Conceptual Planning Process for Electrical Construction

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Abstract: The competitive nature of the construction industry has motivated many specialty contractors to search for ways to improve efficiency by increasing their quality and decreasing their costs in order to strengthen their market share. As a result, contractors are turning to "better planning" as a method for improving their efficiency and, consequently, increasing their profitability. In fact, a consensus exists in the construction industry that more formalized *preconstruction planning* is necessary to remain successful in an increasingly competitive industry. This paper presents a model electrical preconstruction planning process that was crafted from outstanding processes used on several successful electrical projects. Furthermore, a method to evaluate the effectiveness of planning, by comparing *actual* planning to the *model* process, is briefly introduced. From this assessment, "effective planning" was correlated to project outcome, and evidence is provided that better planning is, indeed, related to successful performance.

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Introduction

The importance of planning is unmistakable given the challenges faced by a very competitive construction market. These challenges include reducing costs, improving labor productivity, minimizing changes, and maximizing resources in order to remain competitive in today's construction industry. These challenges are intensified by increasingly tight timelines and more complex projects that test the management capabilities of even the best companies. As a result of these trying times, project planning is experiencing renewed attention. Among the many questions that are arising from this re-energized interest in planning are:

- What *is* planning?
- What steps should be followed when we plan?
- What activities should be performed when we plan?
- How will planning improve a project's performance?

Project planning involves determining a course of action by establishing milestones, selecting alternatives, and making decisions. Kerzner (1989) states that planning must be systematic, flexible, iterative, and must be performed throughout the life of the project. Specifically, preconstruction planning, which is the focus of this paper, is defined by Oglesby et al. (1989) as "setting down procedures in detail about who, what, why, how, when, and where; and it is done well in advance of the time when particular tasks are to be undertaken." Preconstruction planning, from a contractor's point of view, may include reviewing plans, developing a schedule, preparing a tracking system, developing a site layout sketch, and preparing numerous written procedures that prepare the project team to run an efficient job.

Need for Model Preconstruction Planning Process

Project planning has been in and out of the spotlight for the past 35 years. In the 1970s and early 1980s, project planning was included in several textbooks as part of the project management and control processes (Kerzner 1989; Oglesby et al. 1989). During the late 1980s and early 1990s, Laufer published several independent studies on construction project planning (Laufer and Cohenca 1986; Laufer and Tucker 1987; Laufer et al. 1993). And, throughout the 1990s, Gibson conducted numerous research projects on owner project planning (Gibson et al. 1993; Gibson and Hamilton 1994). More recently, Gigado (2004) completed a study that presented a "systemic approach" to planning that can standardize and improve the prime contractor's preconstruction planning process. Gigado's proposed model provides a "best practice" approach to the prime contractor's preconstruction planning process.

In general, relatively few studies on planning have been produced since the late 1990s. Yet, a consensus exists throughout the construction industry that better, more formalized planning is necessary to stay competitive in an increasingly aggressive industry. In fact, one professional association has stated:

> The lack of preconstruction planning is surely the greatest failure of contractors in the entire construction industry… The greatest benefits of preconstruction planning are the project control and organization that lead to increased productivity, fewer accidents, and increased profitability" (Plumbing-Heating-Cooling Contractors (PHCC) National Association 2002).

There is a clear trend toward formalizing the construction planning process. Consequently, the purpose of this paper is to

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present a model electrical preconstruction planning process that was crafted from outstanding processes used on several successful electrical projects. In addition to developing a model planning process that can, and should, be implemented on electrical construction projects, evidence is provided to support the theory that better planning contributes to better project performance. A method is briefly introduced, which evaluates the effectiveness of project planning that has occurred on a project by comparing the *actual* planning to the *model* process. From this assessment, "effective planning" can be correlated to successful project outcomes.

Method Used to Develop Model Planning Process

Sampling Plan

The goal of the research was to develop a model preconstruction planning process that was based on projects that were well-planned and performed well, and then to quantify the correlation between "effective planning" and project performance. Therefore, a rigorous sampling plan was developed. The primary objective of the sampling plan was to select approximately 25 companies who would respond to a questionnaire and participate in an interview about the planning activities performed on two recently completed projects—one "successful" and one "less than successful." This resulted in a minimum sample size (n) of 50 projects for analysis. The size of the sample was driven largely by cost. Because the data collection process included conducting face-to-face interviews with all participants, cost was a significant factor in the development of the sampling methodology.

Due to the stringent cost considerations, a two-stage random sampling process was used because of its practical economic advantage over simple or stratified random sampling. In the first stage of two-stage sampling, electrical contractors, who were also members of the National Electrical Contractors Association (NECA), were divided into 13 groups based on NECA regional districts. Seven regions were selected randomly using a random number generator. In the second stage of two-stage sampling, approximately four companies were randomly selected from within the seven randomly selected regions, to form a sample size of approximately 28 potential participants. While each selected company within each of the seven regions was invited to participate in the study, some companies declined. These companies were replaced by other randomly selected companies that agreed to participate.

Overall, planning and performance data were collected from 27 willing NECA companies, who provided usable data on 55 projects. Each participant completed a questionnaire and participated in a 4-hour interview about the planning and performance of their submitted project. The questionnaire, which was mailed to participants before the interview, focused on project performance in terms of budget achievement, profitability, on-time completion, and teamwork. The interview, which was conducted in person, focused on the planning activities and activity sequence used to plan projects. The interview was open ended, and the researcher wanted to learn about the *specific* activities used by each interviewee on their "successful" or "less than successful" project. Hence, contractors were asked to describe the planning they performed on their project, starting with the process they used for bid preparation and proceeding through the completion of planning, which generally occurred shortly after execution.

Modeling Methodology

The modeling process involved identifying all activities performed as part of each project's planning process and also identifying a rough sequence in which each activity was performed. The activities were assigned standardized sequence scores to represent whether an activity was performed during the prebid (1.X), preconstruction (2.X), or postexecution (3.X) stage of planning. The sequence scores for each project were then numbered sequentially, so that 1.1, 1.2, 1.3, etc. represented the first, second, and third activities performed during the prebid stage. Likewise, 2.1, 2.2, 2.3, etc. represented the first, second, and third activities performed during the preconstruction stage, and so on. Overall, 123 activities were recorded for potential inclusion in the model planning process.

The process to select activities for the model preconstruction planning process had four sequential stages: (1) data analysis using cross tabulations and correlations to determine the difference in performance of the activities on "successful" and "less than successful" projects; (2) construction of a model planning process based on the planning activities performed by projects that had successful outcomes; (3) initial evaluation of each project in the data set using a scorecard to determine how closely the "successful" and "less than successful" projects matched the model process; and (4) correlation between "model match" and outcome.

Research Limitations

The results of this study are limited to projects that: (1) are performed by union contractors who are members of NECA; (2) ranged in work hours from 600 to 265,000 h; (3) ranged in contract value from \$60,000 to \$23 million; and (4) ranged in duration from 12 to 250 weeks. Caution should be exercised when evaluating projects with; (1) work hours less than 1,000 or greater than 75,000 h; (2) contract values less than \$140,000 or greater than \$10 million; and (3) a duration longer than 110 weeks. Very little data were available in these marginal ranges. The size of the sample is also noted as a potential research limitation. A larger sample size (additional projects) might have permitted further refinement of the model planning process.

Development of Conceptual Planning Process

Selection of Activities for Model Planning Process

The activity selection process involved identifying significant differences between *performance* and *nonperformance* of each recorded activity by the "successful" and "less than successful" projects. Each project's planning process was coded with a series of 0s and 1s, where 0 indicated that an activity was *not performed* and 1 indicated an activity *was performed* as part of the project's planning process. Cross tabulations were executed to identify significant differences in activity performance, and correlations were calculated to identify the relationship between activity performance and project outcome. Activities were chosen for inclusion in the model preconstruction planning process if the following criteria were met:

1. Significantly more *successful* projects performed the activity than *less than successful* projects (p value ≤ 0.05); or
2. The activity was performed frequently by both *successful*

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Table 1. Excerpt from Spreadsheet Coded for Significant Cross-Tabulations and Correlations

Act number	Activity	Cross-tabulation codes[a]	Correlation codes[b]
ACT_1	Select team members (PM, foreman, subs, suppliers, etc.)	3	0
ACT_2	Develop planning responsibility matrix	6	0
ACT_3	Conduct formal turnover/ planning kickoff meeting for project	6	0
ACT_4	Review plans and specifications after award	1	2
ACT_5	Review specifications for quality requirements	3	1
ACT_6	Create list of "unknown" information/begin RFI process	1	2
ACT_7	Convert "unknown" to "known" information	6	0
ACT_8	Compare est. (bid) work activities and materials to planned performance	1	2

[a]Cross-tabulation codes: 1=signif. more frequently performed by successful; 2=mod. more frequently performed by successful; 3=frequently performed by both; 4=signif. more frequently performed by less-than-successful; 5=mod. more frequently performed by less-than-successful; 6=not frequently performed by either.

[b]Correlation codes: 0=not correlated; 1=mildly correlated ($0.05 < p < 0.10$); 2=strongly correlated ($p < 0.05$).

and *less than successful* projects (frequency of performance was greater than 50%); or

3. There was a strong correlation between activity performance and outcome (p value ≤ 0.05), where performance of the activity resulted in a positive outcome.

Table 1 presents an excerpt from a spreadsheet that has been coded for activity significance. If activities were moderately significant or had a moderate correlation between activity performance and outcome ($0.10 \geq p$ value > 0.05), the activity was included in the model as *recommended for performance*. However, these *recommended* activities were not included in future data analyses; only the *significant* activities were used to evaluate the relationship between planning and performance. The *recommended* activities are shown in the process model diagram (indicated by an "*R*" following the activity number in Table 2) to acknowledge that they are moderately significant and might warrant future study, and therefore, contractors should consider performing these activities if resources are available to do so. Overall, 73 activities were included in the model process, and of those, 64 were significant and were used to correlate planning to performance.

Sequence of Activities in Model

An initial examination of the data revealed that many of the activities occurred in approximately the same sequence on all of the projects. Therefore, it was felt that calculation of an average sequence number for each activity would be a useful method for identifying an approximate sequence of activities in the model planning process. The activity sequence numbers were summed and averaged across the projects, and then the activities were sorted in ascending order to evaluate the rough sequence of the activities. This numeric procedure was used in conjunction with a qualitative procedure that involved examining each project's planning process and sequence of activities. To perform the qualitative examination, a separate worksheet was developed for every project that listed only the activities performed as part of the project's planning process. The activities were ordered by the sequence they were performed, and then all of the worksheets were examined carefully to identify trends in the activities performed and their sequence of performance. Through an iterative examination process, a framework was sketched out that captured the sequential relationship among activities. The results from the qualitative analysis were compared to the numeric sorting of activities in the quantitative analysis to evaluate differences between the sequencing. There was remarkable agreement between the two methods, which provided a degree of confidence that the proper sequence had been developed. The model preconstruction planning process is presented in Table 2, and the framework is identified in Fig. 1.

Stages of Model Planning Process

During the interview process, and subsequently during the analysis process, it became clear that the preconstruction planning process actually began during bidding and continued briefly through construction execution. The model preconstruction planning process reflects this three-stage composition, and the three stages of planning were identified as: (1) bid preparation planning; (2) preconstruction planning; and (3) jobsite management planning.

Bid Preparation Planning

Planning for a project initially begins during the bid preparation stage, as a project manager or estimator begins to review the contract documents in order to estimate the time, materials, labor, overhead, and overall cost to complete the work. The main goal of bid preparation planning is to do sufficient planning to accurately estimate the cost of the work, while also preparing a project to enter the postaward/pre-execution stage.

Ten significant bid preparation planning activities were identified, and two additional activities were highly recommended for performance. These twelve activities (shown in Table 2) could be further divided into five categories of bid planning, including: (1) scope review, (2) schedule review, (3) management team selection, (4) cost estimating, and (5) bid submission.

Preconstruction Planning

Preconstruction planning generally occurs after the contractor has been notified of a pending award. One of the first steps to preconstruction planning is to transfer the planning that was performed, and knowledge that was gained, during the bid preparation planning stage over to the preconstruction stage. The main goal of preconstruction planning is to prepare a project for successful execution. Consequently, most of the planning should occur immediately following a notice of award and should be essentially complete before physical construction begins.

Forty two significant preconstruction planning activities were identified, and four additional activities were highly recommended for performance (Table 2). These 46 activities could be further divided into ten categories of preconstruction planning, including: (1) team selection and turnover, (2) scope and contract review, (3) administrative setup, (4) buyout process, (5) material

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Table 2. Conceptual Preconstruction Planning Process

Stage	Activity category	Act number	Activity
Bid preparation	Scope review	1	Review plans and specification for project requirements
		2-R	Conduct site visit (*performance recommended*)
		3	Create a list of questions that need to be answered or issues that need to resolved before submitting bid
	Schedule review	4	Review customer's schedule and timeline
Management team selection		5	Think about and tentatively select project manager and field supervisor
Cost estimating		6	Prepare quantity takeoff
		7	Develop bill of materials
		8	Solicit pricing from subcontractors/suppliers/vendors
		9	Determine estimated work hours
		10-R	Establish est. crew size, labor ratios, and/or average labor rates (*performance recommended*)
		11	Develop cost code scheme
	Bid submission	12	Prepare scope letter or proposal and submit to customer
Preconstruction planning	Team selection and turnover	13	Finalize selection of project manager, field supervisor, and other key team members
		14	Hold turnover meeting between estimator and project manager (when applicable)
		15	Hold separate turnover meeting between project manager and field supervisor
		16	Hold prejob (planning) kickoff meeting with internal team members to assign responsibilities
	Scope and contract review	17-R	Review contract for unfavorable or high risk clauses (*performance recommended*)
		18	Project manager reviews plans, specifications, and schedule
		19	Field supervisor reviews plans, specifications, and schedule
		20	Create a *list of issues* that need to be resolved and begin the request for information (RFI) process
		21-R	Conduct site visit (*performance recommended*)
		22	Compare estimated (bid) work activities and materials to planned performance
		23	Identify value engineering and prefabrication opportunities and how to simplify the work
		24	Prepare construction takeoff
	Administrative setup	25	Set up project files and create contact list
		26	Set up computerized tracking and control system (forms, database, schedule, tracking)
		27	Initiate a change management system
		28	Initiate a request for information (RFI) tracking and processing system
		29	Initiate a submittal tracking and processing system
		30-R	Develop a "labor requirements/expectations" letter (for background check, etc.) (*performance recommended*)
	Buyout process	31	Review subcontractor/supplier/vendor pricing and qualifications
		32	Negotiate pricing and contract conditions and select subcontractors/suppliers/vendors
		33	Develop and issue purchase orders and contracts for materials and equipment
		34	Order long-lead-time materials and equipment
		35	Request submittals, cut sheets, and shop drawings
		36	Develop and process log and book of submittals, cut sheets, and shop drawings
Preconstruction planning	Material handling plan	37	Develop material delivery and handling plan
		38	Develop material storage and staging plan
	Budget prepartion	39	Develop, review, or expand cost code scheme
		40	Develop budget by breaking down labor, material, overhead, and profit costs
		41	Develop schedule of values
	Layout and sequencing plan	42	Develop installation sequence and layout drawings
		43	Develop field instructions, including panel, pull, or conduit schedules
		44	Develop prefabrication drawings for field use (when applicable)
	Schedule development	45	Review customer's schedule and timeline
		46	Identify work that impacts electrical activities
		47	Review the work sequence and long-lead-time material/equipment delivery dates
		48	Coordinate electrical schedule with the customer's schedule

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Table 2. (*Continued.*)

Stage	Activity category	Act number	Activity
		49-R	Create a bar chart schedule (*performance recommended*)
	Tracking and control	50	Customize the computerized tracking and control system (database/schedule/etc.) for the current project
		51	Develop labor and materials tracking report
	Construction execution kickoff meeting	52	Review meeting schedule
		53	Review request for information (RFI) process
		54	Review change order process and field change management process
		55	Review submittal processing procedure
		56	Review billing and invoicing procedures
		57	Review project and field reporting and tracking procedures
		58	Review electrical and customer schedules
Jobsite management planning	Mobilization	59	Mobilize and set up the jobsite (trailer, telephones, water, first aid, etc.)
	Administrative setup	60	Set up field files, document control system, and as-built record keeping
		61	Customize the computerized tracking and control system (database/schedule/etc.) for the current project
		62	Review customer coordination meetings schedule
	Scheduling and reporting	63	Review or establish look-ahead scheduling process
		64-R	Review daily reporting requirements (*performance recommended*)
		65-R	Establish/review subcontractor start and finish dates (when applicable) (*performance recommended*)
		66-R	Identify tools/special tools and equipment requirements (*performance recommended*)
	Labor management plan	67	Evaluate and plan crew size or crew mix
		68	Forecast weekly crew requirements
		69	Develop labor hours reporting process
	Installation procedures	70	Prepare or provide crews with layout/installation drawings and field instructions
		71	Prepare or provide crews with prefabrication instructions (when applicable)
	Safety procedures	72	Review company safety plan, procedures, lessons learned, and OSHA requirements
		73	Schedule weekly safety meetings with the crews

handling plan, (6) budget preparation, (7) layout and sequencing plan, (8) schedule development, (9) tracking and control, and (10) construction execution kickoff meeting.

Jobsite Management Planning

Although the bulk of the planning occurs during the preconstruction stage, some of the planning carries over into the execution stage and primarily involves preparing the jobsite for effective execution and management of on-site operations. Hence, jobsite management planning occurs after the project has been executed but should be completed within two months following the start of physical construction (Laufer et al. 1993). The main goal of jobsite management planning is to plan for the operational management of on-site activities, including physical installation, crew scheduling, and safety.

Eleven significant jobsite management planning activities were identified, and three additional activities that were highly recommended for performance (Table 2). These 14 activities could be further divided into six categories of jobsite management planning, including: (1) mobilization, (2) administrative setup, (3) scheduling and reporting, (4) labor management plan, (5) installation procedures, and (6) safety procedures.

Assessment of Planning Effectiveness

The effectiveness of a project's planning process, which is the key to successful project performance, can be assessed by: (1) comparing the planning activities that were *actually* performed to those that *should* have been performed; and (2) determining whether each activity was performed at the proper time (i.e., during bidding, after award, or after execution). Consequently, the effectiveness of a planning process can be evaluated by determining how closely the actual planning process matched the model planning process, where the model represents the "ideal" set of activities. Furthermore, the following theory about the relationship between "closeness-of-fit" and project performance was developed:

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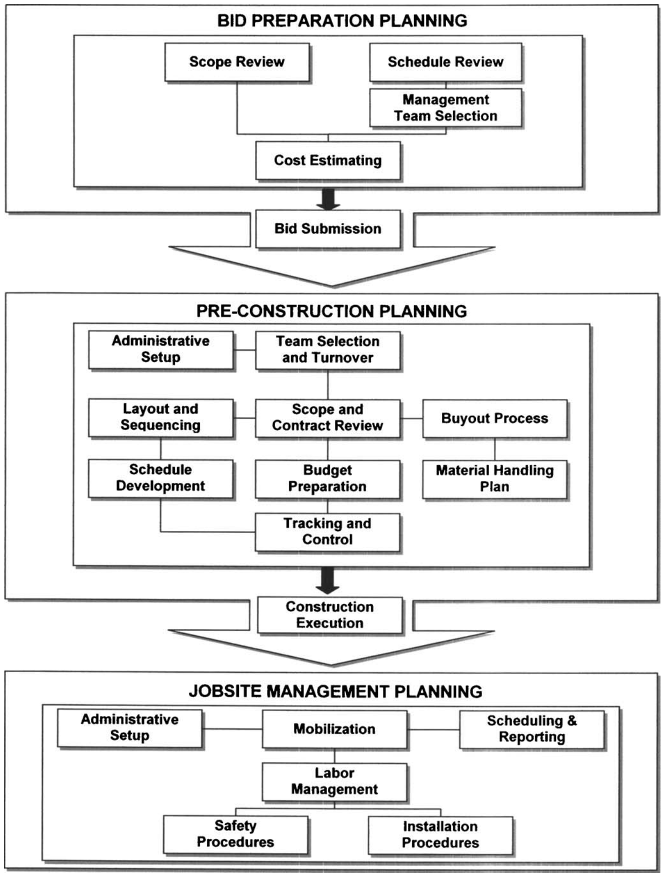

Fig. 1. Conceptual preconstruction planning process framework

"Projects that implement a preconstruction planning process that closely matches the model process will perform more successfully than projects that do not implement a planning process similar to the model."

Development of Planning Effectiveness Scorecard to Assess Planning

The questionnaire provided the following instructions to contractors: "…the project you select for this survey should be considered 'successful' primarily because of its outstanding planning effort." Consequently, the "outstanding planning effort" was determined subjectively by the project manager. Hence, a method was needed to assess "outstanding planning effort" in a quantitative way. One way to evaluate each project's planning process was to determine how closely the project's process matched the model process and then to correlate the degree of "match" with successful performance, where a closer match to the model was viewed as more effective planning. Recall that the model process was constructed from those projects that were planned well and performed well. Therefore, it was anticipated that those projects that closely matched the model planning process also performed more successfully.

The planning effectiveness scorecard was developed as a tool to evaluate how closely a project's actual planning process matched the model planning process. Sanvido (1988) used a similar concept in order to evaluate a theoretical model of the conceptualized management functions that support jobsite operations. In Sanvido's study, he developed a *conceptual construction process model* and created a simple worksheet to record whether the management functions were performed at the right *level*, such as craftsman level, superintendent level or project manager level. He then assigned each function a score based on when it was performed, with functions performed at a lower level than optimum considered as suboptimized and functions performed at a higher level than optimum considered as overcontrolled. He then created an index to represent how closely a project's management functions matched the model process and was able to demonstrate that projects that closely matched the model achieved better cost and schedule performance.

A similar process was used to assess the closeness of fit between actual planning processes and the model process developed through this research. The model electrical preconstruction planning process was used as the framework for creating a planning effectiveness scorecard. The first step to filling out the scorecard involved comparing a project's actual planning process to the model process and then recording the project's activity performance on the scorecard using a "model match" number. The model match number was an ordinal number (0–1) to indicate whether an activity was performed at the optimal time using the following scale: activity performance: 1.00=activity was performed at the proper model stage; 0.75=activity was performed earlier than the model; 0.50=activity was performed one stage later than the model; 0.25=activity was performed two or more stages later than the model; and 0.00=activity was not performed.

Using this scale, a higher number assigned for each activity in the model represented a closer fit to the model. This process of scoring projects based on whether the activities were performed at the proper stage of planning—or not at all—provided a way to assess the "outstanding planning effort" of the projects in the data set and to distinguish those with higher overall scores (to indicated better planning) from those with lower overall scores (to indicate poor planning). A perfect model match would receive a total summed match score of 64 ($1\times64=64$), while a summed score of 0 would indicate that none of the activities were performed. Table 3 presents an excerpt from the planning effectiveness scorecard and the model match numbers for a new sample project (6-L).

Correlation between Effective Planning and Project Performance

The correlation between each project's summed model match score and project outcome (1=successful and 0=less than successful) was calculated using Spearman's rho, and the results showed a correlation of 0.75, which was significant at the $p<0.000$ level (Table 4). Likewise, a graph plotting the summed model match score against project outcome supported the theory that higher model match scores (indicating a closer match to the model) correlated to projects with more successful outcomes (indicating better performance) (Fig. 2), which signifies that more effective planning contributed to more successful outcomes. Furthermore, the median number of planning activities performed by the successful performers was 42, while the median number performed by the less than successful performers was 24.

Individual correlations between planning effectiveness and various performance factors were also examined. Specifically, the correlation between the summed model match score and percent profit was calculated using Spearman's rho, and the results showed a correlation of 0.44, which was significant at the $p<0.001$ level, indicating that more effective planning might

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Table 3. Excerpt from Planning Effectiveness Scorecard for Project 6-L

Activity category	Act number	Activity	Score: Project 6-L
Scope review	Act 01	Review plans and specifications for project requirements	1.00
Scope review	Act 02	Conduct site visit (*performance recommended*)	0.00
Scope review	Act 03	Create a list of questions that need to be resolved before submitting bid	0.00
Schedule review	Act 04	Review customer's schedule and timeline	1.00
Management team select	Act 05	Think about and tentatively select project manager and field supervisor	1.00
Cost estimating	Act 06	Prepare quantity takeoff	1.00
Cost estimating	Act 07	Develop bill of materials	1.00
Cost estimating	Act 08	Solicit pricing from subcontractors/suppliers/vendors	1.00

Note: Match scores: 1.00=activity was performed at the proper model stage; 0.75=activity was performed earlier than the model; 0.50=activity was performed one stage later than the model; 0.25=activity was performed two or more stages later than the model; and 0.00=activity was not performed.

contribute to greater profitability. Likewise, a correlation between the match score and percent change in work hours yielded a value of −0.50, which was significant at the $p<0.000$ level, indicating that more effective planning might be a factor in a smaller change in work hours. Furthermore, the correlation between the match score and percent schedule growth yielded a value of −0.25, which was significant at the $p<0.06$ level, indicating that more effective planning might contribute to smaller schedule growth or creep.

These correlations provide evidence that projects that used a planning process similar to the model planning process tended to outperform those projects whose planning process was poorly matched to the model.

Table 4. Correlation between Summed Model Match Score and Project Outcome

		Summed model match score	Project outcome
Correlation	Summed model	1	0.750
Sig. (2-tailed)	match score	—	0.000
Correlation	Project	0.750	1
Sig. (2-tailed)	outcome	0.000	—

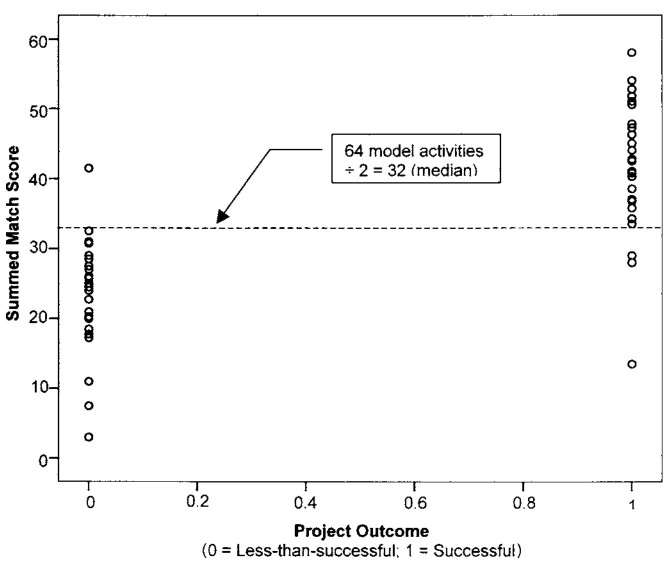

Fig. 2. Summed model match score versus project outcome

Model Validation

Using a methodology that was similar to the original study, data were collected on 12 additional projects for the purpose of model validation. A questionnaire was administered and an interview was conducted to collect planning and performance data on one successful and one less than successful project per contractor. The main goal of the validation analysis was to correlate the effectiveness of each project's preconstruction planning process (using a summed model match score) to its outcome. It was, again, hypothesized that projects with a larger summed match score (to indicate more effective planning) would achieve more successful outcomes.

Each of the 12 validation projects was classified as successful or less than successful, and a planning effectiveness scorecard was completed for each project, comparing the actual planning process to the model process. A summed model match score was calculated, and the score was correlated to the project's outcome using Spearman's rho. The results showed a correlation of 0.73, which was significant at the $p<0.007$ level, and is consistent with the results from the original study. Fig. 3 plots the summed model match scores against each project's outcome. The median number

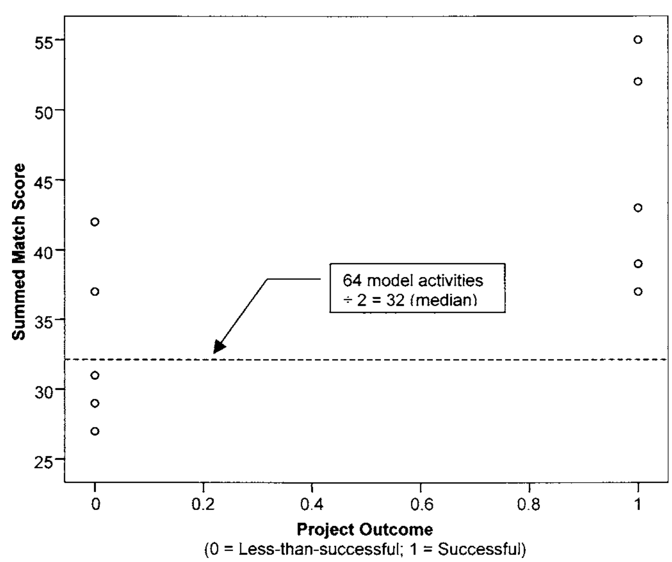

Fig. 3. Validation summed model match score versus project outcome

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of planning activities performed by the successful performers was 43, while the median number performed by the less than successful performers was 34. Hence, the validation data collection and analysis provided support for the findings of the original study.

Practical Applications

The model electrical preconstruction planning process has both industry and academic practical applications. Electrical contractors can adopt a similar planning process in order to improve or formalize their planning practices and structure their programs after successful practices used by their peers. Contractors can also use the planning effectiveness scorecard to evaluate how closely their own planning process matches the model process in order to pinpoint specific activities or practices that should be added or improved. Furthermore, in the future, contractors will be able to use a computerized planning evaluation process that will be based on more sophisticated assessment techniques, which is expected to be a future product of the current research. The computerized tool will allow contractors to monitor the planning and performance of their projects in order to identify particularly effective planning practices.

Academic professionals can compare the model electrical preconstruction planning process to previous research in order to identify similarities to, and potentially validate, previous results. Furthermore, the current research will act as a stepping stone for the development of a more advanced preconstruction planning evaluation process, which will ultimately be computerized. Likewise, since evidence points to a relationship between more effective preconstruction planning and project performance, this relationship can be investigated and quantified, which is the next logical step to the current research.

Conclusions

This paper presented a method for developing a model electrical preconstruction planning process that was structured after several successful projects in industry. Consequently, a key finding of the research was that successful preconstruction planning *can* be modeled, resulting in a formal planning process that can be implemented by electrical contractors. Furthermore, the research revealed that successful projects tended to use a planning process that was similar to the model process and that a correlation exists between more effective planning and project outcomes. However, the writers also noted that, while effective planning can contribute to better performance, other factors can also play a part in successful outcomes, especially when used in conjunction with good planning. In particular, good planning combined with good project management can contribute to more successful performance.

It is anticipated that the current research will lead to additional investigation and discovery. Future work will include investigating and quantifying the relationship between preconstruction planning and project performance and the development of a more sophisticated technique to evaluate the effectiveness of the planning that has occurred on a project. As part of the evaluation process, a user-friendly computerized evaluation tool will be developed for use by electrical construction contractors.

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