with a clear vision of the scope of the project.

Parfitt and Sanvido (1993) developed a checklist of critical success factors for building projects. The checklist was intended to be a management tool to help avoid pitfalls and increase the opportunity of project success. These authors bring to light several points not identified in many studies--the importance of building a cohesive team atmosphere early in the process and evaluating whether project rewards are appropriate to the task.

In their book, *Construction Project Management* (4th edition), Clough, et al. (2000) address production planning. "Production planning" is their term to differentiate the planning that takes place by the contractor prior to construction from the more general form of planning that can be much broader in scope. The use of checklists is suggested to minimize overlooking items that can be critical later in the project. These authors speak to a formal versus informal planning process used by contractors. A more formal planning process that breaks the construction project down into clear and simple defined steps is emphasized. Organizing the plan on paper and having a system where specific aspects of the plan can be readily accessed during the course of construction are equally important. This concept appears unique to these authors. While other research cited provides clarity as to some specific actions that should be taken during the planning phase, these authors do not address the importance of a defined process for managing planning. Despite this perceived deficiency the authors have identified a number of specific factors that appear key to the project set-up phase.

Gidado (2002) was the one author found whose work solely focused on pre-construction planning from the contractor's perspective. Gidado categorized construction planning deliverables into four distinct categories (i.e., Programming and Scheduling, Method Statements, Organizational and Systems Set-up, and Site Set-up). Unfortunately, some of the factors identified under the headings are minor in nature and project-type specific. One can hope the author intended these more as examples to make a point than actual pre-construction planning factors. The lesser examples are mixed with factors that seem to have high relevance, some of which have been identified by other authors cited. Gidado makes a point to differentiate financial planning factors from physical planning factors (i.e., those directly relating to the physical construction process while still recognizing that these two types of factors converge in many areas). While the study has strengths, the message is often diluted by the author's tendency to lose sight of the bigger picture, and the reality that many project owners are unlikely to modify their bid proposal process to allow more time for planning.

The final study that was considered involved the work of DeWit (1986). This study was chosen as a source of possible factors as DeWit made the unique observation that project success or failure varies depending on the perspective of the stakeholder judging the project. This observation was felt to add credence to this approach in only considering the contractor's perspective, by acknowledging the value of considering individual project stakeholders' views separately.

Factors identified in the above author's work have been summarized in Table 2.1. In some cases the researcher chose to eliminate factors for inclusion in this table based on the belief that the factors did not fit the constraints of this study. To ensure validity in

this approach to variable selection, transparency is needed (R.B. Cobb, Professor, Colorado State University, personal communication, October, 2005).

Table 2.1

Project Set-up Factors by Category

Project Goals and Objectives	Organizational Support	Project Team	Systems and Controls	Risk/Opportunity Management	Means and Methods
Clear project vision	Senior management commitment	Project management experience	Project meeting frequency	Re-bid project	Project schedule
Clear financial objectives	Human resource support	PM commitment	Job cost control	Risk identification	Sub schedule
Clear schedule milestones	Equipment resource availability	PM authority	Cost to complete analysis frequency	Risk mitigation plan	Long lead item identification
Clear project scope	Contractor past experience	PM availability	Quality control plan	Project safety plan	Site layout
Clear project organization	Reliable information systems	PT stability	Standardized project administrative procedures	Contract document review by project team	Access plan
Personnel goals	Open communication flow	PT experience	Standard communication procedures	Opportunity assessment	Work package breakdown
Political environment	Functional manager support	PT involvement	Project tracking systems	Re-engineer means and methods	Planning for maximum production
Economic environment		PT atmosphere		Project uniqueness	
		PT motivation/ buy-in	Project status frequency	Project technical uncertainty	
		PT availability to fully commit			
		Planning for team morale			
		Team building activities			
		PT adaptability			

PM = Project Manager PT = Project Team

In making judgments as to which factors from literature would be included in this study, a specific process was followed, that at a minimum, would allow other researchers to both understand the decision making process and view the categorization of factors.

To begin the process the first two delimitations--factors relating to the project set-up phase and the contractor's perspective--are the two most critical parameters in the selection process. The other delimitations have applicability to other aspects of this study, but are more limited in their impact on factor selection. This is because many factors can have similar applicability across different sectors and sizes of companies. These two delimitations guided the factor selection process.

Being unable to find literature that would provide guidance in selecting factors best suited to the parameters, my own industry experience was used in establishing a framework for activity selection. First, the factors were organized into major categories (see Table 2.1) based on the work of the authors cited earlier in this section. These authors' categorization overlapped in many areas such as organization, project team, systems and controls. In a few areas each of the authors listed categories that were unique to their work. In the end, my own judgment determined the final list of categories for use in this study. The list of categories selected and their brief definitions will help the reader understand how individual factors are assigned to a category follows.

1. Project Goals and Objectives – Includes factors such as project vision, schedule milestones, project financial goals, and project scope.
2. Organizational Support – Includes factors relating to resource support the company can provide the project team in terms of equipment, human

resources, systems, senior management support, etc. in setting up and planning the project.

3. Project Team – Everything to do with planning and implementing proper staffing of the project.
4. Systems and Controls – Types of systems and controls available to the project team to manage the project including items such as job cost control, cost to complete schedules, and standardized administrative procedures..
5. Risk/Opportunity Management – Project due diligence including identifying risk avoidance plans and identifying opportunities for improving project performance.
6. Means and Methods – Physical planning for construction activities.

After completing the review of literature, the next challenge was eliminating factors that did not reasonably meet the requirements of this study. The first two delimitations (i.e., applicable to project set-up and from the contractor's perspective) guided the selection process here. For applicability to the project set-up phase, factors were considered for inclusion if they clearly appeared to be applicable to the pre-construction planning phase.

Researcher experience was key in determining which factors would be applicable to a contractor's application versus the owner or designer. The second delimitation, contractor's perspective, was the next determinant. Factors deemed as those that could be implemented by a contractor were considered for inclusion.

Finally for a factor to be included it must be both determined to have application in the project set-up phase and be an activity that the contractor could implement. Thirty

years experience in the industry provided an advantage in interpreting literature toward making a sensible determination of what activities should be included.

Defining Business Performance Measures in the Construction Sector

The purpose is to review broad base constructs that can be considered to measure business performance, and then to refine the same for application in the heavy civil construction sector. When looking at performance measures in the construction sector, one can look at both the company as whole and the construction projects that are the primary source of revenue for most contractors. In addressing the topic of performance measures, this section is categorized into the following components:

1. General industry performance measures (a) Financial measures; and (b) Non-financial measures
2. Applicability for the construction sector
3. Dissertation topic application
4. Identifying superior performance

One of the general challenges in trying to determine which constructs should be utilized to measure performance is the audience these measures seek to serve. There is no simple answer. Wall Street would undoubtedly argue creating value for the shareholder is the single most important performance factor. A seasoned manager might argue performance must be measured from the broader perspective of all stakeholders of a company, including employees, customers, shareholders, local communities, suppliers and others who can have a material impact on the business. Some performance measures are historically focused (Mills, Rowbotham, & Robertson, 1998). Profit is one example.

Other performance measures focus both on historical performance and predicting future performance, such as economic profit, which is discussed later. Non-financial measures to some extent seem ambiguous in nature and can vary greatly across different businesses. Literature offers a broad array of choices (see discussion that follows). Non-financial variables often lend themselves to both qualitative and quantitative measurements. This section will attempt to address some of the more common performance measures used in business today. It is important to qualify at this point, that the performance measures most significant to a business can vary greatly depending on the type of business, its evolutionary stage, the current environment of operation, to name a few. The main focus is to present an argument as to which general business measures have the most application for the heavy civil construction sector in today's environment.

In the previous section, the three most common project success measures were identified (i.e., financial performance (cost and/or budget), technical performance (quality) and schedule (on-time performance)). These measures became the framework for addressing performance in this paper.

General Industry Performance Measures

Performance measures in business typically can be classified into two categories, those financially based and those non-financial in nature. Financial measures commonly include traditional accounting measures (Mills et al., 1998) such as profit, cash flow, and the like. Non-financial measures often focus on more subjective items such as businesses reputation, quality, and/or experience in particular areas. There is a diversity of possible

measures that exist for each category as is evident in the following discussion. The measures included in this paper are those that seem most often referred to in financial management journals and books. Where applicable, a discussion of each measure's weakness is provided. Perceived weaknesses will help narrow the list in terms of this paper.

Economic Profit

Over the last few decades, economic profit (EP), as a tool to measure value creation in a business, has been the topic of a proliferation of articles or books on the subject. Probably most well known is a Stern Stewart & Company book on Economic Value Added, commonly known as EVA (Stewart, 1990). EVA is a variant of economic profit (Mills et al., 1998) and considered a valid way to measure a business's performance. EP is derived by taking the net operating profit after tax (NOPAT), minus a capital charge based on the product of the capital invested in the business and the cost of capital (Copeland, Koller, & Murrin, 1994; Mills et al., 1998).

EP = NOPAT – (Invested Capital X Cost of Capital)

The concept of EP is argued to be a more appropriate measure in that it takes into account the cost of capital deployed for investments in the business. Some would argue it is a forward-looking measure concerned with future economic profits, where operating profit or net income solely looks at historical performance (Mills et al., 1998).

While the concept of EP appears straightforward, it takes some level of business sophistication to effectively implement. In a conversation with Hugh Rice, Chairman of Fails Management Institute (FMI), Mr. Rice argues that EP has never taken hold in the construction industry (H. Rice, personal conversation, October 2004). While he believes EP and/or EVA are very appropriate indicators of overall business performance, his consulting firm has struggled selling this concept to clients. Understanding that the construction industry in the United States is a highly fragmented industry, with 80% comprised of businesses with less than $200 million in revenues (Engineering News Record, 2002; U.S. Census Bureau, 2003), it is dominated by smaller closely held companies that often do not have the capabilities to measure their business beyond some of the most fundamental measures. Economic profit then, while a potentially a strong measure of financial performance, becomes less attractive as a financial measure in a sector dominated by smaller closely held businesses such as construction.

Return on Investment (ROI)

One common measure of general business performance is return on investment (ROI) (Chen & Lee, 1995). ROI in its simplest form is equal to net income divided by the book value of assets. While ROI has been used broadly for many years, it often comes under fire by economists and financial managers (Chen & Lee, 1995; Kaplan & Norton, 1992). The main issue that has plagued ROI is that it is not a strong indicator of the earnings potential of a business. A high ROI could simply mean management has not kept up with capital investment needed in the business. Investment is the denominator in the ROI equation. A smaller denominator would increase the rate of return despite a

numerator (profit) that may remain unchanged. Performance measurement solely based on ROI can breed short-term thinking in a management team (i.e., if I hold down investment despite the consequences for the longer-term health of the business, ROI will be higher). Because of the ongoing debate, ROI is not likely to be a strong candidate for performance measurement.

Net Income, EBIT and Gross Profit

Net income (NI), and its closely related relatives, earnings before interest and tax (EBIT) and gross profit (GP), are some of the most commonly used historical measures of business performance. When one speaks of the "bottom-line" in terms of performance, they are typically referring to one of these profit measures from the income statement. Recognizing almost any type of business utilizes profit (also commonly referred to as earnings or income) as a measure of performance, one or several of these profit measures would be applicable for the construction sector. It is a common phrase "The primary reason for being or staying in business is making a profit" (Schleifer, 1990, p. 93). As profit measures are derived from historical results; they are not considered to be forward looking measures of performance. This is not necessarily a weakness, but an observation.

Other Financial Measures

There is a long list of additional financial performance measures that are common across many sectors of business. Most of these measures are derived from relationships between different values resident in a financial statement (Peterson, 2005). These

performance measures can include: the quick ratio, the current ratio, a debt to equity ratio, ratio of fixed assets to net worth, current assets to total assets ratio, days sales outstanding, assets to revenues, a general overhead ratio, and the ratio of current liabilities to net worth (Davidson, Stickney & Weil, 1979; Peterson, 2005). One can make a case that each of these measures, on an individual basis, is important in some respect, but no one of these measures by itself presents a global picture of business performance (Peterson, 2005). Understanding that a more global indicator of financial performance for this study is needed, all of these measures are being ruled out for consideration.

Collins (2001), in his book *Good to Great,* faced the challenge of how to measure greatness in a business. He considered a variety of possible measures, but realized consistent standards of measurement did not often exist and the risk of introducing bias would be greater if some of the lesser defined measures were considered (Collins, 2001). Collins ultimately opted for a measurement tied to long-term stock returns of public companies (i.e., earnings per share). (Note: Collins had the advantage of a focus on public companies whose financial results are published). This clearly is a financial measure largely tied to profit performance of companies. Most construction businesses are privately held, so one cannot go to the business section of the newspaper and check earnings per share (EPS) data for a large portion of the industry. Given there is not a publication providing reliable financial performance on private construction companies, this data will need to be obtained via the questionnaire. Still, profit (earnings), like Collins' measurement of EPS in other industries, is a measure that is commonly understood and appropriate to this construction audience.

Non-Financial Measures

As one might expect, the business community is often conditioned to think of performance in terms of measures derived from the financial statement. While this may be true for some businesses, others are taking a broader perspective. Kaplan and Norton (1992) equate utilizing one form of measure to flying an airplane with just one instrument gauge, a potential formula for disaster. A combination of measures offers a much better view as to where the business is headed. This section seeks to identify some of the non-financial measures that are more common across multiple business sectors. Many of the performance measures presented in this section can be measured either qualitatively and/or quantitatively.

Performance measures, especially leading indicators of performance, cannot solely be dependent on information derived from financial data (Eccles, 1998). Variables, such as quality, customer satisfaction, innovation, market share, technical advancement, and internal production measures should be considered (Kaplan & Norton, 1992) in analysis of non-financial performance indicators. At this point the temptation would be to go into a discussion of each of these variables, but while it might be interesting to look at how different organizations might measure these variables, doing so would be missing the larger issue. There generally is no established standard metric for measurement and little in the way of published national data. Financial measures have the distinct advantage here in that many of the measures are governed by Generally Accepted Accounting Principles (GAAP), which drive common reporting standards. This disparity in comparability presents a huge challenge if one is trying to compare two

businesses to identify the top performer. Recognizing Collins already faced this dilemma and elected to measure what constitutes a great company based on a readily available and uniformly applied measure, EPS, this author relied on Collins' experience. While all of the non-financial measures arguably are important in their own right, many must be ruled out to measure top performance, since they are not uniformly applied or available company to company. Additionally, recognizing the fact that construction is a highly fragmented industry (Engineering News-Record, 2002; U.S. Census Bureau, 2003) dominated by closely held businesses, the availability of information is even more limited given one cannot turn to stock market results and published company reports for data. As a result of this challenge, technical performance and schedule were ultimately eliminated as potential measures of performance in context of this study. A more thorough discussion of some of the difficulties of measuring these two variables follows.

Applicability for the Construction Sector

From the previous discussion, it is evident that certain profit measures (i.e., gross profit, EBIT or net income) would be appropriate performance indicators as they are widely recognized and available. Profit is also one of the general indicators of overall business performance. For purposes of this study, earnings before interest and tax (EBIT), also commonly referred to as operating profit, has been selected as the most compelling measure of profit related performance. Gross profit was not selected, as it is a measure which typically reflects profit before a company's general and administrative expense is taken into account. Net income was not selected as it is a measure after taxes and interest charges are accounted for. For example, there can be particular years where,

high and/or low tax charges can skew this measure. Thus while EBIT may not be ideal from every perspective, it generally is a reliable measure of operating performance and a measure most businesses report, regardless of size.

Schedule and technical performance, as previously mentioned, were not selected as viable performance measures. No industry-wide measures are known that are published and measure quality and schedule with a common metric. Beginning with schedule, most literature points to the obvious, on time performance (Fisk, 2003). This means the project was delivered on or ahead of schedule. The consequence to the contractor of not delivering a project on schedule is typically being assessed liquidated damages. Liquidated damages are defined as a daily amount payable to the owner resulting from contractor caused delays to the project (Gould & Joyce, 2003). No literature was located that provides specific guidance for measuring schedule performance. Several types of interval scales could be designed to measure on time performance. First, one might simply ask respondents to report how many projects in a given time period(s) experienced liquidated damages. While this approach would provide a sense of how prevalent late performance was across the spectrum of projects, it does not necessarily define the impact on performance, especially in terms of profit margin impact. Another option to evaluating this performance factor would be to have respondents report the annual dollar value of liquidated damages paid in a given time period(s). Given historical revenues are being reported as part of the survey instrument, liquidated damages as a percentage of revenues can easily be calculated. The concern that comes to mind is ease of response on the part of the contractors. It is not known whether most contractors track liquidated damages year over year. Based on the

researcher's knowledge of the industry, it seems unlikely that many companies keep any useable records on liquidated damages. Literature provided no guidance here.

Quality, as a measure of performance, potentially poses the most difficult challenge analytically. Much of the literature reviewed points to meeting and/or exceeding design specifications as a primary measure of quality. Meeting design specifications is a detection-based measure (Sebastianelli & Tamini, 1996). This type of measure commonly looks at the number of defects or errors in a project identified through an auditing process. It is doubtful construction companies track quality as a detection-based measure consistently in industry. Occasionally a construction contractor must rework a specific component of a project that did not initially meet the applicable specification. In construction this is often referred to as a "call back." Designing a question in the survey instrument to measure callbacks or warranty work is one possibility for measuring quality. The larger issue concerning all these potential performance measures is the lack of a standard for defining and measuring quality across the sector.

Dissertation Application

Earnings before interest and tax, as a performance measure is straightforward, given respondents need to have access to historical financial results to respond to a questionnaire. This measure is, for the most part, uniformly applied. Content validity is also a primary concern when considering applicability (i.e., do the results measure what they were intended to measure?) (Creswell, 2002; Fink, 2002). Construction industry researchers are clear in their opinions that cost/financial performance is a common

indicator of project success. Based on the above arguments, EBIT is a fair measure of over-all company performance.

Identifying Superior Performance

Once EBIT was selected as the key outcome measure of construction performance for this study, the next step was to define what constitutes superior performance. The Construction Financial Managers Association (CFMA), largest national organization of financial professionals serving the construction industry, annually conducts a comprehensive survey of construction performance. This organization is one of the few professional associations that complete in-depth surveys of financial results in the construction sector. Equally as important, the CFMA (Building Profits, 2005) breaks their results down by construction sector. This was critical to this study in that one of the delimitations was a focus solely on the heavy civil sector. CFMA was the only professional association that provided a detailed performance breakdown for this sector. and went the additional step of defining metrics for determining best in class performance (BIC), also critical to this study. CFMA divided respondents into quartiles, with BIC defined as those respondents who fell into to the top quartile. For the heavy civil sector, BIC performance was defined as construction companies who have EBIT as a percentage of revenues at or above 3.9%. For this study 3.9% EBIT was considered in conjunction with participant responses as to what margin percentage constitutes superior performance. Chapter 4 and 5 provide a final perspective that led to a determination for defining superior performance in this study.

CHAPTER 3 – METHOD

This chapter describes the procedures utilized to conduct this study. The purpose is to investigate correlations between project set-up practices and construction company performance. A quantitative survey research design was selected. A survey instrument was developed specifically for this study. Procedures employed in the development of this survey instrument are discussed later in this chapter. Within this design, multiple regression was utilized to explore the contribution various project set-up activities have on company performance. Cluster analysis was also used to explore how construction company characteristics influence patterns of variance. From the literature review, best practice activities (BPA) were identified for the project set-up phase. It was not a goal of this study to identify project set-up activities, but to focus on which activities have the most impact in achieving superior performance. In this regard, this study attempts to further work of other researchers.

Basis for Choice

An associational research approach was chosen to identify correlations between multiple independent variables, project set-up activities, and a single dependent variable, performance. The non-experimental research approach is appropriate given the independent variables cannot be manipulated (an attribute independent variable), nor will

there be random assignment of participants to groups. The associational approach is ideal for predicting a single dependent variable (DV) from multiple independent variables (IV) (Gliner & Morgan, 2000).

Because of the attribute independent variables, only comparative or associational research approaches are appropriate. The study of human subject actions, as is the case in this study, often cannot be studied in isolation. A single IV and DV may be influenced by other variables. It is therefore preferable to examine multiple variables simultaneously (Mertler & Vannatta, 2002). Multiple-regression enables the researcher to predict which combination of IVs best predicts the variance in the DV (Gliner & Morgan 2000; Mertler & Vannatta, 2002). In this study multiple project set-up activity categories were simultaneously analyzed to predict the variance in construction company performance (EBIT).

Having more IVs can help to better predict the outcome and better control for extraneous effects. Adding more levels to a variable improves the researcher's ability to better explain the relationship between the independent and dependent variables (Gliner & Morgan, 2000). More variables and levels led this researcher toward the selection of an associational approach.

Cluster analysis was utilized to evaluate patterns of variance based on individual construction company characteristics (second research question). This form of multivariate analysis provides identification of subgroups of cases from a population that is homogeneous in nature (Garson, 2007). Hierarchical clustering, versus other forms of cluster analysis, was chosen as this is typically appropriate for samples where $N < 250$ (Garson, 2007). Each case is considered and ultimately combined with other cases that

have the highest similarity (lowest distance to another case or cluster). A pair of cases (two variables) is plotted forming the *x* and *y*-axis. "The Euclidean distance is the sum of the square root of the sum of the square of the x distance plus the square of the y distance (Recall high school geometry: this is the formula for the length of the third side of a right triangle.)" (Garson, 2007, p. 1). Cases with similar distances are then clustered together.

Research Questions

This study's approach utilizes BPA appropriate to the project set-up phase, as identified from literature, to determine which activities appear to have the most impact on construction company performance. Given this straightforward approach, two research questions were designed for use in this study.

1. How do the various components of project set-up contribute differently to overall performance?
2. How do these patterns of variance differ based on construction company characteristics?

The first question sought to explain which project set-up activities have the most impact on performance. The second question recognizes that construction companies often vary in terms of business characteristics, and that differences can influence both performance and which project set-up activities are most beneficial. Variable assignment was relatively straight-forward with respect to each research question. Project set-up activity variables all correspond to the first research question along with the dependent variable performance defined by profit margin. The descriptive variables-- construction type, company size (Revenues), average project size and profit margins--related to the second

research question that addressed company characteristics. A further discussion of variables and their application can be found later in the variable section.

Participants and Sampling

The theoretical target population for this study was all heavy civil construction companies in the United States with annual revenues less than $200 million. Construction in the United States is a highly fragmented industry, with 80% of the industry comprised of businesses with less than $200 million in revenues (Engineering News-Record, 2002; U.S. Census Bureau, 2003). The heavy civil construction sector is comprised of engineering projects such as dams, roadways, bridges and similar projects (NAICS Definitions, 2003).

For survey research, industry association directories are quite common as a means to access a sample of the population. The sampling frame for this study utilized membership directories from the American General Contractors (AGC) Association. Heavy civil contractors from all 50 states were included. The AGC, in 2005, had 12,759 members of which approximately 4,720 fall into the heavy civil category (L. Mock, National AGC Office, personal communication, February 24, 2005). Recognizing there are non-AGC member companies in the United States, it is not known how many heavy civil companies actually comprise the national population. The AGC is widely known to have the largest membership of general contractors nationally; thereby, providing assurance that this Association can provide a representative sample generalizable to the U.S. heavy civil population. There are different forms of AGC directories produced. The complete membership directory is not available to the public. Therefore the AGC

Membership Directory/Buyers Guide (2004) of contractors was utilized in developing the sampling frame. Suppliers and subcontractors largely use this directory to locate general contractors they wish to pursue for supplier quotes and subcontractor relationships. This directory is ideal for survey research as it provides the names of senior executives and construction sector type. From this directory 1,334 construction companies were identified that met the requirements for this study and became the sampling frame.

Multistage sampling is a common method for identifying a sample when the researcher does not have the names of companies, organizations or individuals that comprise the target population. In multistage sampling, also called clustering, the researcher first identifies groups or organizations from which to obtain names. Heavy civil construction companies can be differentiated from other types of AGC member contractors, such as commercial builders, based on member descriptions provided in the directories. All heavy civil construction companies identified were included in the selected sample. Based on an accessible population of 4,721 AGC members, a selected sample of $n = 1{,}334$ was used. Not all AGC member companies agree to be listed in the AGC Buyers Guide resulting in selected sample less than the 4,721 AGC members. A response rate in excess of 15% of the selected sample was targeted. Unsolicited surveys often yield a lower response rate than other types of surveys (Fink, 2003).

Participants received the mailed survey at their place of work. It was anticipated most participants would complete the survey at the workplace.

Measures

Independent variables in this study were separated into three categories: those relating to project set-up activities, those relating to the characteristics of the participating company, and those relating to the qualifications of the respondent completing the questionnaire. The variables in the last category-- qualifications of the respondent-- are descriptive in nature and were utilized to increase the reliability of responses. Questionnaires from respondents deemed as not having the appropriate experience qualification level were not used in the final data set. A copy of the questionnaire can be found in Appendix C. All of the project set-up activities utilized ordinal Likert scales with five levels. Importance scales response options were from low importance (1) to high importance (5). How often an activity was practiced was "never" (1), "seldom" (2), "usually" (3) and" always" (4). Most of the company characteristic variables were interval scales with varying numbers of levels reporting percentages and years. Other descriptive variables were a combination of ordinal and nominal measures.

The single dependent variable, financial performance, was intended to best identify level of performance for a construction company. Chapter 2 provided an in depth discussion of the challenges and experiences of researchers in determining a reliable measure of performance. In the end, the use of a common financial measure, such as EBIT, was selected because it appeared to be the most reliable.

Table 3.1 provides a schematic of the variables in relationship to the two research questions. The descriptive variables relating to the respondent do not directly relate to a research question, but are solely intended to demonstrate the qualifications of the respondent to participate in the survey.

Table 3.1

Variable Assignment to Research Questions

Demographics respondent and company	Project set-up composites (Research question 1)	Construction company Characteristics (Research question 2)
Years in business	Goals and objectives	Construction type
Current position	Systems and controls	Revenues
Years experience in current position	Risk/opportunity	Project size
Years employed at current employer	Means and methods	Time to plan
Total years of experience	Project team selection	
Highest level of education	Organizational support	
Type of college degree		

Note: Only composites for each category of project set-up activities are displayed.

The instrument utilized multiple content sections. In addition to the cover letter, the actual questionnaire had two primary sections. The demographic section of the questionnaire was itself comprised of two key components. The first component collected data on the performance of the company employing the participant. This information was essential in understanding the specific characteristics of the participating company. The second component addressed background questions concerning the respondent. This information was important in helping to ensure the participant in fact had adequate qualifications to respond.

The second section of the instrument addressed differences in how each company approached the project set-up phase. From past research, key BPA that can be deployed during this early phase of a project were presented. The instrument then measured both

activities an company utilized and how much importance was placed on each activity. This information was essential in discerning differences in approaches.

Instrumentation

A mailed survey instrument was utilized to collect data. After a thorough literature review, it was determined that an instrument did not exist that could be modified to meet the requirements of this study. The researcher developed the questionnaire specific to this study. A survey was identified as the logical form of data collection as it allowed efficiently reaching a reasonably large selected sample of potential participants geographically across the United States. The instrument developed and the accompanying cover letter can be found in Appendix C and D, respectively.

In an effort to increase survey response rate, it was important to keep questions as simple as possible. Reporting revenues and profit (EBIT) in dollars was simpler than asking the respondent to calculate margin percentages. Respondents were asked to report EBIT and revenues for the most recently completed fiscal year and an average for the last 5 years. In designing the questionnaire it was determined there may be a risk that some participants would not make the effort to report historical financial averages. From a practical standpoint 5-year averages provide a more reliable picture of the companies' financial performance than the most recent year's performance. Fortunately most respondents provided 5-year historical averages, increasing reliability of the financial data reported.

Instrument validity is accomplished by insuring the instrument measures what it was intended to measure (Thomas, 2004). Development of this questionnaire involved a multi-step process to accomplish this goal:

1. Conceptual versions of the questionnaire emerged and were discussed among peers in Quantitative Data Collection course at Colorado State University. This course focuses on the development of survey instruments for use in doctoral research. The researcher benefited not only from peer input during this course, but also from the experience of the course instructor.
2. The researcher completed a course in proposal development where class peers and the instructor provided critical insight to survey design.
3. The researcher then provided drafts to a select group of peers and faculty in the Construction Management Department at Colorado State University for feedback.
4. Two local senior managers of civil construction companies in the Denver metropolitan area provided feedback on the questionnaire.
5. Two of the researcher's committee members are methodologists who also provided valuable input in helping guide the development of this questionnaire.

After development of the questionnaire, the questionnaire was pilot tested. Pilot testing is viewed as essential to survey research. Pilot testing helps to reduce the possibility of misunderstandings, and lessens the introduction of bias from written instructions and/or questions (Thomas, 2004). An initial pilot was sent to 52 participants selected systematically from the developed AGC database. The first pilot test sampling frame was

developed by sorting the database alphabetically by company name and then choosing the first and fifth participant from each alphabetical category. The second pilot test sampling frame was established by selecting participants by state versus alphabetically. This was intended to ensure better representation of the pilot sample geographically. Ninety-six participants were chosen taking the first and the fifth participant from each state. Two states of small populations had limited companies in the database accounting for the reduction from 100 to 96 in the sampling frame.

Internal consistency reliability enables the researcher to confirm the instrument is measuring a single concept or construct (Gliner & Morgan, 2000). Reliability testing, Cronbach's alpha, was conducted for the variables that comprise each of the six project set-up categories in the questionnaire. Cronbach's alphas ranged from .68 to .87 and are reported in Table 4.8 (see Chapter 4). A reliability coefficient above .70 is an indication of strong internal reliability (Agresti & Finlay, 1999; Gliner & Morgan, 2000).

In addition to assessing reliability, the researcher conducted a thorough review of both questionnaire responses and handwritten comments provided on the questionnaires by pilot test participants. Participants were encouraged to provide additional comments regarding the content and structure of the questionnaire in completing it. Two key modifications were made as a result of pilot testing process. First, after discussions with industry representatives and private sector consultants who routinely conduct survey research it was determined that to increase response rates the questionnaire should be eye catching and well designed aesthetically. Utilizing graphic arts that depict construction themes and four color printing on the questionnaire cover presented an attractive first appearance. It is believed this helped catch the eye of potential respondents drawing

them into the content of the survey. In other words this was the "hook." Second, the financial section of the questionnaire required the respondent to provide recent year financial results, and five-year averages. This was an area of concern as it required reporting of what is typically considered confidential information (profits and revenues) and required some effort on the part of the respondent to locate the historical data requested (5 year averages for profit and revenues). To alleviate some this concern the cover letter emphasized that all responses would be kept strictly confidential and highlighted the fact that the researcher could not identify any respondents from the questionnaires returned. Despite this effort on the first pilot of the survey, 40% of the respondents did not provide complete financial information. At this point it was determined that a second pilot should be attempted. The questionnaire was modified with new language in bold print just before the financial section emphasizing the importance of reporting financial results. Additionally, the language from the cover letter stating financial information would be kept strictly confidential and could not be identified to the company or person responding was restated in this section of the questionnaire. As a result of these changes the second pilot yielded largely complete responses in the financial section.

Validity

Content validity is deemed as most important to this study. There is no statistic that establishes content validity (Gliner & Morgan, 2000). Content validity addresses the issue of whether the instrument properly measures the concept one is trying to measure (Creswell, 2003; Gliner & Morgan, 2000). In practical terms strong content validity for

this research instrument would be established if the items in the instrument measure the types of activities that are common in construction planning.

Content validity was established in a four-step process. The first step entailed a thorough review of literature. From literature a detailed list project set-up activities were generated. Activities that were cited repeatedly by multiple authors were generally considered for inclusion. Secondly, the researcher has spent 30 years managing in the construction sector including 18 years as the CEO of several very large construction businesses. Despite the risk of injecting bias, the researcher's experience was valuable in further ensuring activities chosen represented commonplace practices. The third step entailed having several experienced industry representatives and key construction industry faculty review the survey instrument. These representatives looked not only at the general instrument design, but the set-up activities chosen in terms of their content. As a final step the survey instrument was pilot tested twice.

Data Collection

Data were collected through the use of a mailed questionnaire. A cover letter, questionnaire, and a self-addressed postage paid return envelope were mailed to all participants. Total number of respondents was improved by the significant efforts in refining the questionnaire. Notwithstanding this additional effort, the overall response rate (actual sample/selected sample) accounting for returned surveys was 9.48% (121/1277).

It was important to ensure that the respondents were capable of representing the participant organization in responding to this questionnaire. The ideal individual

responding should have had broad knowledge of the company culture, philosophy, financial performance, project management/operational procedures, and policies. Typically a senior manager, such as company CEO, president, executive vice president, or operations manager would be best suited to respond to the questionnaire. To the extent possible, mailed questionnaires were addressed to a senior manager at the participant company. The cover letter highlighted the importance of directing this request to a qualified respondent. Demographic questions pertaining to the qualifications of the respondent (i.e., years with company, current position) provided an additional screen to further ensure the reliability of the response. Based on responses to these questions individual respondents deemed to be lacking in experience and/or senior management responsibility were to be separated from the main sample. All of the respondents were deemed to have met these qualifications. Table 4.2 (Chapter 4) documents that all of the respondents held meaningful management positions in their respective companies. In fact 95% of the respondents were senior executives in their organization with 75% of these senior executives being the president or CEO of the business. Ecological external validity (Gliner & Morgan, 2000) is believed to have been increased given the senior management positions that these respondents held in their respective organizations. Similarly demographic information on annual sales for the respondent's company, type of civil construction services performed, and years in business were also collected. This data enabled the researcher to investigate relationships between these factors and various project set-up practices. No respondents were deemed to be from construction fields outside of the civil sector.

Procedures for Conducting Study

Following the proposal defense, the focus was on piloting the questionnaire and obtaining Human Subjects approval for this study. Concurrently with the above, a database of 1,334 potential study participants was completed. Once the questionnaire and database were finalized, the researcher made preparations to pilot the study. The cover letter included an option for participants to request a summarized version of the study results by emailing the researcher. A CSU email address was established at this time to accommodate respondents' email requests for a summary of study results. Fifty-seven surveys were returned as a result of wrong addresses or the company was no longer in business. As responses to the survey were received the primary investigator inputted the data. This was deemed important as it enabled this researcher to gain insights and a working knowledge of the data. Upon completion of data entry, analysis commenced. Support from committee methodologists was essential during this period, both with statistical analysis and interpretation of results. Upon completion of data analysis, the results were summarized and reviewed with the entire committee.

Human Research Protection

This researcher has successfully completed human research protection training at Colorado State University. Prior to commencing this study, an application for human research was submitted to Colorado State University Human Research Committee (HRC) on April 20, 2006. This application was approved by the HRC on. July 7, 2006. A copy of the approval letter can be found in Appendix E.

CHAPTER 4 – DATA ANALYSIS

It was hypothesized that certain categories of project set-up activities contribute differently to overall construction company performance. It was further hypothesized that patterns of variance would differ based on construction company characteristics. Survey questions addressing project set-up activities were categorized into six sections--project goals and objectives, systems and controls, risk/opportunity project due diligence, means and methods, project team selection, and organizational support. To assess the first hypothesis, six composite variables were created from the data for the project set-up activities in each of these categories. Importance responses were treated as source evidence. Multiple regression was used to assess the relationships between these categories (predictor variables) and the outcome variable average 5-year EBIT margin. Five year average EBIT margin was computed by dividing average 5 year EBIT (Dollars) by 5 year average revenues (dollars).

In assessing the second hypothesis, how patterns of variance differ based on construction company characteristics, demographic data were primarily utilized. It was theorized that the type of heavy civil construction services performed, size of the construction company, profit margin, and average project size might impact how often certain project set-up activities are deployed.

Construction types included concrete paving, asphalt paving, bridges/structures, underground utilities, earthwork, and a combination of the above. There were three

respondents who reported concrete paving as a construction type. This type and their data were deleted from the data set. A number of respondents indicated they performed both earthwork and underground utilities. In practice it is quite common for the same company to perform both these services, therefore these two types were recoded and combined under the heading "earthwork." Additionally, data as to whether or not a construction company has adequate time for planning before the construction start were assessed.

Descriptive Statistics

Descriptive statistics (means, standard deviations, percentages, and frequencies) were calculated for all appropriate survey items. There were two open ended questions in the survey instrument. Given only a small percentage of the participants responded to these two questions, no effort was made to attempt to code these responses..

One hundred and twenty one participants responded to the national survey. Most respondents provided demographic information. Demographic questions included

Company

1. Construction type
2. Years in business
3. Size of company
4. Number of construction projects annually

Participant

1. Years of experience in current position
2. Years employed with current employer

3. Total years of construction experience
4. Highest level of education completed
5. If a bachelors degree was completed in what field

Construction Types

Table 4.1 provides a summary of construction types of work by the represented companies. Construction types varied with contractors performing multiple construction types being the largest category (n = 37) followed by bridges (n = 24), asphalt paving (n = 14), earthwork (n = 11), underground utilities (n = 11), and concrete paving (n = 3).

Table 4.1

Responses to Survey Question: "What Type of Heavy Civil Construction Does Your Company Most Often Perform?" (n =*102)*

Construction Type	*n*	%
Concrete Paving	3	3
Bridges	24	24
Asphalt Paving	14	14
Underground Utilities	11	11
Earthwork	11	11
Most of the Above	37	37

Current Position

In Chapter 3 the importance of having qualified participants respond to the survey was emphasized. Ideally the participant responding would be a senior manager in the organization highly familiar with the company's financial performance, project management procedures, and company policies. Table 4.2 documents that all of the respondents hold meaningful management positions in their company. In fact 95% of the respondents were senior executives with 75% of these senior executives being the president or CEO of the business.

Table 4.2

*Responses to Survey Question: "What is Your Current Position at Your Current Employer?" (*n = *102)*

Position	*n*	%
CEO	70	70.7
Senior Executive	24	24.2
Operations Manager	4	4
Estimating Manager	1	1
Project Manager	0	0
Project Superintendent	0	0
Other	0	0

Ecological external validity (Gliner & Morgan, 2000) is believed to be increased given the senior management positions these respondents held in their company. Years of experience with their respective organization, discussed next, further contributes to external ecological validity.

Years of Experience

Overall most respondents' employers had been in business for many years (M = 42.2, SD = 20.85). Longevity of the business suggests overall experience in their market sector. Years of experience (see table 4.3) in current position were notable (M = 15.04, SD = 10.49). Years employed with current employer (M = 24.98, SD = 11.02) and total years of construction experience (M = 31.39, SD = 9.10) were also notable.

Table 4.3

*Means and Standard Deviations for Employer Years in Business and Employee Experience (*n = *102)*

Experience	*M*	*SD*
Years in business	42.20	20.81
Years experience in current position	15.04	10.49
Years employed by current employer	24.98	11.02
Total years experience in construction	31.39	9.10

Experience of both the respondents and the respondents' employer is important in further documenting qualifications to respond to this survey.

In addition to experience, education is also an attribute that helps to define qualified respondents. Eighty-six percent of the respondents had completed a bachelor's degree and/or a graduate degree (see Table 4.4). Only 2% of the respondents reported having a high school degree and 12% attended college, but did not graduate. Of those respondents who earned a bachelors degree most respondents (97%) were in a related field (see Table 4.5). Civil engineering degrees topped out the list at 40% of those responding. Construction management degrees followed at 27%.

Table 4.4

*Responses to Survey Question: "What is the Highest Level of Education You Have Completed?" (*n = *101)*

Education	*n*	%
High school degree	2	2
Attended college, no degree	12	11.9
Bachelor's degree	68	67.3
Attended graduate school, did not graduate	13	12.9
Graduate degree	6	5.9

Table 4.5

Responses to Survey Question: "If You Completed a Bachelor's Degree What Field Was Your Degree In?" (n = 102)

Degree	*n*	%
Civil Engineering	37	31.5
Construction Management	24	27.0
Business	20	22.5
Engineering, Other	4	4.5
Architecture	1	1.1
Other	3	3.4

Time to Plan

All of the participants (n = 121) responded to "Does your company typically have adequate time to plan projects before physical construction starts?" Thirty four percent of the respondents indicated they did not have adequate time to plan while 63.6% indicated they did have time for planning. Table 4.6 summarizes the reasons for lack of planning time from those who reported inadequate time for planning. Twenty-eight percent of the respondents indicated they would delay a project start date to provide time for planning, while 71.9% would not delay a project.

Table 4.6

Responses to Survey Question: "If No, What is the Primary Reason that Prevents Your Company from Having Enough Time for Planning Construction?" (n = *47)*

Response	*n*	%
Owner has quick construction start date	21	44.7
Project team still completing another project, and therefore only has limited availability for planning	22	46.8
Both	4	8.5

Revenues and Average Project Size

Revenues and average project size help to define the individual characteristics of a construction company. A composite variable was computed for average project size. Five year average number of projects was divided into average 5 years' revenues to calculate average project size. Means and standard deviations are summarized in Table 4.7.

Table 4.7

Means and Standard Deviations for Average Project Size and Revenues

Project Size and Revenue ($)	*M*	*SD*
Average project size	2,396,029	4,795,345
Most recently completed year's revenue	50,043,770	47,956,385
5 year average revenue	37,545,214	33,532,234

Three sections in the questionnaire provided participants the opportunity to give qualitative (open-ended) responses. Very limited responses were only received pertaining to additional project set-up activities of the questionnaire ("If yes, please list the project set-up activities"), providing inadequate information to allow for coding. In review of these responses four comments were notable:

1. Consider third party interference
2. Identify difficult owners during the planning phase
3. Plan for structured handoff procedures between estimating and project team
4. Develop partnering procedures during planning

Each of these items could be categorized as potential additional project set-up activities.

Reliability

Reliability testing was completed to assess internal consistency of the importance ratings for the items that measure the various aspects of project set-up categories

(Morgan, Leech, Gloeckner & Barrett, 2004). Two options were available for assessing reliability utilizing either the importance rating or the how often practiced rating. In the questionnaire participants were asked to both rate the importance of each project set-up activity and then rate how often they practiced this same activity. During data entry it was observed that frequently a participant would rate an activity as highly important and then rate how often the activity was practiced as never or seldom (lower rating). It was theorized the reason not to practice an activity often that was rated as highly important has to do with resources or other limitations of the individual or company. As a result importance ratings presented a more stable platform for assessing internal consistency.

Cronbach's alpha was calculated for each category of project set-up activities. All alphas were positive and greater than .70, except for the categories of organizational support category (.687) and systems and controls (.691), supporting strong internal consistency reliability (see Table 4.8).

Each of the categories in Table 4.8 was comprised of 5 to 11 project set-up activities. Understanding Cronbach's alpha provides a measure of internal consistency across multiple items for which the researcher desires to obtain a summated score. (consistency index). It is important to delete individual items that potentially reduce this score. Two project set-up items that measured project set-up activities were deleted from the project set-up category (project scope defined and organization has relevant past project experience) as a result of this analysis.

Table 4.8

Internal Consistency Reliability with Cronbach's Alpha for Each Project Set-up Category

Variable Category	*Cronbach's Alpha*
Importance goals and objectives practiced	.751
Importance systems and controls practiced	.691
Importance risk/opportunity due to diligence practiced	.782
Importance means and methods practiced	.758
Importance project team selection practiced	.826
Importance organizational support practiced	.687

Outputs for reliability indicated if these two items were deleted greater internal consistency reliability would be achieved, providing a better indication that each project set-up item has the capacity to measure the single construct, performance. Deletion of the first item, project scope defined, increased the Cronbach's Alpha for importance goals and objectives by .055. Deleting the second item, organization has relevant past project experience, increased Cronbach's Alpha by .462 for organizational support practiced.

Preliminary Data Management

Descriptive statistics, including frequencies and box plots, were run to identify data entry errors. Routine data entry errors were identified from this descriptive information and corrected. Revised data sets were then created for data analysis.

Means can be significantly impacted by outliers (Agresti & Finlay, 1999). Box plots were run on all project set-up activities (both for importance and how often practiced) to provide a graphical summary of data and to identify potential outliers. In reviewing the box plots, five potential outliers were identified. After further investigation it was determined that these respondents should be classified as outliers and deleted from the data set. Two of these respondents were extremely small businesses in terms of revenues (Revenues < $1,000,000) and not representative of the population this study is intended to generalize to. Two of the respondents had profit margins that were so great they were beyond anything normally encountered in this sector, even by upper quartile performers. The fifth outlier related to a respondent who provided significantly incomplete data and an interpretation error.

Composite variables were created for each of the six categories--Project Goals and Objectives, Systems and Controls, Risk/Opportunity Project Due Diligence, Means and Methods Planning Before Construction Starts, Project Team Selection, and Organizational Support. Project set-up activities within each of the categories were collapsed into one composite variable. This provided for a smaller number of variables in the multiple regression equation.

Analysis of Research Questions

First Research Question

The first research question seeks to analyze relationships between frequency of project set-up categories are practiced and overall company performance. As discussed earlier, six composite variables were created, one for each category of project set-up

activities. Simultaneous multiple regression was utilized to predict which project set-up categories contributed to overall company performance (5 year average profit margin). Table 4.9 presents a summary of descriptive statistics, Table 4.10 presents intercorrelations and Table 4.12 displays beta coefficients.

Table 4.9

Means and Standard Deviations for Contributions of Project Set-up Activities to Overall Performance (How often practiced)

Variable	*M*	*SD*
Average 5-year margin (%)	.0517	.0314
Average Project Size ($)	2,570,528	4,988,649
How much goals and objectives	3.18	.55
How much systems and controls	3.13	.51
How much risk and opportunity	2.76	.59
How much means and methods	3.20	.52
How much project team	2.89	.37
How much organizational support	3.23	.42
Adequate time to plan	.59	.49
Construction type bridges	.23	.42
Construction type asphalt paving	.13	.34
Construction type earthwork and utilities	.27	.45
Construction type most of the above	.38	.49

Table 4.10

Intercorrelations for How Much Project Set-up Activities Contribute Differently to Overall Performance

Variable	1	2	3	4	5	6	7	8	9	10	11	12
Average profit margin	-.087	.116	.161	.347	.205	.091	.009	.015	-.062	-.067	.031	.072
Predictor variable												
1. Average project size	---	.050	.180	.078	.001	-.031	.160	-.077	.050	-.109	-.112	.135
2. Goals & objectives		---	.586	.589	.744	.472	.394	.333	.245	-.112	-.210	.059
3. Systems & controls			---	.773	.586	.325	.357	.158	.092	-.260	-.115	.205
4. Risk & opportunity				---	.636	.503	.410	.251	.092	-.141	-.099	.108
5. Means & methods					---	.582	.438	.356	.080	-.120	.009	.006
6. Project team						---	.720	.331	.166	-.164	-.065	.029
7. Org. support							---	.168	.068	-.155	-.184	.217
8. Adequate time to plan								---	.083	.124	-.088	-.077
9. Const. type bridges									---	-.208	-.327	-.420
10. Const. type asphalt										---	-.233	-.299
11. Const. type earthwork & utilities											---	-.471
12. Const. type some of above												---

In assessing the assumption of multicollinearity, several statistics provide an indication of collinearity. First, A preliminary analysis of the correlation summary (Table 4.9) indicates there are no high correlations between predictors. For a correlation to be observed as high Field (2002) suggests $R > .80$. Second, Field advises investigating variance inflation factors (VIF). VIF is an indicator as to whether one predictor variable has a linear relationship with another predictor variable. There are no distinct rules,

however a VIF score above 10 and a tolerance below .2 0 may be cause for concern in assessing multicollinearity. Table 4.11 shows that these limits are not exceeded.

Table 4.11

Variance Inflation Factors (VIF) and Tolerance for Project Set-up Categories and Company Characteristics

Category	VIF	Tolerance
Average project size	1.24	.889
How much goals and objectives	2.80	.357
How much systems and controls	3.22	.311
How much risk and opportunity	3.21	.312
How much means and methods	3.24	.308
How much project team	3.14	.318
Adequate time to plan	1.26	.791
Construction type bridges	1.70	.588
Construction type asphalt	1.44	.697
Construction type earthwork and utilities	1.48	.675
Construction types some of the above	1.77	.585

Table 4.12

Regression Analysis of How Project Set-up Activities Contribute Differently to Overall Company Performance

Variable	B	SEB	β
Average Project Size		.000	-.082
How much goals and objectives	-.005	.009	-.094
How much systems and controls	-.019	.011	-.304
How much risk and opportunity	.033	.009	.628
How much means and methods	.010	.011	.173
How much project team	-.007	.015	-.087
How much organizational support	-.009	.012	-.114
Adequate time to plan	-.004	.007	-.066
Construct type bridges	-.003	.010	-.036
Construction type asphalt paving	-.006	.011	-.067
Construction type some of the above	.004	.009	.069

Note. $R^2 = .093$ ($n = 93$)

From the model summary, only one variable, how much risk and opportunity, significantly contributed to the total model ($p<.001$). Regression results indicate that the over-all model only partially predicts company performance (Profit margin), $R^2_{adj} = .093$; $F_{(11,81)} = 1.86$; $p = .057$.

Second Research Question

The second research question investigates the impact of company characteristics on how often certain project set-up activities are practiced utilizing hierarchical cluster

analysis (see Chapter 3, Basis for Choice, for a discussion of this method). It was theorized that the characteristics of an individual company may influence how often project set-up activities are practiced. As an example one might suspect that size of a company and/or project size might influence how often specific project set-up activities are practiced.

The following variables were selected for cluster analysis:

1. All six composite variables for project set-up categories addressing how often practiced.
2. Construction type
3. Average revenues (describes size of company in terms of sales)
4. Average profit margin (an indication of project success)
5. Average size of project

These variables were chosen as they best represent characteristics of the individual construction company. The last four variables listed above describe the characteristics of the company. The first addresses project set-up categories. The vast majority of cases were combined in the first cluster indicating little variance among cases. That is, there were no distinct clusters that could be readily identified among the companies. Because there were no significant clusters that could be identified no graphical outputs are presented.

Supplementary Analysis

Given the multiple regression analysis predicted a limited portion of the variance in performance, further analysis seemed warranted. The underlying assumption for

further analysis is founded in the belief that top performing construction companies practice certain project set-up activities more often than lesser performing peers. The intent is to investigate if significant differences exist. In the following analysis descriptive statistics (means and standard deviations) and *t*-tests between groups are utilized to explore differences.

Lastly, project set-up categories are re-evaluated using factor analysis. In some studies factor analysis is performed as a first step before regression analysis. However, given the large amount of literature concerning construction planning activities and the categorization of the same, the groupings derived from the literature were initially analyzed. For purposes of this research, factor analysis was utilized on an exploratory basis to look for other options to group related variables (project set-up activities). One question that emerged during the initial analysis was whether the six categories derived largely from the literature were appropriately grouped. As explained earlier in this chapter, composite variables were developed for each of the six categories to reduce the number of variables in the multiple-regression equation. To further investigate the grouping of variables, factor analysis was utilized to explore revised categories for analysis.

Contrasting Mean Scores Based on Profit Margin Performance

Utilizing "select cases" function in SPSS, participants were categorized into two groups--those with profit margins exceeding 5% and those with profit margins less than or equal to 5%. The CFMA (Building Profits, 2005) defined superior performance as construction companies with margins exceeding 3.9%. The questionnaire asked

participants to define superior performance based on profit margin ranges: (a) less than 2%; (b) 2 - 4%; (c) 5 - 7%; (d) 8 - 10%; and (e) greater than 10%. The frequencies reported in table 4.13 indicated the mode was the 5 - 7% range (47.7%). Based on these results and the findings from CFMA, it was determined that construction companies with margins exceeding 5% would be deemed as superior performers for this analysis.

Table 4.13

Defining Superior Operating Performance (EBIT as a percentage of revenues) (n = *111)*

Respondents'	*n*	%
Less than 2%	0	0
2 - 4%	7	6.3
5 - 7%	53	47.7
8 - 10%	25	22.5
Greater than 10%	26	23.4

Descriptive statistics, means and standard deviations, were run for each group. Results are reported for highly and least practiced project set-up activities (see Tables 4.14 and 4.15). By observing mean scores for the project set-up activities, in descending order, a gap was identified in the 3.31 to 3.39 range. The value 3.33 was chosen as the mean score at which a cut-off was made for highly practiced project set-up activities. Likewise, the same observations were made for least practiced project set-up activities, with a mean score of 2.80 (gap observed) or below chosen as the cut-off point. In contrasting results in Table 4.14 based on profit margin groups, several differences are

noted. First, in all cases except for the project schedule activity, construction companies with higher profit margins practice each of the activities listed more often, albeit in some cases not significantly more often. Second, construction companies with higher margins practice a larger number of activities (means equal to or exceeding 3.33) than the lesser performers. Additional "highly practiced" activities:

1. Risks identified
2. Opportunities identified
3. Production goals established
4. Long lead items identified
5. Maximum production planning

The one activity lesser performers practiced more often than higher performing peers was "project managers with relevant experience."

Table 4.15 summarizes mean and standard deviations for those activities least practiced. The lesser performing group of companies practice two-fifths (41.66%) more project set-up activities less often (mean score < 2.80). It is worth noting that the majority of least performed activities (bottom 6) were common to both groups of companies (mean score < 2.80).

Table 4.14

Means, Standard Deviations and t-test Results for Highly Practiced Project Set-up Activities

Project set-up activity	Participants with profit margins > 5% (n = 45)		Participants with profit margins ≤ 5% (n = 60)			
	M	*SD*	*M*	*SD*	*df*	*t*
Safety plan established	3.80	.462	3.27	.802	102	3.44*
Senior management commitment	3.78	.420	3.67	.475	103	1.27
Project schedule established	3.53	.625	3.65	.515	103	-1.02
PM has high level of commitment	3.53	.505	3.37	.520	103	1.28
Job cost control tracking systems established	3.52	.821	3.33	.837	102	1.15
Financial expectations established	3.51	.843	3.42	.671	103	.639
Production goals established	3.42	.583	3.27	.821	102	1.73
Opportunities identified	3.42	.583	2.98	.792	103	3.13*
Planning for maximum production	3.42	.583	3.25	.751	103	1.28
Long lead items identified	3.42	.809	3.12	.825	103	1.98
Risks identified	3.38	.716	3.05	.910	103	2.0
PM has relevant project experience	3.20	.405	3.35	.481	103	-1.69

*p = .001

Table 4.15

Means, Standard Deviations and t-test Results of Least Practiced Project Set-up Activities

Project set-up activity	Participants with profit margins > 5% (n = 45)		Participants with profit margins ≤ 5% (n = 60)			
	M	*SD*	*M*	*SD*	*df*	*t*
Contract documents reviewed	3.27	.817	2.78	.865	102	2.92*
Standard communication procedures	2.86	.632	2.77	.745	102	.698
Assess technical difficulty	3.16	.673	2.73	.980	102	2.51
Plan for project team atmosphere	2.76	.609	2.60	.724	101	1.13
Work package established	2.93	.809	2.60	.942	103	1.90
Plan to capitalize on opportunities	3.00	.707	2.60	.807	103	2.65
Re-engineer means and methods	2.73	.580	2.37	.641	102	2.96
Plan for risk mitigation	2.84	.737	2.33	.837	103	3.26*
Assess project uniqueness	2.53	.757	2.31	.793	102	1.50
Project team re-bids project	2.45	.999	2.15	.799	102	1.67
Plan for project team morale	2.31	.668	2.13	.747	103	1.28
Plan for project team building	1.98	.690	1.92	.857	102	.400

*$p < .001$

t-*tests Between Groups*

To investigate two independent groups (top performers and lesser performers) on a normal outcome variable an independent sample *t* test is appropriate (Morgan et al., 2004). To ensure the type I error rate remains at or below the 0.05 level corrections must be made for each pairwise comparison (Field, 2000). The Bonferroni method is the

easiest way to make these corrections by dividing the type I error rate ($^{\alpha}$) by the number comparisons (0.05 ÷ 12 = .004). These pairwise comparisons are reported in the last two columns in Table 4.14 and 4.15.

Factor Analysis

Given one of the composite project set-up categories was significant in terms of accounting for the variance in project performance, further analysis was conducted utilizing a modified data set. Factor analysis, which is a multivariate statistical method often used where a large number of variables exist with many being intercorellated, was chosen (Agresti & Finlay, 1999; Mertler & Vannatta, 2002). The variables can often be reduced to groupings or clusters of related variables.

Utilizing SPSS's factor analysis function, a rotated component matrix was created of all project set-up items. This output was then utilized to identify new categories that composite variables could be developed from. In the output, variables were grouped based on the strongest correlations. In some cases items loaded on more than one factor. In developing new composites, for the most part variables were maintained in the factors where the correlations were the highest. For five items, the researcher relocated each item to another cluster based on professional experience. Three categories were excluded from this analysis as they contained three or less variables. Once the new groupings were finalized (Seven groups), new composites were created in the data set (see Table 4.16). Utilizing these new composites, reliability testing was completed (Cronbach's alphas) and new regressions were run.

Table 4.16

Rotated Component Matrix Categorization of Project Set-up Activities

Items Practiced	Component											
	1	2	3	4	5	6	7	8	9	10	11	12
Expectations and vision										.636		
Financial expectations established		.478										
Schedule milestones											.514	
Expectations for Project Organization		.581										
Project scope defined											.714	
Meeting frequency established										.569		
Quality control plan established		.434										
Safety plan established												
Cost to complete schedule established	.476											
Standardized administrative procedures	.731											
Standardized communication											.444	
Job cost control tracking systems	.803											
Team re-bids project												.794
Contract documents reviewed	.497											
Risks identified			.664									
Risk mitigation action plan			.597									
Opportunities identified	.662											
Plan to capitalize on opportunities	.617											
Re-engineer means and methods	.404											
Assess project uniqueness			.708									
Assess technical difficulty			.845									
Project schedule		*.819*										
Sub schedules identified		*.588*										
Production goals established		.755										
Work package established							.628					
Long lead items identified		*.488*										
Site plan established		.768										
Plan for maximum production		.657										
PM has relevant project experience								.633				
PM has high level of commitment								.628				
PM has adequate time to plan								.737				
Project team has relevant experience				.722								
Plan for project team stability				.717								
Plan for project team motivation					.729							

Table 4.16 Cont...

Variables Practiced	Component											
	1	2	3	4	5	6	7	8	9	10	11	12
Project team adaptable					.565							
Project team involved in planning				.543								
Plan for project team morale					.519							
Plan for project team building				.529								
Project team atmosphere					.530							
Senior management commitment						.513						
Human resource support happen					.680							
Reliable information systems happen	.483											
Organization has relevant experience				.401								
Functional manager support happen						.644						
Open communication with head of office					.418							

Note. Five items were re-categorized in this matrix based on researcher's experience. The items re-categorized are identified in italics.

Seven new composite categories were established from the factor analysis. These were:

1. How often project controls established
2. How often project goals established
3. How often risk analysis completed
4. How often project team selection and morale building
5. How often project manager selection
6. How often work package defined
7. How often senior management commitment

Cronbach's alpha overall appeared weaker than the alpha's run on the original data set (see Appendix F). Additionally thee new composites accounted for less variance in performance (profit margin) than the original composite categories. Regression results

with the new composites indicate that the overall model minimally predicts company performance (Profit margin) with an adjusted R^2 of .024.

Summary

From chapter 1, study context and scope, the assumption was made that there is a correlation between the quality of project planning and the ultimate performance of a project. Regression analysis indicated a partial relationship between the project set-up activities and profit margins ($R^2 = 0.093$), however; only the risk/opportunity composite variable was significant ($p<.001$). The researcher's expectation was clearly that more of the set-up activities would contribute significantly to the variance in profit margin. Acknowledging these findings, supplementary analysis was completed contrasting mean scores (see Supplementary Analysis in Chapter 4) of top performing construction companies with their lesser performing peers. This analysis (see Table 4.12) demonstrated that top performing construction companies both practice like activities more often and also rated more project set-up activities higher in terms of how often practiced. This distinction suggests there may be differences in approaches during the project set-up phase of a project between top performers and their lesser performing peers.

CHAPTER 5 – DISCUSSION

Generalizing to the Target Audience

One of the goals of this study was to address several perceived gaps in literature. For the most part, past studies approached pre-planning from a very broad perspective (see Appendix A). Understanding that the construction industry comprises a diverse cross-section of construction fields spanning from residential and commercial buildings to industrial plants and highways, one might theorize not all construction planning activities are applicable to all fields. Therefore this study focused on the heavy civil sector of the industry to explore depth rather than breadth of the industry. In the literature reviewed, many of the studies focused solely on very large companies (Hudson, 1997; Jaselskis, 1988; Jolivet, 1986: Kwak & Ibbs, 2000). These large organizations certainly represent an important component of the industry, but truly are not representative of the typical contractor (see Chapter 3, Participants and Sampling section). Additional foci were construction companies with annual revenues less than 200 million dollars and the perspective of construction contractor. This is important as other key stakeholders, as an owner's representative or designer, may not always share the same views as a contractor, thus potentially influencing results such that they may not be representative of a typical contractor (see Appendix A for researchers' perspective).

Another perceived gap in the literature was the selection of outcome variables in studies. Many outcome variables in studies reviewed were very subjective (Belassi & Tukel, 1996; Cleland, 1986; DeWit, 1986; Hudson, 1997; Jaselskis, 1991; Pinto & Slevin, 1988), thus more difficult to measure. There are neither industry standards nor national data for the measurement of outcome variables such as on time project completion or quality. Selecting financial performance (Profit margin) for this study was intended to provide a more measurable outcome variable. The primary intent of the study was to narrow the focus, thereby, increasing the ability to generalize to the target audience; the heavy civil construction sector.

Discussion of Results

Despite varied approaches to data analysis, only 9.3% of the variability in the outcome variable was explained. The risk/opportunity composite variable accounted for most of this variability. Identifying project risks and opportunities during planning was clearly an activity top performing construction companies practiced often (see Table 4.12). Risk and opportunity assessment was an established area of importance in much of the literature that was reviewed (see discussion in Chapter 2, Project Set-up Practices). This study confirms that indeed, heavy civil contractors should allocate time to this activity during the project set-up phase.

What of the other categories of project set-up activities? Despite the lack of relationships between the other predictor variables and the outcome variable, there were still notable findings from the descriptive analysis. From Table 4.12, one can see that a number of financial/performance goals and controls are actively practiced by the

performers. These activities include establishing production and financial expectations in terms of goals, and utilizing project job cost control tracking systems as a measure of performance. Commitment from both the project manager and the senior management to the construction company was also identified as essential to project success. While it would seem obvious to most that a high level of commitment from the manager leading the project is a given, in practice this is not always the case. Certainly having the full support of top management at the home office is important. Preparing project schedules is traditional before most heavy civil projects commence and arguably is common in most types of construction. So it was no surprise this activity was rated highly as important. Coupled with developing project schedules is another activity top performers practiced often: identification of long lead items. For most who have experienced building construction projects, delays resulting from not identifying a permanent material that requires significant lead time to obtain from a supplier or fabricator can be very costly. Not only is the project delayed, but a domino effect can ripple through other dependent project activities, not to mention increase the potential for financial losses. Lastly, many would argue most importantly, project safety planning was rated the highest. This is good to see, as project safety should be at the top of every contractor's list.

What was very interesting was contrasting the activities most practiced by top performers versus those practiced by the lesser performing peers. Five project set-up activities were not rated as highly in terms of how often practiced by the lesser performers. These activities included:

1. Production goals established
2. Project opportunities identified
3. Planning for maximum production
4. Long lead items identified
5. Project risks identified.

Two of these activities, risk and opportunity identification, did account for some of the variance as discussed above. The other three activities may be worth study in future research. In summary results displayed in Tables 4.12 and 4.13 present a consistent pattern of difference of mean scores favoring the higher performers. These descriptive results present an argument that top performing construction companies practice certain project set-up activities more often. The reader is referred to subsequent sections that discuss weaknesses and future research for a more in-depth discussion of where these results might lead.

t-tests were also completed for all of the activities in Tables 4.12 and 4.13 to explore whether there were significant differences between top performers and the lesser performing peers. Only two project set-up activities in the highly practiced group, safety plan established and opportunities identified, were significant ($p < .004$). In the least practiced project set-up activities group once again only two activities were significant ($p < .004$), contract documents reviewed and risk mitigation action plan established.

At the end of the questionnaire participants were asked if they had adequate time to plan and, if not, what the primary causes were for lack of planning time. Over 1/3 of the participants reported they did not have adequate time to plan. Table 4.6 showed the majority of the reasons were almost evenly split between construction owners having

quick project start dates and the contractors' project teams committed to completing other projects thus limiting their time available to plan. This was the only other variable that was significant (see Table 4.11) although it accounted for little of the variance in the outcome variable.

Four qualitative comments were summarized in Chapter 4. Each of these comments is worthy of consideration as a project set-up activity in future research. Two of the comments-- plan for structured handoff procedures between estimating staff and project team members and developing partnering procedures during planning--would be interesting to explore in a structured interview study. One could envision developing a better understanding of the different processes for handing off a project from an estimator or estimating department to field staff. Likewise, structured partnering processes to increase cooperation between owner representatives and the contractor's organization could be a topic in itself. Partnering has been in existence for over a decade in the heavy civil sector and no doubt there are some planning approaches that have proved more successful than others in establishing partnering programs.

In summary results displayed in Tables 4.12 and 4.13 present a consistent pattern of difference of mean scores favoring the higher performers. These descriptive results present view for further consideration that top performing construction companies practice certain project set-up activities more often. The reader is referred to the following sections that discuss weaknesses and future research for a more in-depth discussion of where these results might lead.

Weaknesses

Looking back over the evolution of this dissertation, several thoughts emerge. Based on the observations made this researcher is still troubled that more of the variance in the dependent variable was not explained by a broader group of independent variables. Despite efforts to evaluate alternative clustering of project set-up activities, no increase in variance was achieved. It appears this study may have been underpowered. There is risk of a type II error occurring, not rejecting the null hypothesis when in fact it is false, in this study (Agresti & Finlay, 1999 and Gliner & Morgan, 2000). Typically the researcher has the most control over sample size in survey research. Increasing sample size often provides the best opportunity to improve power by reducing variability. The risk of a type II error decreases for a set α- level as sample size is increased. Potentially a stronger relationship exists between performance and how often categories of project set-up activities are practiced than is identified in this study. A larger sample may be the key to verifying this. Admittedly sample size is a potential weakness of this study.

A Likert scale was included to rate the importance of each activity in the survey instrument. The original thinking was to revalidate literature in terms of the importance of each activity. One could question whether it was worthwhile including the importance scale in the survey. Eliminating this aspect of the questionnaire from future questionnaires might increase response rate.

Even after creating six composite variables to better manage the number of project set-up activities, there were 11 variables included in the regression equation. After accounting for missing data the sample was reduced to $n = 93$. One would have preferred to have had a larger sample given the number of variables.

Future Construction Planning Research

There are multiple considerations researchers who wish to further study in this topic area might consider. Increasing the response rate in an effort to produce a larger data set to work with should be a high priority, especially in view of the earlier discussion regarding increasing power. In the following section a perspective is provided addressing some of the challenges faced when conducting survey research in this sector. Despite significant efforts to improve the instrument and survey process, the response rate was still marginal. This is especially true when one is specifically targeting senior executives, as was the case in this study. Taking this into account and given the nature of the construction sector, what else can one do to improve response rate? One idea is to explore whether permission could be obtained from an industry association to distribute the questionnaire at a national or regional industry meeting where one has more captive audience. The analogy would be similar to a large classroom setting where students are asked to complete a survey during class time. Another idea that may be worth exploring is contacting one of the national construction industry consulting firms to see if they would grant access to their industry database. Publicly available industry directories did not provide email addresses of key executives, thus eliminating the email option for data collection. Construction industry consultants typically have their own databases and to the extent they are interested in the area of research, they may consider making their database available. Lastly, in populations where response rates may be challenging, researchers sometimes focus solely on one approach to data collection as was the case in this study.

Significant effort was put into the piloting and design of the questionnaire developed for this study. Color graphics were designed for the cover of the questionnaire. Cover letters were placed inside the color cover of the questionnaire to increase "eye appeal." With regard to the financial information section statements were included both in the cover letter and the questionnaire emphasizing that this information could not be identified with a respondent and would be kept confidential. These are just a few examples of key efforts deployed to enhance response rate and quality. This survey instrument may be of value for future studies and would be available with permission.

One weakness identified in the data set was the average project size in dollars. Utilizing the select cases function in SPSS it was determined 79.13% of the respondents had average project sizes less than $2,500,000.00. Twelve respondents reported average project size greater than $5,000,000.00. After segregating these respondents into groups based on project size it was apparent the resulting data sets ($X > 2.5$M and $X > 5.0$M) were not large enough to conduct comparative analysis. Perhaps future surveys will yield larger data sets more broadly distributed in terms of average project size, which may also increase power. Based on a larger data set one might theorize distinct differences would be observed between groups on average project size. Researcher's experience suggests that larger projects typically have more resources available which may result in different project set-up practices being utilized. .

Literature was the basis for both identifying and grouping project set-up activities into categories (see Literature Review chapter). For the most part survey respondents indicated there were no additional project set-up activities that should have been considered for inclusion. In this regard, the literature seemed to have provided good

guidance. Still, some concern exists as how the set-up activities were categorized. This concern stems from the researcher's industry experience and some of the additional analysis (factor analysis) that was performed. Relying on the literature appeared to be the best way to guard against bias, especially given the researcher's long history in industry. However, on reflection, more diligence in this area in future research may yield different results. It is worth noting that after the factor analysis resulted in revised grouping of variables, the new categories established seemed to relate better to each other from a practical standpoint. Cronbach's alphas for these new categories are reported in Appendix F. Future research might consider two options:

1. Re-assessing the categorization of project set-up activities before more thorough analysis is considered.
2. Creating one continuous list of project set-up activities not categorized.

It was deemed important to include a few questions in the survey instrument addressing whether or not the contractor had adequate time to plan and, if not, the reasons for lack of planning time. This potentially is an intriguing area for further research. If one supports the belief that diligent planning during the project set-up phase is important to project success, then study into how key project stakeholders can ensure the availability of adequate time to plan is worthwhile. One should consider this topic not only from the contractor's perspective, but also from the vantage points of the owner and designer. The literature reviewed for this study did not address this perspective.

There may be merit in considering a second stage qualitative component as a follow up to this study. Originally the researcher was considering a mixed method design, but because of employment in the construction private sector it was determined

too many potential conflicts might arise by including a qualitative component. The opportunity to meet with a cross-section of construction industry executives after analysis of the quantitative data, to discuss the findings could prove to be very beneficial. In particular, exploring the challenges encountered during the project set-up phase and more specifically how some of the activities are practiced could provide real insights into which activities are practiced most often and why.

Finally, considerable effort was committed to development of the survey instrument. The questionnaire was rigorously pilot tested. As a result of these efforts, the vast majority of returned surveys were fully completed, including the section requesting financial results. It is also worth noting that no survey was returned with questions or comments concerning a particular section or question. This is a good indication that instructions and wording of questions were clear and concise, enabling participants to respond without any confusion. Also evidence of the quality of data received. The survey instrument could be of value for future work in this subject area. Hopefully these efforts may benefit other researchers in the future.

Views on Survey Research in the Construction Sector

Survey research can be challenging in the private sector of the construction industry. Academics are regularly competing for the industry managers' time with the private sector organizations that also distribute surveys. As a 30-year veteran of the construction industry, I can attest to the reality that seldom a week goes by when some form of survey does not arrive in the mail (postal or email). The vast majority are often thrown away or deleted. A few, for specific reasons, are ultimately completed. Why do

some surveys catch the eye of the recipient while others do not? Certainly, if the topic is of interest, this can overcome even boring packaging of the survey. But what else motivates one to read and potentially get hooked into completing the survey? Several survey texts are cited in this study and each of these texts, among others, offer valuable ideas to increase survey response. What I found largely missing from almost all of these texts is an honest acknowledgement of the differences in approaches and resources the private sector enjoys versus academics conducting survey research. I have observed over the years a distinct difference between surveys from academia and those from the private sector. The private sector surveys generally are multi-color, marketed/advertised well, very polished in appearance as to look and feel, and user friendly. The American Marketing Association (2007) recommends the use of graphics to make the survey experience more visually engaging. They also suggest avoiding "research-ese" language, which can be challenging for academics who are trying to balance higher institution requirements, such as human research requirements/guidelines with making the instrument more appealing. Surveys received from academia generally are less polished (often black and white) and the covers letters often ramble. One would suspect many of the private sector organizations conducting survey research have bigger budget allocations for survey development, administration, and analysis. Some private sector organizations may have access to state of the art software and/or consultants who provide the same for survey design. Private sector organizations that regularly conduct survey research may even have proprietary processes. While I would argue a portion of the private sector survey instruments have not been as rigorously designed and tested to the

standards required by most universities, the private sector recipient is largely unaware or concerned.

Most in academia are required to meet the important standards of Human Subjects Committees (HRC) as directed by federal guidelines. While the purpose and intent of the HRC is critical to assuring no participant is negatively impacted by participating in a study, this requirement relating to the cover letter in particular can be troublesome. Case in point, after adding the "health warning" the HRC required for this study, it added approximately one-half page to the cover letter. The cover letter is a key component in attracting respondents. In survey research that is far removed from the medical or similar fields where physical harm is a risk to a participant, these requirements, when not applied thoughtfully in the cover letter, can diminish survey response and potentially confuse respondents. The competition in the private sector does not have to meet these requirements. Wording must be chosen carefully and having some degree of flexibility from the HRC while still meeting their intent can be crucial. It is my understanding some universities decentralizes the HRC requirements to the school or department level. By doing so faculty closer to the field of study may be in a position to make better decisions as to meeting the intent of human subject review without inadvertently impacting the success of the study.

The days of the black and white typed questionnaire mailed in a standard envelope are numbered. Survey research in the private sector is a competitive environment. Competing for the limited time managers have to complete survey's is likely to only become more challenging. To not understand these challenges when contemplating a survey design would potentially diminish response rates.

Issues Around Publication

. Where to publish is another question routinely presenting a struggle. I conducted this study for two reasons. First, to address a passion about the importance of good planning before one commences construction. Second, some of my findings and learning will find its way to benefit the private sector audience intended. In thinking about publishing my results I am concerned that industry is reached. The dilemma, as many of those who write and publish in construction management and construction engineering fields may have encountered, is that we are very limited in choices of peer reviewed journals. Of the journals available most have limited readership. In fact, I would challenge anyone to find one of these journals on a coffee table in a construction contractor's lobby. The Construction Industry Institute (CII) has the same concern (Hudsen, 1997). CII is a research organization founded in 1983, funded largely by private sector construction companies. In 1987 CII realized that merely publishing their findings was not adequate in reaching the industry audience. To address this issue in 1990 CII expanded their scope to dispense their findings through educational programs. While the efforts of CII are notable, their research appears biased towards large construction contractors. Given CII funding is arguably derived large companies, this bias is to be expected. As pointed out in this study the large contractors represents a small portion of the construction industry sector. The challenge for academic researchers is how we balance the requirement for publishing in peer reviewed journals and still reach a private sector audience? What troubles me the most is that during the last three years while conducting this research I had the opportunity to read many fine articles published in these largely obscure journals. There has been some very good work done that no

doubt could be beneficial to industry. If not for my departure from the private sector and my association with CSU in the PhD program, I would not have been aware of this research. It seems a waste to not more broadly share this information with the industry. I believe most university researchers in the construction field want to reach industry and make an impact with their research. Perhaps stronger higher education/industry relationships focused on sharing and distribution of research finding would help. As an example major trade associations, like the AGC, have education subcommittees. These committees, working with higher education, could potentially create a process to review and distribute research findings. Ideally only articles that have been previously peer reviewed would be considered. Researchers would have to re-write their findings, taking out the "research-ease" language, and targeting for an industry audience. These articles might then be included in a quarterly or bi-monthly magazine directed at industry. If industry finds this publication of value they will financially support this effort. Worst case industry does not take an interest and the effort is terminated. If industry does take an interest in good research presented appropriately it is possible more support will follow including research funding. This could result in a win-win situation for all primary stakeholders in the construction sector.

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APPENDIX A

CATALOG OF RELEVANT LITERATURE

Catalog of Relevant Literature Highlighting the Researcher's Perspective

	Respondents				Study Perspective						Project Phase Focus					
AUTHOR	Study Date	Company Performance	Company Size	Respondent Qualifications	Contractor (Company)	Owner	Designer	Mixed	Other	Procurement	Set-up	Execution	Close-out	Maintain	Mixed	Not Defined
BELASSI & TUKEL	96	NR	NR	NR				X							X	
BRODKORD & MCCOY	86	NR	NR	NR				X							X	
CLELAND	86	NR	NR	NR		X									X	
DE WIT	86	NR	NR	NR				X			X					
GIDADO	04	NR	NR	NR	X						X					
GOBELI & LARSON	86	NR	NR	NR				X								
HUDSON	97	NR	X	NR				X							X	
JASELSKIS	91	NR	X	X	X										X	
JASELSKIS	88	NR	X	NR				X							X	
JOLIVET	86	NR	NR	NR				X				X				
KNAK & IBBS	00	NR	X	NR	X										X	
KOHRS & WEINGARTEN	86	NR	NR	NR				X								
MARTIN & WEBSTER	86	NR	NR	NR	X	X										X
MC COY & BRODKORB	86	NR	NR	NR			X								X	
MORRIS	86	NR	NR	NR				X							X	
MC COY	86	NR	NR	NR				X								
PINTO & SLEVIN	88	NR	NR	NR				X							X	
SALAPATAS	86	NR	NR	NR		X									X	
STUCKENBRUCK	86	NR	NR	NR				X							X	
TORTORA	93	NR	NR	NR				X							X	
TUMAN	86	NR	NR	NR				X								
NOONAN & THAMHAIN	86	NR	NR	NR				X								X

APPENDIX B

DEFININING PROJECT SUCCESS AUTHOR TABLE

AUTHOR	SCHEDULE	COST			TECHNICAL PERFORMANCE	QUALITY	SAFETY	ENTERPRISE STRATEGIC MISSION	CLIENT SATISFACTION	PROJECT FUNCTIONALITY	CONTRACTOR SATISFACTION	PROJECT TEAM SATISFACTION	CONTRACTOR OR COMPANY PROFITABILITY
		OWNER	CONTRACTOR	NON-SPECIFIC									
BELASSI & TUKEL (1996)	X			X	X			X	X	X	X	X	
BRODKORD (1986)	X			X	X			X					
CLELAND (1986)	X	X			X			X					
DE WIT (1986)	X			X	X				X	X	X	X	
GOBELI & LARSON (1986)	X			X	X								
HUDSON (1997)	X			X	X								
JASELSKIS (1988; 1991)	X			X	X						X	X	
JOLIVET (1986)	X			X	X								
KOHRS & WEINGARTEN (1986)	X			X	X								
NORRIE & WALKER (2004)	X			X	X								
MACKIE (1986)	X			X	X								
MARTIN & WEBSTER, (1986)	X			X	X								X
MC COY (1986)	X			X	X								
MORRIS (1986)	X			X									
NOONAN & THAMHAIN (1986)	X			X	X			X					
PINTO & SLEVIN (1988)	X			X	X			X	X	X			
SALAPATAS (1986)	X	X			X								
STUCKENBRUCK (1986)	X			X	X			X	X		X	X	X
TOTORA (1993)	X			X									
TUMAN (1986)	X	X	X		X			X	X	X	X	X	X

APPENDIX C

QUESTIONNAIRE

Construction Project Set-up

Your answers are important for the success of this study and the advancement of industry. Please answer all questions to provide the benefit of your perspective.

Demographics - Company

► **What type of heavy civil construction does your company most often perform?**

- ☐ Concrete Paving
- ☐ Bridges/Structures
- ☐ Asphalt Paving
- ☐ Underground Utilities
- ☐ Earthwork
- ☐ Most of the above

► **How many years has your current employer been in business?** _____ years

Demographics - Respondent

The following questions relate to the individual completing this questionnaire.

► **What is your position at your current employer?** (circle one)

President and/or CEO	Senior Executive	Operations Manager	Estimating Manager	Project Manager	Project Superintendent	Oth

► **How many years of experience do you have in your current position?** ____years

► **How many years have you been employed with your current employer?**___ years

► **How many total years of construction experience do you have?** ___ years

► **What is the highest level of education you have completed? (select one)**

- ☐ Did not finish high school
- ☐ High School Degree/Diploma/ GED
- ☐ Vocational Training Program
- ☐ Associate's Degree
- ☐ Attended College but did not graduate
- ☐ Bachelor's Degree
- ☐ Attended Graduate School but did not earn a degree
- ☐ Graduate Degree

► **If you completed a <u>Bachelor's Degree</u> what field of study was your degree in?**

- ☐ Construction Management
- ☐ Civil Engineering
- ☐ Engineering Other (Mechanical, Chemical, Electrical, etc)
- ☐ Business
- ☐ Architecture
- ☐ Other – *Please list:* _____

Financial

The following questions address your company's recent financial performance. **Reporting financial results are critical to this study.** The financial results you are providing will be kept strictly confidential. The researchers cannot identify the financial results reported below with your company.

► Please provide financial results for all shaded areas in the following financial table:

	Most Recently Completed Fiscal Year	**Average for Last Five Years**
Earnings (profit) before interest and tax [EBIT]		
Revenues [sales]		
Number of projects		

► **How would you define superior operating profit [Earnings before interest and tax also referred to as EBIT] as a percentage of revenues in the heavy civil construction sector?**

☐ less than 2%
☐ 2% ~ 4%
☐ 5% ~ 7%
☐ 8% ~ 10%
☐ greater than 10%

Project Set-Up Activities

The next section specifically addresses project set up activities [also known as pre-planning and/or pre-construction activities] at your company.

► **First please rate each activity as to its importance during project set-up at your company (on the left) and then indicate how often it is practiced (on the right). Please circle your choices.**

PROJECT GOALS AND OBJECTIVES

Importance (Low ◄——► High)						How often do you practice this activity? (circle one for each activity)			
1	2	3	4	5	Project expectations/vision established	Never	Seldom	Usually	Alwa
1	2	3	4	5	Project financial expectations established	Never	Seldom	Usually	Alwa
1	2	3	4	5	Schedule milestones established	Never	Seldom	Usually	Alwa
1	2	3	4	5	Expectations for project organization established	Never	Seldom	Usually	Alwa
1	2	3	4	5	Project scope defined	Never	Seldom	Usually	Alwa

SYSTEMS AND CONTROLS

Importance (Low ◄——► High)						How often do you practice this activity? (circle one)			
1	2	3	4	5	Project meeting frequency established	Never	Seldom	Usually	Alwa
1	2	3	4	5	Quality control plan established	Never	Seldom	Usually	Alwa
1	2	3	4	5	Project safety plan established	Never	Seldom	Usually	Alwa
1	2	3	4	5	Schedule for cost to complete analysis to be periodically completed	Never	Seldom	Usually	Alwa
1	2	3	4	5	Standardized project management/administration procedures established	Never	Seldom	Usually	Alwa
1	2	3	4	5	Standardized communication procedures	Never	Seldom	Usually	Alwa
1	2	3	4	5	Project job cost control tracking systems utilized	Never	Seldom	Usually	Alwa

RISK/OPPORTUNITY PROJECT DUE DILIGENCE *(Completed before project construction start)*

Importance (Low ◄——► High)						How often do you practice this activity? (circle one)			
1	2	3	4	5	Project team re-bids project – confirms original bid estimate	Never	Seldom	Usually	Alw
1	2	3	4	5	Project team completes in-depth review of contract documents	Never	Seldom	Usually	Alw
1	2	3	4	5	Project risks identified	Never	Seldom	Usually	Alw
1	2	3	4	5	Project risk mitigation action plan established	Never	Seldom	Usually	Alw
1	2	3	4	5	Project opportunities identified	Never	Seldom	Usually	Alw
1	2	3	4	5	Plan established to capitalize on perceived project opportunities	Never	Seldom	Usually	Alw
1	2	3	4	5	Re-engineer means and methods for possible improvements	Never	Seldom	Usually	Alw
1	2	3	4	5	Assess project uniqueness	Never	Seldom	Usually	Alw
1	2	3	4	5	Assess technical difficulty	Never	Seldom	Usually	Alw

MEANS AND METHODS PLANNING BEFORE CONSTRUCTION STARTS

Importance (Low ◄——► High)						How often do you practice this activity? (circle one)			
1	2	3	4	5	Project schedule developed	Never	Seldom	Usually	Alw
1	2	3	4	5	Subcontractor schedules identified	Never	Seldom	Usually	Alw
1	2	3	4	5	Production goals established for major items of work	Never	Seldom	Usually	Alw
1	2	3	4	5	Work package breakdown established	Never	Seldom	Usually	Alw
1	2	3	4	5	Long lead items identified	Never	Seldom	Usually	Alw
1	2	3	4	5	Site plan established	Never	Seldom	Usually	Alw
1	2	3	4	5	Planning for maximum production	Never	Seldom	Usually	Alw

PROJECT TEAM SELECTION *(Note –In items pertaining to the project manager, if your organization uses the term/position "project superintendent" or another similar title in lieu of "project manager" please consider these items as if worded for this alternative position).*

Importance (Low ◄——► High)						How often does this happen? (circle one for each activity)			
1	2	3	4	5	Project manager has relevant project experience	Never	Seldom	Usually	Alw
1	2	3	4	5	Project manager has high level of commitment to project	Never	Seldom	Usually	Alw
1	2	3	4	5	Project manager has adequate time available for project	Never	Seldom	Usually	Alw

Importance (Low ◄——► High)					*The following items relate to the selection of the other project team members and include positions such as project engineer, project supervisors, etc.*	How often does this happen? (circle one for each activity)			
1	2	3	4	5	Project manager has relevant experience	Never	Seldom	Usually	Alw
1	2	3	4	5	Project team stability (likely to be employed through duration of project)	Never	Seldom	Usually	Alw
1	2	3	4	5	Project team motivated – strong project buy-in	Never	Seldom	Usually	Alw
1	2	3	4	5	Project team is adaptable to changing situations	Never	Seldom	Usually	Alw
1	2	3	4	5	Project team members actively involved in pre-construction planning	Never	Seldom	Usually	Alw
1	2	3	4	5	Plan for project team morale in place	Never	Seldom	Usually	Alw
1	2	3	4	5	Planning for team building activities	Never	Seldom	Usually	Alw
1	2	3	4	5	Project team atmosphere	Never	Seldom	Usually	Alw

ORGANIZATIONAL SUPPORT ***(Defined as support from company and management to project team during planning stage)***

Importance (Low ◄——► High)						How often does this happen? (circle one)			
1	2	3	4	5	Senior management commitment	Never	Seldom	Usually	Alw
1	2	3	4	5	Human resource support (personnel support)	Never	Seldom	Usually	Alw
1	2	3	4	5	Reliable project information systems	Never	Seldom	Usually	Alw
1	2	3	4	5	Organization past experience relevant to project	Never	Seldom	Usually	Alw
1	2	3	4	5	Functional manager support (Manager support from accounting, HR, Equipment/maintenance etc.)	Never	Seldom	Usually	Alw
1	2	3	4	5	Open/honest communication flow between project and company head office	Never	Seldom	Usually	Alw

► **Do you typically have adequate time to plan projects before physical construction starts?**

☐ Yes ☐ No

If "no", what is the primary reason that prevents you from having enough time for planning construction?

☐ Owner has a quick construction start date.

☐ Project team still completing another project, and therefore only has limited availability for planning.

☐ Other:

_____

► **Would you delay the physical construction start date to allow more time for planning the project if you feel there is a need?**

☐ Yes ☐ No

► **Are there any project set-up activities not addressed in the items above that you would add to make this characterization of set-up activities more complete?**

☐ Yes ☐ No

If yes, please list the project set-up activities.

_____

_____

_____

_____

_____

If you would like a free copy of the study results please don't forget to email us at the address listed in the cover the letter.

Thank you again for investing the time to complete this survey.

APPENDIX D

SURVEY INTRODUCTION LETTER

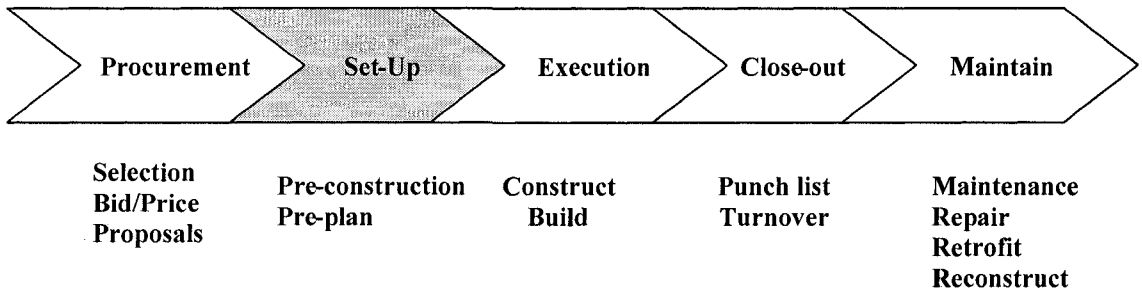
Subject: How Differences in Heavy Civil Project Set-up Practices Impact Project Success

Dear _____:

An unknown contractor once remarked that not properly planning for construction would be like flying an airplane without an instrument panel. That is why some industry leaders feel strongly that the **pre-construction planning phase** of a project may be the most important phase in impacting project performance. Past research has indicated that planning for successful construction can be difficult to implement and is sometimes overlooked by contractors. Your input is essential in assisting the Construction Management Department, at Colorado State University, investigate what top performing civil construction companies do differently during the pre-construction planning phase of a project.

This phase will be referred to as the "project set-up phase" in this survey.

Construction Phases



This research seeks to consider the **heavy civil sector** of the construction industry from the construction contractor's perspective. Therefore, only contractors who routinely perform work in the following construction areas should complete this survey:

- Highway construction
- Heavy civil construction
- Heavy engineering projects

We estimate this survey can be completed in 10 to 20 minutes. Ideally, a senior executive in the organization should complete this survey. Your response will be kept strictly confidential. The researchers, from your responses on the enclosed questionnaire, cannot identify you or your company. There are no known risks associated with participation in this study. If you have any questions about your rights as a volunteer in this research, contact Janell Meldrem, Human Research Administrator, Colorado State University, at
970-491-1655.

The goal of this research is to advance construction education both to students and industry by understanding better what makes a construction company a top performer. Your participation in completing this survey is entirely voluntary. Please direct any questions concerning the actual survey to:

Dr. Larry Grosse
Department Head
Construction Management Department
Colorado State University
970-491-7958

A copy of a summary of the results will be made available to all respondents. You can request a copy of the results by sending us an email at CMinfo@cahs.colostate.edu indicating 'send summary of Construction project set-up study' in the subject line. No additional message is needed. The summary of results will be emailed upon completion of the study.

For your convenience a self-addressed, stamped return envelope is included. We understand your time is valuable, and greatly appreciate the time you have taken to share your perspectives. Your contribution and that of your peers across the country will help Colorado State University and other institutions better serve its construction management students and the industry. Thank you in advance for taking the time to complete this survey.

Best regards,

Dr. Brian Cobb
Principal Investigator

APPENDIX E

HUMAN RESEARCH APPROVAL

From: Meldrem,Janell [Janell.Meldrem@Research.ColoState.edU]

Sent: Monday, July 17, 2006 4:35 PM

To: Bill Yearsley

Cc: Cobb,Brian

Subject: RE: human research,PI Brian Cobb, How Differences in Heavy Civil Project Set-up Practices Impact Project Success

Your project, How Differences in Heavy Civil Project Set-up Practices Impact Project Success, has been approved as of July 17, 2006 with the condition that the approved cover letter is used. The approval is for a maximum of 2,000 survey participants. The HRC ID is 06-145H.

The approval is being processed and will be sent in the next several days.

* *

Janell Meldrem
HRC Administrator
321 General Services Building
Colorado State University
Fort Collins, CO 80523-2011
970-491-1655
FAX: 970-491-2293
http://www.research.colostate.edu/rcoweb/

APPENDIX F

INTERNAL CONSISTENCY RELIABILITY TABLE

Internal Consistency Reliability with Cronbach's Alpha of Revised Project Set-up Categories from Supplementary Analysis

Variable Category	Cronbach Alpha
Importance project controls established	.743
Importance project goals established	.820
Importance risk analysis completed	.695
Importance project team selection/morale	.848
Importance senior management commitment	.554
Importance project manager selection	.647