A POST CONSTRUCTION EVALUATION OF SUBCONTRACTOR PERFORMANCE

by

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ABSTRACT

KURRISA K.I. VIALET. A Post Construction Evaluation of Subcontractor Performance
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Construction projects are increasing in complexity and thus more contractors are becoming more reliant on subcontractors that are trade specific to complete a project. Since a large portion of the work is subcontractor-driven, the success of a project related to time, money, and quality is highly dependent on the work that the subcontractor completes. Job success is also highly dependent on the general contractor's relationship with subcontractors and the clarity of goals that they set.

This research created a tool in the form of a survey to evaluate the subcontractor's performance at the end of the project. The questions created for this survey were based on a literature review and evaluation of the general contractor's processes & programs. Based on this review Critical Success factors and Key Performance Indicators were identified, to evaluate a subcontractor performance. Some of this CSFs and KPIs included Schedule/time, Money, Quality and Safety. For the purposes of this research, the electrical and mechanical subcontractor of three projects of similar size and volume were evaluated by the onsite general contractor teams. The survey was tailored to the role that the survey taker held on that project, such as Project Manager, Engineer, or Superintendent.

The results and review of this survey succeeded in collecting qualitative data that focused on providing actual feedback and insight about the subcontractor's performance from the review of each GC employee. Results from this sample showed that the subcontractor's foreman and project manager involvement (or lack thereof) was a large factor in the positive and negative

performance of a subcontractor respectively. Those subs with good leadership and project management support ranked more favorably overall and higher in each individual category. The review of each of the performance cards by the general contractor employees noted that the survey can be beneficial as input for future projects and repeat subcontractors, to continue building relationships and to set the next project up for success.

ACKNOWLEDGEMENTS

I would like to acknowledge Dr. Jake Smithwick for leading my thesis committee. I would also like to acknowledge my colleagues for their input and feedback on the survey questions developed for this research specifically; Victoria Sprague, Scott Edwards, Daniel O'Brien, Blake Dulin, Brittney Battle, Hayden Miller, Connor Mosser, Jeff Humbert, Brooke Trice, Landon Towery, Dillon Wood and Thomas Ivy.

DEDICATION

This thesis is dedicated to my family for their constant support in my studies and their reminders to always finish what I've started.

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ANP Analytic Network Process

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Sub Subcontractor

INTRODUCTION

Construction is one of the world largest industries, responsible for the building of new forms of infrastructure. According to Alzahrani (2013), the construction industry is important for developing countries as it brings new buildings, roads, and bridges in to fruition. It is also a large economic booster as an influx of construction creates a temporary workforce for skilled labor on each project and the culmination of each building leads to employment of more individuals. This is in addition to other economic boosters such as growth and development for the area. Given its important economic standing construction projects are anticipated to be highly successful. While the success of the project can now be defined in multiple ways, the overall basis of construction success is still tied to the iron triangle: on time, under budget, and within specifications (Alzahrani 2013). Similarly the foundation of construction, using skilled labor to transition from a design to a tangible outcome has not changed, but the industry has significantly evolved over time.

The construction industry is growing at a fast rate but the industry's adaption to change has not kept pace (Kumaraswamy 2001). Project designs are becoming more complicated, with the increased involved of various stakeholders between planning and construction (Dooli 2009). Modern day construction requires a more inclusive approach to project management and execution, versus the stand alone projects of the past. Today's projects instead require buy in from multiple parties across multiple sectors and disciplines. This necessary buy in leads to building relationships amongst each sector of the construction industry. The relationships in construction include relations between owners, funding sources, the building end users, property management, architecture, and design engineering firms, utility companies, vendors and manufacturing companies. The relationship between general contractors (GC) and

subcontractors is also a crucial piece to overall project success and thus will be reviewed throughout this research intent.

The general construction team runs the project from the aspect of day to day coordination, to include scheduling, maintaining a budget, developing work plans and project flow, quality assurance and control, processing requests for information (RFIs), and reviewing materials and shop drawings for construction and fabrication. The GC team individuals serves as a construction manager through one of the following roles safety manager, project managers, project engineers and superintendents. The actual work in place however, is completed by subcontractors that are typically trade specific. It is now typical to have around 80%-90% of the scope of work for a construction project to be divided amongst subcontractors (Hinze 1994)

Given that the work needed to be completed on a construction project is now typically subbed out to trade specific contractors as previously mentioned. The success of a project is no longer reliant on just the general contractor's work. It is now dependent on the subcontractor's work and the ability of both the subcontractor and general contractor's ability to manage the construction process. Selecting the right subcontractor is challenging in that the subcontractor needs to meet the requirements set forth by the GC, client, and the needs of the project scope of work. The general contractor that participated in this study has a prequalification process for subcontractors. The prequalification process ensures that at a minimum the standards set forth by the General Contractor can be met if the bid were to be awarded to that particular subcontractor. Once the subcontractors are vetted through the prequalification process to include a review of their financials and safety record they are allowed to bid on the general contractor's pursuits.

The prequalification process and subcontractor selection are all part of the

procurement process (Sullivan 2011). Selection of the subcontractor varies based on the project delivery type. While a prequalification process allows for the general contractor to evaluate the readiness of a subcontractor to be awarded a job, it also creates pool of subcontractors that are consistently eligible to bid projects being pursued by the GC. As subcontractors are vetted through this process they become eligible to bid jobs that they are invited to by the general contractor. This suggests that regardless of the project delivery type a rotation of qualified subcontractors will be invited to each bid. The repeated invites leads to the repeated use of subcontractors, therefore increasing the working relationship between subcontractors and the General Contractor can be beneficial to the overall project success.

Both the prequalification process and the selection of subcontractors are a part of the procurement process. Procurement of subs of per project can then be viewed as the transitional point between preconstruction and construction. Given that the preconstruction and procurement phase deals primarily with bidding and awarding a job the relationship gained between the GC and the subcontractor is mostly limited to the executives and estimating. This preconstruction process places the GC and subcontractor in a unique position to set up the job adequately and verify that the entire scope of work that should be completed by the subcontractor is accounted for (Pesek et. Al 2019).

While ensuring that the project has the right tools to succeed greatly affects the outcome of the project, procurement of subcontractors is a just one portion of the construction duration timeline. Thus managing the resources and subcontractors during the construction phase of the project has arguably an even larger effect on the overall project outcome. Considering that input the onsite general contractor team has the longest time period in which to build a relationship

with the subcontractor as they have to work with the subcontractor for the entire duration of the project; from scope and contract review to punch list. The onsite GC team also works with multiple stakeholders from the subcontractor closely, in lieu of working solely with estimating or executives. The onsite team throughout the course of the project will in some form build a relationship with the subcontractor executives, estimating, project management, and operations (superintendent, foremen, and tradesmen). This experience provides the onsite team with a different vantage point in being able to provide feedback on the performance of a subcontractor because they are able to capture a more holistic view, plus manage the job, outside the realms of procurement.

The primary question of this research is, "how key performance indicators can be incorporated into an evaluation to review subcontractor performance?" The current research reviews a number of key performance indicators and their ranking as markers of project success, by multiple methods. There is also research that uses the input of general subcontractors to determine what those KPIs should be. This research differs from past research by its focus on evaluation of subcontractor performance by the general contractor team. The questions to evaluate performance of the subcontractor is based on the GC programs and the research of key performance indicators for project success. If the onsite general contractor team can provide feedback on the performance of the subcontractor, then the collected information can be used as an effort to bolster the relationship between subcontractors and the general contractor, or prepare the next project team with more insight on how to manage the subcontractors chosen during procurement. This should then aid in boosting project successes with repeatedly used subcontractors.

Thus the purpose of this research is to create a survey that accurately incorporates key performance indicators and Critical Success Factors relevant to the General Contractor to evaluate subcontractor's post construction performance on a project. The structure of this thesis in support of this research is as follows: review of General Contractor roles; literature review of procurement, contractor relationships and roles, CSF & KPIs, and methods of evaluation; methodology of the evaluation tool; discussion with general contractor employees and review of survey results.

LITERATURE REVIEW

If procurement truly is a case by case method, what is the baseline used to determine if the right method, companies, subcontractors or contracts are being used to deliver a quality job? An interesting outlook is shared in the article “Construction Procurement Auctions: Do entrant Bidders Employ More Aggressive Strategies than Incumbent Bidders?” (Sheng 2012). This outlook lends to the ideology that bidders that have consistently been awarded work are not as competitive in their bidding as new company that hasn’t been awarded before (Phillips 2011). As bidders are selected repeatedly, there is a tendency to continue picking them (and therefore less of a need to bid as competitively).

Using different companies, or at the very least shortlisting, forces each company to evaluate if the scope is truly covered for low bidders and if higher priced, less competitive bidders have priced the company out of a job. Another factor to consider is performance based awards. Companies that consistently perform well in areas of quality, safety, cost and schedule may be awarded more opportunities than a company that has subpar performance. One strategy used was a fuzzy base construction procurement system where in data from RFPs and bids were evaluated and verified to determine if they should truly be awarded the job (Luu 2005). This process uses a scoring system to rank each line to then determine the best fit per the job. In the article "Construction Procurement Routes: Re-Defining the Contours of Construction Procurement.", the company B&Q actually looked at their bid pool and made adjustments to obtain more competitive bidders (Tookey 2001). This article further confirms that the procurement method is truly unique to the client and the project, and a standard method cannot generally be applied. Procurement can truly be used to set up the plan for a successful job. As

issues and risks are discussed and mitigated at the beginning it is easier to focus on the construction process going forward. Procurement may even be the key to continuous sustainable development (Ngowi 1998).

While construction companies tend to use their lists of subs that have already met their qualifications, repeated use of the same subs can create cost disadvantages over time for the GC. However, it does allow for general contractor to complete benchmarking exercises with their subcontractors (Kärnä 2016).

Based on the conducted literature review there are existing methods of evaluating subcontractor performances on construction projects; as well as research that leads towards predicting a subcontractor's performance. The majority of articles focuses on the framework for setting up evaluation processes and the critical success factors (CSF) or Key Performance Indicators (KPI) used to identify and evaluate a subcontractor and its respective weight in their evaluation. Using a base of critical success factors provides a smarter way to identify the factors that can actually contribute to project success (Alzahrani 2013). Besides the typical CSFs (cost, time, Scope/ Specification Compliance), there are more factors at a construction level that can lead to the success of a project.

The research in "The impact of contractor's attributes on construction project success: A post construction evaluation" identified 35s Critical success factors and through survey evaluation were able to group the corresponding CSFs into 10 main clusters (Alzahrani 2013). These clusters are Health, Safety, and Quality; Past Performance; Environment; Management and Technical Expertise; Resources; Organization; Experience; Size and Type of Previous project; and Finance.

Another method of evaluating or prioritizing success factors is the Analytic network process (ANP) which is also an adaption of the AHP. Construction projects' success is dependent on the project success (Scope/ Specification Compliance , time, money) and the job success or appraisal (knowledge/ skill set/ work ethic and execution) (Cheng 2006). The research noted in "Job performance Evaluation for Construction Companies" utilized the ANP method to evaluate job performance success factors in relation to project success factors (Cheng 2006).

This research uses the ANP developed questionnaire to compare employee performance factors that affect Job performance to project performance. Project performance then for the purposes of this research is linked to the iron triangle with the Critical Success Factors of Money, Time, and Schedule. Then the Job Success is a factor in project success that identifies the human aspect and is more rooted in the ability for the individuals involved, to maintain the right relationships and complete the tasks as needed. In order to evaluate specific topics that affect job performance the research further broke down the KPIs to task related identifiers. These KPIs were specific to what would be needed to successfully execute and complete a take. These Task specific KPIs that affect overall job success were identified as (ability, knowledge, quality, efficiency, responsibility, consistency). They were then compared to relationship performance (attitude, punctuality, Co-operation Equity and consistency) and its effect on Project performance success factors such as cost time, quality, scope, and profit.

The effect of subcontractor selection on Job performance is the main concept of this research project. The article "Improved construction Subcontractor Evaluation Performance Using ESIM" emphasizes that subcontractor performance is crucial to project success which

leads to the concept of evaluating subs prior to the start of the job (Cheng. 2012). In this particular article the Subcontractor Rating Evaluation Model (SREM) was developed. The model evaluated subcontractor performance and historical data. This article also lists some cons about using a pre and post construction system because of the subjective nature of the factors used. Therefore the SREM model takes more of an algorithm based approach.

As noted in the "Subcontractor Evaluation and Management Framework for Strategic Partnering," Subcontractor and GC relationships can often be strained due to issues that may arise eon the job (EOM 2008). As result this article proposes the idea of providing a subcontractor feedback and evaluation framework that can be used to continuously improve the performance of both parties and continue to maintain a solid working relationship. This is helpful because as the GC is aiming to become more effective in subcontractor selection the idea of creating and maintaining better performing, quality-driven subs is important to sustain the market and increase the strength of the subcontractor pool. Other articles further add to the importance of maintaining subcontractor relationships and evaluating performance (Abbasianjahromi 2011, Manu 2015).

In the article by Kale (2001) relationships between parties are looked at as transactions or the movement of some form of goods between parties. This article further introduces the concept of "social embeddedness" which was defined as the continuous transactions between firms as well as promoting the diffusion of information about firms and coordination with each other. The research explained that the subcontractor and contractor relationship is a transaction that potentially can boost the economic standing of firms. Transactions that influenced by and dependent on levels of confidence and mutual trust as described in this article. The subcontractor and contractor relationship while it may be apparent to be based on price is more complicated as

it based on human input through the performance of trades as well of all of the uncertainties of a construction site. Unlike a standalone industry a subcontractor and general contractor's relationship is based on performance of projects that are consistently different and that each present their own set of issues. Evidently affecting each other if one were to falter. The human asset of the firms is crucial to creating and maintaining longer relationships.

METHODOLOGY

The methodology process as described in Figure 1 consisted of a literature review to create a project participant survey.

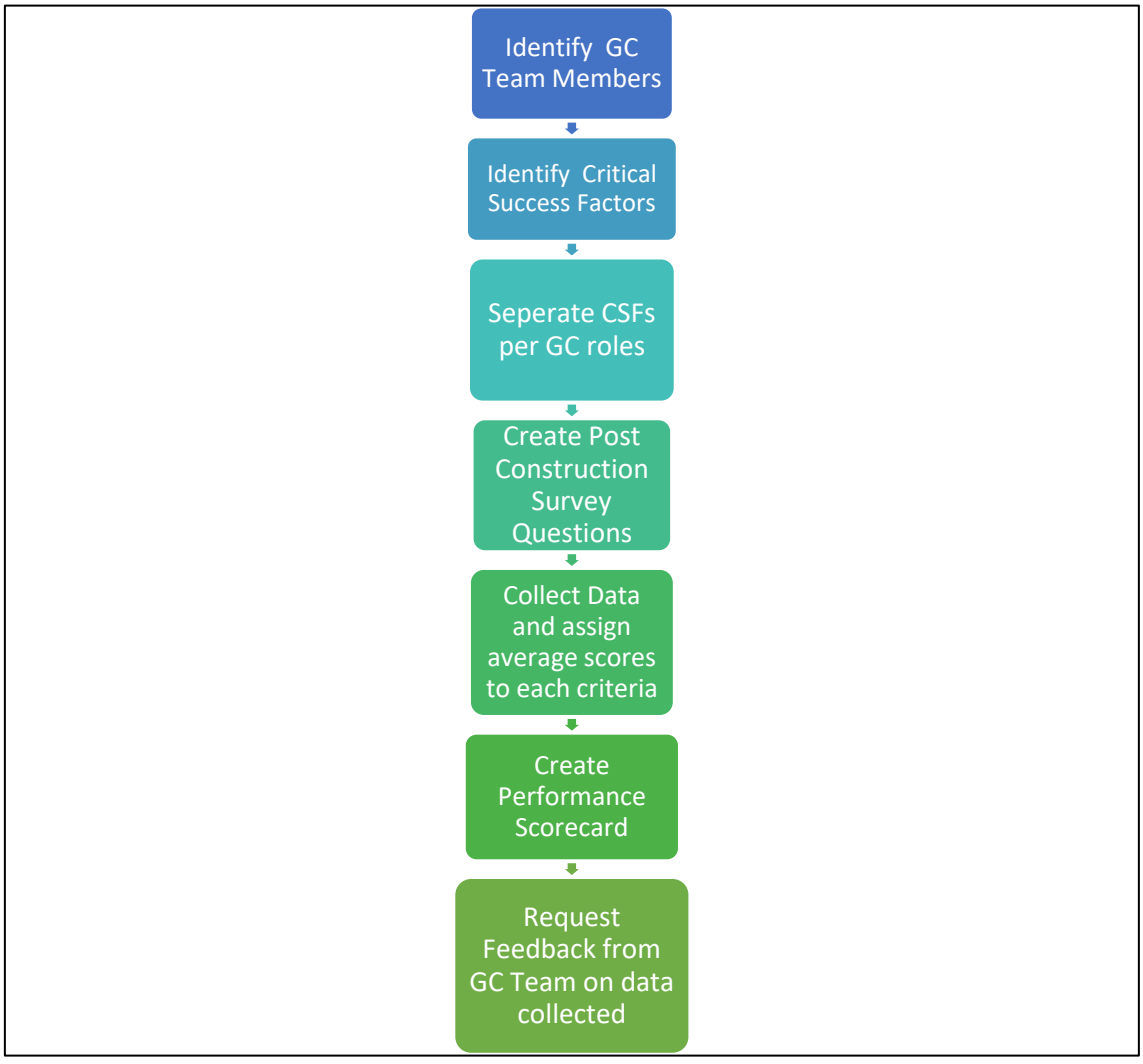

Figure 1: Methodology Process

Two main points gathered from the literature review were used to build the basis of this survey:

- The idea of providing a subcontractor feedback and evaluation framework that can be used to continuously improve the performance of both parties and can aid in continuing to maintain a solid working relationship. (EOM 2008)
- Using a base of critical success factors provides a smarter way to identify the factors that can actually contribute to project success. (Alzahrani 2013).

The literature review was used to identify the Key Performance Indicators and Critical Success Factors for construction project success. Based on the literature review Scope/ Specification Compliance, Time and Money affects the overall project success and has been chosen as the three main Critical Success Factors for the survey. Articles by Kale (2001) and Alzahrani (2013) both referenced the iron triangle of Scope/ Specification Compliance, Time and Money. As understood from the literature review and shown in Figure 2 project success is also affected by the human input on a project site or job success as referenced in Kale (2001).

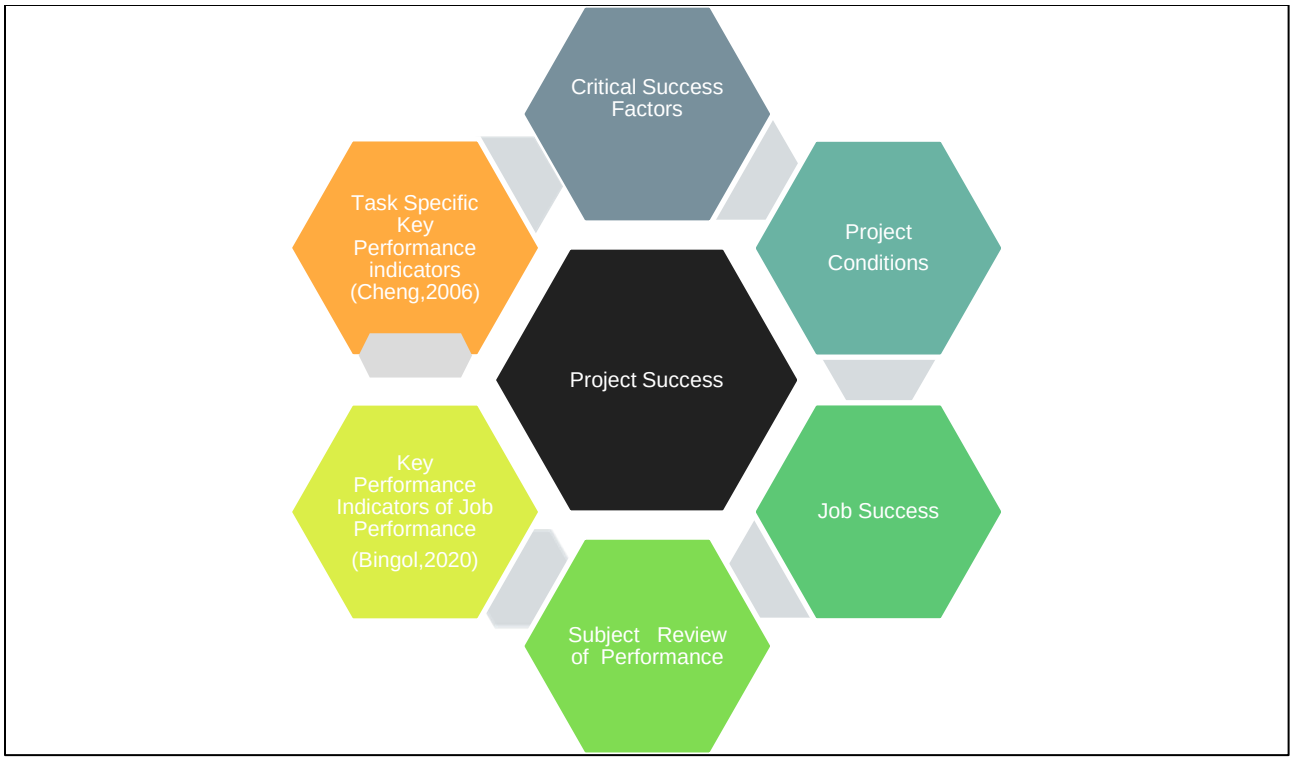

Figure 2: Project Success Components

Thus the survey was also tailored to reflect the employee performance to Task specific Key Performance Indicators that influence job success. These were identified as responsibility, consistency, ability, efficiency, knowledge, and quality. Health and Safety was also identified by Kale (2001) as a KPI, however given the general contractor's development of specialized safety programs that becomes a part of a subcontractor's signed contract and thus scope of work; it was evaluated separately by each survey respondent. Figure 3 shows the KPIs and CSF identified per the researched articles.

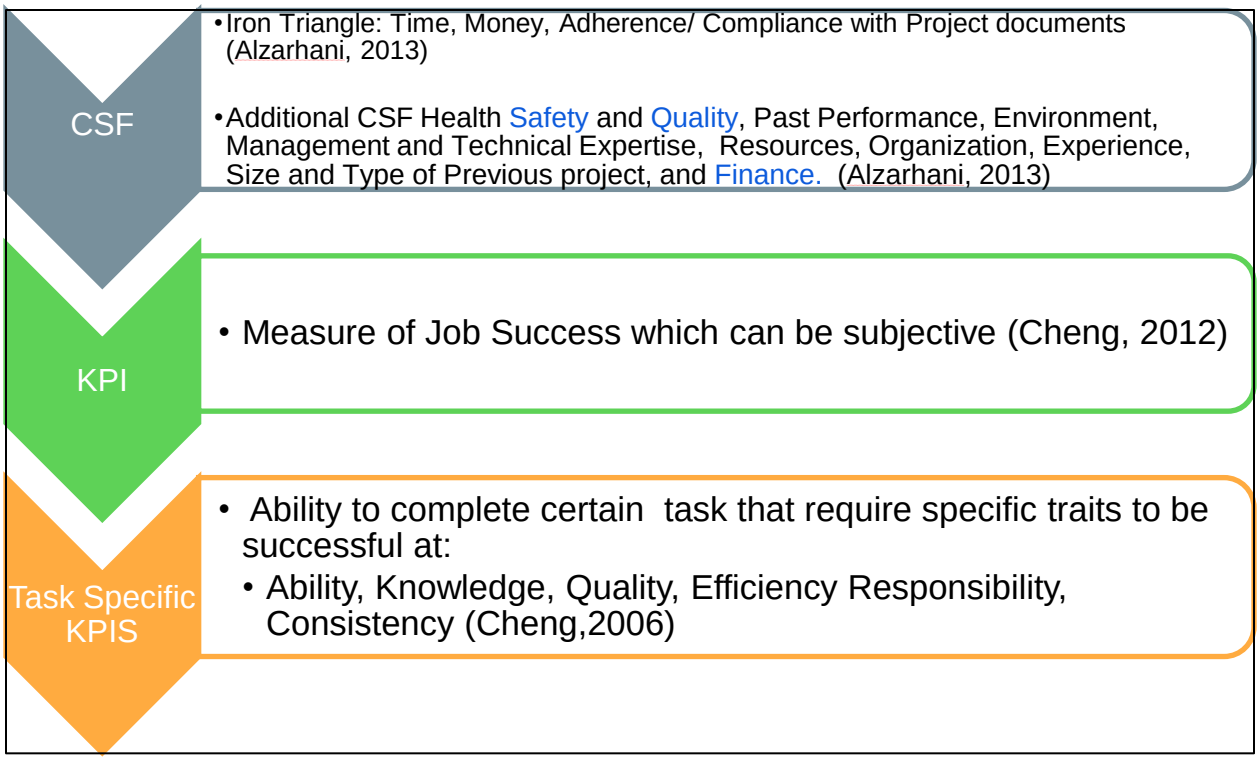

Figure 3: CSFs and KPIs Factors

The first round of survey development consisted of a comprehensive survey that went into details of all aspects of performance of a subcontractor. This process resulted in a questionnaire that was projected to take upwards of 15 minutes to answer. This lead to separating the questions per each role, to minimize the response time.

Hence, the survey was separated into four sections, three of which were tailored specifically to each construction management team role: Project Manager, Engineer, and Superintendent. The fourth section was dedicated to safety which asked about safety programs that the general contractor had implemented. Figure 4 shows the breakdown of question categories per GC role.

All safety questions required an answer by each survey participant regardless of positon, given that this particular general contractor preaches that safety is everyone's responsibility. The other questions on the survey were asked according to the role that the GC employee held on that project. The last part of the survey asked about the likelihood of recommending the subcontractor for future work as well as a comment section to add feedback about the subcontractor's performance. See Appendix 1 for a copy of the survey.

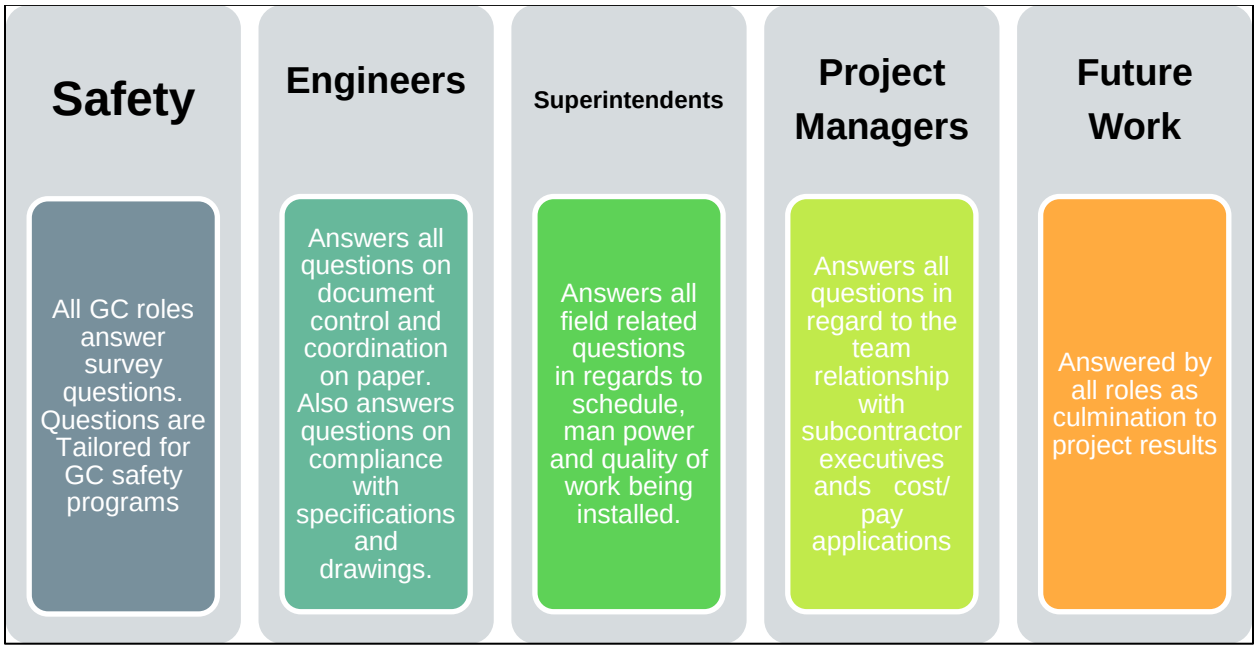

Figure 4: GC Roles and Survey Category

Each question asked had an impact on a critical success factor, for example the project manager questions centered on fair change orders and how submitting pricing changes affects the cost of the project, and the superintendent questions regarding staying up to date with manpower and weekly work plans affects the CSF of schedule/ time. In addition to each question being a marker for a CSF, each question also had underlying KPIs that were evaluated. As noted by Kale (2001), job performance is a more subjective area of key

performance indicators were evaluated by comparing job performance to task specific KPI such as ability, knowledge, quality, efficiency, responsibility, consistency.

The Safety Questions were focused on asking the project team about the subcontractors compliance with certain standards the at the GC safety program, such as compliance with the ladders last program as the last method of elevated access, turning in pre task and job hazard analysis plans on time, and attending the daily morning stretch and flex event/ huddle. While all three of those questions affects safety, compliance with those programs set forth by the GC also exemplifies task performance KPIs such as responsibility and consistency.

The engineering questions asked of the GC team focused on the submittal process, drawing revision changes, constraints and the subcontractor's ability to keep up, identify and turn in the required documentation on a timely enough manner. These questions are directly linked to schedule because the subcontractor performance in this area impacts the capability to get materials released and installed in time via approval of the submittal process or identifying and solving issues and constraints, as well as cost when new drawings or changes in plans are identified. However, the subcontractor's performance in this area is also linked to task performance KPIs such as ability, efficiency, and knowledge, much like the Project manager questions associated with turning in change order and payment information on time. Likewise the survey superintendent questions were focused on meeting scheduled milestones, maintaining manpower, and installing quality work. These items drastically affect the project schedule and quality of the project, which in turn can affect the cost; all three critical success factors that comprise the iron triangle. Figure 5 Lists each survey question per role.

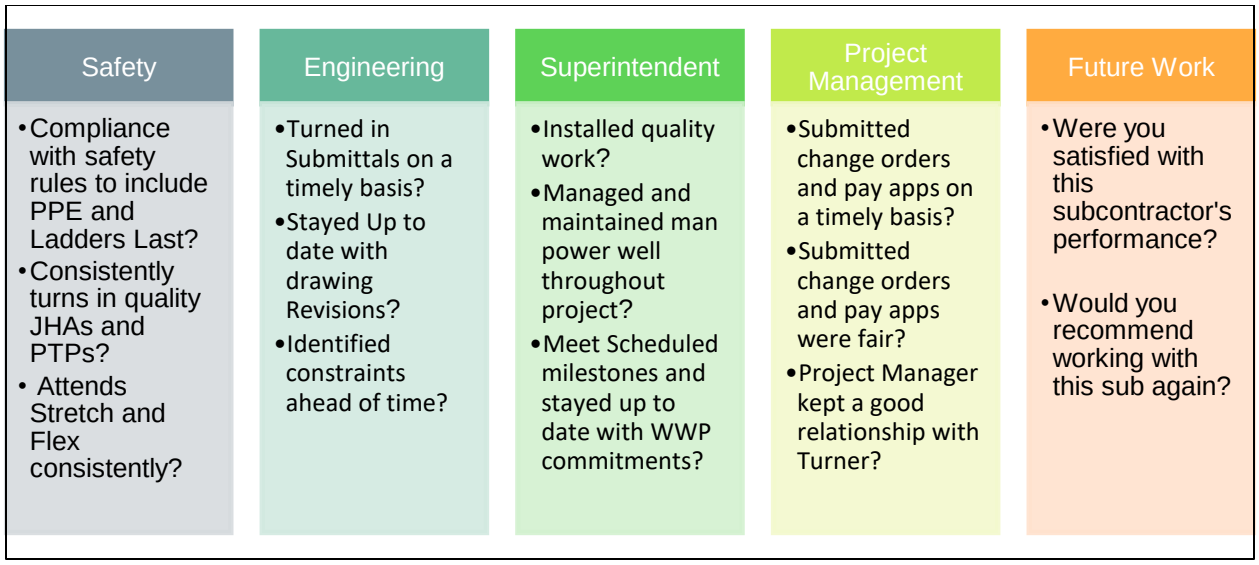

Figure 5: Survey Questions per GC Positions

The questions while tied to Critical Success Factors also uncover the subcontractor's ability to excel in KPIs that are task-specific. The survey questions per role and their relation to each Critical Success Factors and Key Performance Indicators are shown in Tables 1, 2,3, & 4 .

Table 1: Safety Questions Indicators of CSF & KPIs

GC Roles	Critical Success Factors			Task Specifc KPIs					
	Time	Money	Adherence & Compliance	Responsibility	Consistency	Ability	Efficiency	Knowledge	Quality
Safety Questions									
Compliance with Safety Rules to include PPE and Ladders Last	X		X	X	X				
Subcontractor consistently turned in quality JHA & PTPs	X		X	X	X				X
Subcontractor crew consistently attendened Stretch and Flex	X		X	X	X				

Table 2: Engineering Questions Indicators of CSFs and KPIs

GC Roles	Critical Success Factors			Task Specifc KPIs					
	Time	Money	Adherence & Compliance	Responsibility	Consistency	Ability	Efficiency	Knowledge	Quality
Engineering Questions									
Subcontractor turned in Submittals on a timely basis	X	X		X	X	X	X		X
Subcontractor stayed Up to date with drawing Revisions	X	X	X		X	X		X	
Identified constraints ahead of time	X	X				X	X	X	X

Table 3: Superintendent Questions Indicators of CSFs and KPIs

GC Roles	Critical Success Factors			Task Specifc KPIs					
	Time	Money	Adherence & Compliance	Responsibility	Consistency	Ability	Efficiency	Knowledge	Quality
Superintendent Questions									
Subcontractor Installed quality work	X	X	X			X		X	X
Subcontractor managed and maintained man power well throughout project	X			X	X	X			
Subcontractor met scheduled milestones and stayed up to date with WWP commitments	X	X			X	X	X	X	X

Table 4: Project Management Questions Indicators of CSFs and KPIs

GC Roles	Critical Success Factors			Task Specifc KPIs					
	Time	Money	Adherence & Compliance	Responsibility	Consistency	Ability	Efficiency	Knowledge	Quality
Project Mangement Questions									
Subcontractor submitted change orders and pay apps on a timely basis	X	X	X	X	X		X		X
Subcontractor submitted change orders and pay apps were fair	X	X	X	X	X		X	X	X
Subcontractor Project Manager kept a good relationship with Turner	X			X	X				X

The mechanical and electrical subcontractors were chosen for evaluation. Mechanical and electrical contractors have an ongoing presence on a project including in the earlier stages. This statement holds true for the MEP contractors chosen for this evaluation as they have participated in construction from the in ground utility process straight through to commissioning of equipment. The mechanical and electrical contractors also play a large role is setting the pace for other subcontractors, specifically finish trades to begin work on site with power start up, overhead rough in, permanent lights and condition air being big factors for those trades.

Table 5: Project and Subcontractor Samples

Project	Volume	Subcontractor
1	~$11 M	Elec. Sub 1
1	~$11 M	Mech. Sub 1
2	~$18M	Mech. Sub 2
2	~$18M	Elec. Sub 2
3	~$23M	Elec. Sub 1
3	~$23M	Mech. Sub 3

Given the longevity and their integral part in keeping the schedule for the job there is an opportunity to build a relationship specifically with MEP subs. For the purposes of this research the electrical and mechanical subcontractor's performance on three similar projects of volume and duration were reviewed by each GC team member. This resulted in eleven surveys with 9 recipients responding. The surveys were created in Qualtrics and utilized Rich Text to automatically populate the survey questionnaire per GC role. All questions were phrased so that a 5 point Likert scale could be applied. The Likert scale ranged from strongly agree to strongly disagree.

At the completion of the survey each response was assigned a number that corresponded to the Likert scale selection. For example, all responses that received a strongly agreed answer

received a 5 and all responses that received a strongly disagreed answer received a 1. The Likert Scale correlation to a Numerical Value is shown in Table 6.

Table 6: Survey Likert Scale

Likert Scale				
Strongly Agree	**Somewhat Agree**	**Neutral**	**Somewhat Disagree**	**Strongly Disagree**
5	**4**	**3**	**2**	**1**

If more than one survey responder shared the same or similar role on the project (ie Superintendent and Assistant Superintendent) then the responses were averaged together for each question asked of that position. Averaging the responses provided an overall rating in the following categories, Safety, Field Management, Engineering Management, Project Management, Overall Satisfaction, and Consideration for future work. These response were then used to create a performance response scorecard for each subcontractor shown in Figure 6. The results of the performance scorecard was shared with survey takers for feedback on its effectiveness and likelihood to be implemented for future work.

Performance Evaluation Scorecard

Subcontractor: Electrical Sub A
Project: Project 1
Rating Scale:

Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree
5	4	3	2	1

Post Construction Performance Criteria:

Safety Compliance	Engineering Management	Field Management	Project Management
3.25	3.7	2.3	3.7

Overall Satisfaction	Recommendation for Future Work
3.5	3.5

Performance Feedback:
Many safety issues prior to change in onsite management
Electrical Sub A tried very hard for this job. They had some serious issues regarding quality and schedule most of which can be attributed to lack of Foreman ship.
Electrical Sub A was the biggest struggle on the project from every perspective. Management was changed at the foreman and PM level twice due to a lack of ability to manage their own guys. In my opinion the poor quality of install came with the fact that over half of the laborers were temp workers who did not care to meet deadlines, did not care about the level of quality, and definitely did not want to adhere to safety policies from the GC or their own management. They were unprepared and unequipped for Project 1 as a whole.

Figure 6: Subcontractor Performance Scorecard

DISCUSSION AND ANALYSIS

As mentioned in the methodology the project teams of three projects of similar scopes evaluated the electrical and mechanical subcontractors of their projects. The rating of each subcontractor's performance per job and category are listed in the Table 6.

Table 5: Subcontractor Survey Results per Project

Project	Volume	Subcontractor	Safety Average	Engineering Management	Field Management	Project Management	Overall Satisfaction	Future Work
1	~$11 M	Elec. Sub 1	3.3	3.7	2.3	3.7	3.5	3.5
1	~$11 M	Mech. Sub 1	3.3	1.7	1.3	2.0	2.5	1.5
2	~$18M	Mech. Sub 2	4.2	3.7	-	4.7	4.5	5.0
2	~$18M	Elec. Sub 2	4.0	3.3	-	3.3	3.0	3.0
3	~$23M	Elec. Sub 1	4.7	4.7	5.0	5.0	5.0	5.0
3	~$23M	Mech. Sub 3	2.7	2.0	1.0	3.0	1.3	1.33

The survey results as Shown in Table 6 highlighted some key takeaways in the performance levels of the subcontractors.

- Overall 3 out of the 5 subcontractors received a Likert rating of 3 (neutral / average) or higher in the overall satisfaction and future work recommendation categories. Indicating the satisfaction of the possibility of working with that sub again.
- The two subcontractors that received a lower rating or less than a 3 were both mechanical subcontractors. Both of the mechanical subcontractors also had the lowest rating in the field management category that was evaluated by the superintendents on the project.
- The lowest ranking subcontractor is Mechanical Subcontractor 3 that worked on Project 3 with an overall satisfaction rating of 1.3 and a future work recommendation to match. Some of the comments in regard to the subcontractor's performance include:

- *Combative Attitudes and consistently fell short of commitments*
- *Mechanical subcontractor had a hard time sticking to the schedule because of lack of foreman expertise, fabrication and man power. There were a lot of issues even after the project was considered substantially complete that had to be fixed due to their performance on the job. If the submittal process can be addressed up front and knowledgeable field man power can be maintained then the project would have succeeded. Safety was also not a priority for this sub starting with the Project Manager and trickling down to the workers on site.*
- *Mechanical Subcontractor is not managed to handle heavy GC requirements. I feel as if the sub struggled heavily with the project due to two infractions. One was lack of management from the PM and on site Foreman, once this line of communication is broken it is extremely hard to have a successful project. The other infraction is I believe the subs senior leadership is below par, and has created a culture of mistrust and lack of ownership and accountability.*

- Electrical subcontractor 1 worked on both Project 1 and Project 3. Project 3 and Project 1 were occurring simultaneously with Project 1 breaking ground two months ahead of Project 3. There were two different crews assigned to each project and there was a significant difference in performance. Per the feedback provided by the general contractor's team the difference in performance is largely attributed to the lack of foremanship and Project Management involvement on Project 1 versus the competent abilities of the foreman and Project Management on Project 3. This is particularly interesting because the electrical subcontractor was the only subcontractor to receive a

Likert rating of 5 (strongly agreed/satisfied) in multiple categories due to their performance in project 3. The comparison in survey results between the two projects are reflected in Figure 7 The GC team response is listed `:

- Project 1:
    - *Electrical Sub tried very hard for this job. They had some serious issues regarding quality and schedule most of which can be attributed to lack of Forman ship.*
    - *Electrical Sub was the biggest struggle on the project from every perspective. Management was changed at the foreman and PM level twice due to a lack of ability to manage their own guys. In my opinion the poor quality of install came with the fact that over half of the laborers were temp workers who did not care to meet deadlines, did not care about the level of quality, and definitely did not want to adhere to safety policies from GC or their own management. They were unprepared and unequipped for the project as a whole.*
- Project 3 :
    - *Electrical subcontractor was a great sub to work with. They had a few safety issues (lack of PPE and not adhering to the ladder's last policy) that had to be dealt with, but once told they worked quickly to readjust and correct any problems. The project manager was very involved from the submittal process to the infield operations. They ramped up man power as needed and kept their guys motivated. Subcontractor produced quality work on time with no major safety incidents or violations.*

Foreman was on top of his game, kept their guys working and identified constraints ahead of schedule. Great Team to work with.

- *My expectation of the electrical subcontractor is overwhelmingly positive great senior leadership all the way down to the Foreman cannot say enough great things about this company*

- In one of the comments provided by the GC team for the evaluation of Electrical sub 1 on Project 1 it was noted that a lot of temporary labor or staffing companies were used to supplement the labor of the electrical sub, which was not the case of the contractor on Project 3.

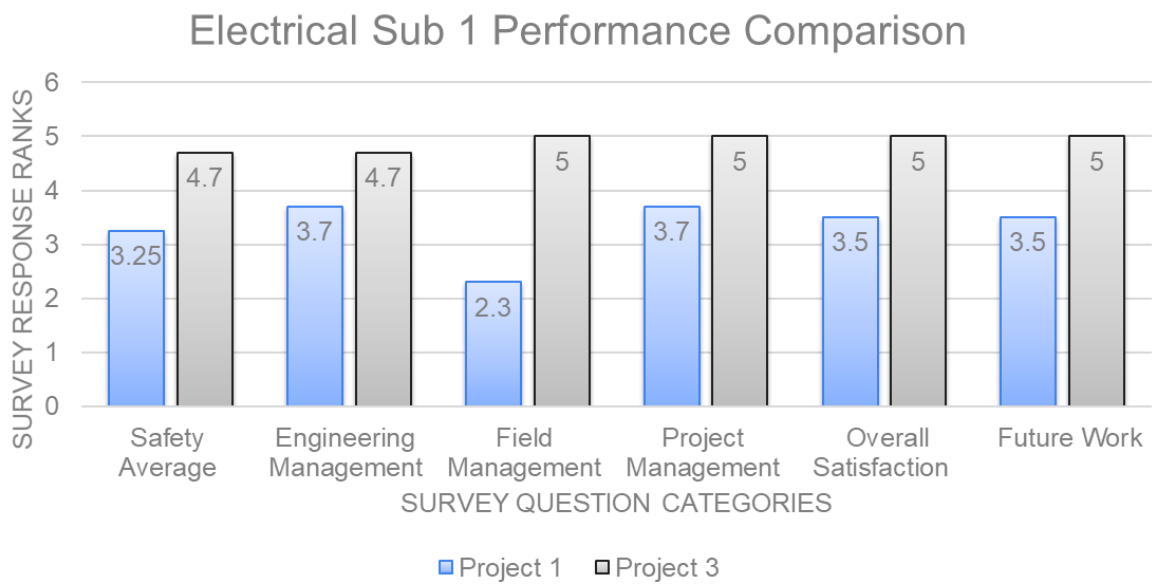

Figure 7: Electrical Subcontractor 1 Between Project 1 and 2

The overall feedback collected from the survey gave some insightful feedback on the performance of the subcontractors from their role's perspective and interaction with the subcontractor. The responses from the superintendents emphasized the importance of having good foremen present on sight to lead the crews. The response from the engineers on site focused on scope and timeliness with getting materials to site. Subs that did not perform well overall, specifically the two lowest ranking subs Mechanical Sub 1 and 3, failed to perform in the field and on the engineering front. This example also highlights the difficulty in recovering from a bad engineering effort since this can cause delays in materials and equipment.

After the completion of Project 1 Mechanical Subcontractor 1 was invited to bid a public low bid job in which they were awarded. The project team that had not previously filled out this survey to evaluate a subcontractor were asked to review the Performance scorecard for this particular subcontractor and comment on how it would have affected their approach had they known of the subcontractors performance from a previous project. After reviewing the project team agreed that reviewing the scorecard would have helped to approach the mechanical subcontractor differently given that some of the concerns expressed in the survey responses were similar to what they were experiencing already on the new project. This included a lack of manpower and falling behind on schedule.

The score card was shared with other GC team members so that it could have been evaluated for its effectiveness. All team members noted that they would be willing to complete a survey of this sort after the completion of a project. They also noted that the information can be helpful especially if the contact information of the project team is provided with each response so that they can be contacted to further provide input on the subcontractor.

This information while beneficial to the general contracting team as can be shown in the collected information and from the post survey questions, it should also be used to positively improve the performance of the subcontractors. That way during the next project the areas where they may have faltered can be addressed. When asked about this issue, the General construction team agreed that the information should be shared with the subcontractor team, however it should be shared as constructive criticism only.

Maintaining a healthy working relationship on site should allow for the opportunity to provide constructive criticism for improvement at the end of the project. However if a healthy working relationship was not maintained then any feedback provided can be looked at in a negative light.

Some of the responses to the survey post questionnaire are listed below.

- Would you be willing to complete a survey (less than 5 minutes) to aid in creating these subcontractor performance ratings at the end of each project?
    - *Yes*
- Do you think a performance tracking method would be helpful to creating a stronger "sub pool" for general contractor, if a there were platform to share feedback with subs?
    - Yes, or at least give the team for the new project a heads up on what they'll need to focus on with each subcontractor.
- If you had seen a performance scorecard prior to subs starting from a previous project do you think you would have had a better idea of what to expect of their performance and how to approach/plan for their team, as well as avoid the same issues from the previous project ?

- *Yes! I think having the contact information for those who have reviewed the subcontractor beforehand if the team were to have questions for them would be extra helpful*

- Do you think if we were able to share feedback with subs, we would be able to increase their performance and build stronger relationships with the General Contractor?
    - *As long as it's not always bad feedback and that it's put in a way of constructive criticism, I think it'd be helpful. This will also just depend on the sub and who is giving that feedback I think*
- Do you find the scorecard helpful in any way?
    - *I think the information is helpful, but I'd hope that the person filling it out is putting the adequate amount of time towards the survey. Also, maybe if the performance criteria were formatted in a color scale for quick viewing, that could be helpful for reviewers.*
    - *Yes, it gives someone who hasn't worked with a subcontractor information on the trade from a reliable source. It would also help better plan and give knowledge to get ahead of the problems on the next job with that trade instead of repeating them.*
    - *The scorecard is short, but very telling of the sub's performance. We saw the exact same behavior and manpower on this job, despite it being much larger. (In reference to mechanical sub contractor's performance from Project 1 to the newly awarded project.)*

- Do you believe that the right foreman and project manager can change the trajectory of a job? (Feel free to expand on this)
    - If anyone says "no", I challenge them. *Yes, I definitely think the right team members (not just Foreman and/or PMs) could change the path of the project. Not only from the sub side but from the GC as well. If there are certain GC people that have better relationships with certain subs than others on the team, maybe that should be a topic of conversation initially.*
    - *Yes, absolutely. The workers can be self-motivated, but if there is a lack of direction, support, and coordination from management, even the most talented workers will flounder.*
    - *Yes, the foreman and project manager are key to the performance of the workers below and around them. If the attitude of the foreman or project manager changes it creates a rippling affect not only throughout the workers below them, but also the other trades around them.*

What are your top 3 qualities in a foreman?

- *Lead by example, Open minded to industry topics such as Lean and new ways of doing things, proper communication*
- *Strong leadership, Understanding of project schedule, Willingness/ability to push production as needed*
- *Problem solving, Competent in work area, works well with own employees other trades and the GC*

Top 3 qualities in a Project manager

- *Leadership, Open Minded, Proper Communication*
- *Strong understanding of project schedule, Willing to provide all needed support to site crews, Honesty*
- *Communication, Leadership, and problem solving*

CONCLUSION

Based on the results collected from this survey it can be determined that evaluating performance of subcontractors can be beneficial to the general contractor's team. The information can help to prepare the team to manage the subcontractor on the next project awarded, serve as a project reference of past jobs, as well as serve as the next team for the manage new projects. It has also been noted that the responses garnered from these surveys can be used to bolster the relationship with subcontractors if approached from a view of constructive criticism and by showing that improving will help the overall project success, for both parties.

A project's success is still dependent on the iron triangle of the cost, time, and within specification. However, the responses of the survey are an indication that achieving those goals are also impacted by other key performance indicators and task specific key performance indicators, as is supported by the literature review research. The feedback responses collected at the end of the survey were the most insightful into capturing the perspective of how subcontractors' performance can be viewed from the GC's team. These responses pointed out that setting the right environment with project leadership, to include members of both the subcontractor and general contractor sets tone for the rest of the employees to follow, and can thus have potential to affect the outcome and success of projects.

Reponses from the survey noted that crews with foremen that were not knowledgeable lacked in areas of showing good leadership and had "poor" performance ratings. Likewise, crews that had PMs that were ill equipped to provide resources to their foremen also had poor per performance ratings from the survey responses. Conversely, those with open relations with the subcontractor from the GCs side can also lead to positive discourse at end of the project.

The smaller sample size of the survey participants and project presented some limitations to the research. The questions asked were tailored to the programs implemented by the GC and thus required input from the GC team to recognize the accomplishments of the subcontractor, while the remainder prompted for a subjective review of their work. This combination of questions led to good responses in the feedback category which became the highlighted success of this research.

To add to the responses received on this survey, in future works additional quantitative data can be collected for this survey by possibly reviewing the tracking mechanisms that projects have in place for subcontractor deliverables against the survey questions that are based on truning in deliverables. As a project success and subcontractor relationship survey, adding that component of quantitative data would be more impactful if; 1) all projects committed to tracking these deliverables 2) the tool used to track these deliverables are consistent across all projects.

Other future works for this research could include,

- Expanding on the qualities of a good Foreman and Project Manger
- Expanding the Survey to reflect the Foreman and Project Manager Performance
- Reviewing GC Team Performance from the Subcontractor's Point of View to create a lesson's learn for the GC team as well

In summary, evaluating the subcontractor's performance at the end of the project by the onsite general contracting team is a beneficial tool. This can be used to provide feedback on subcontractors' performance as well as aid in continuing to build successful trade partner relationships between the GC and subcontractor teams

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APPENDIX

Survey Questions

Copy of Survey:

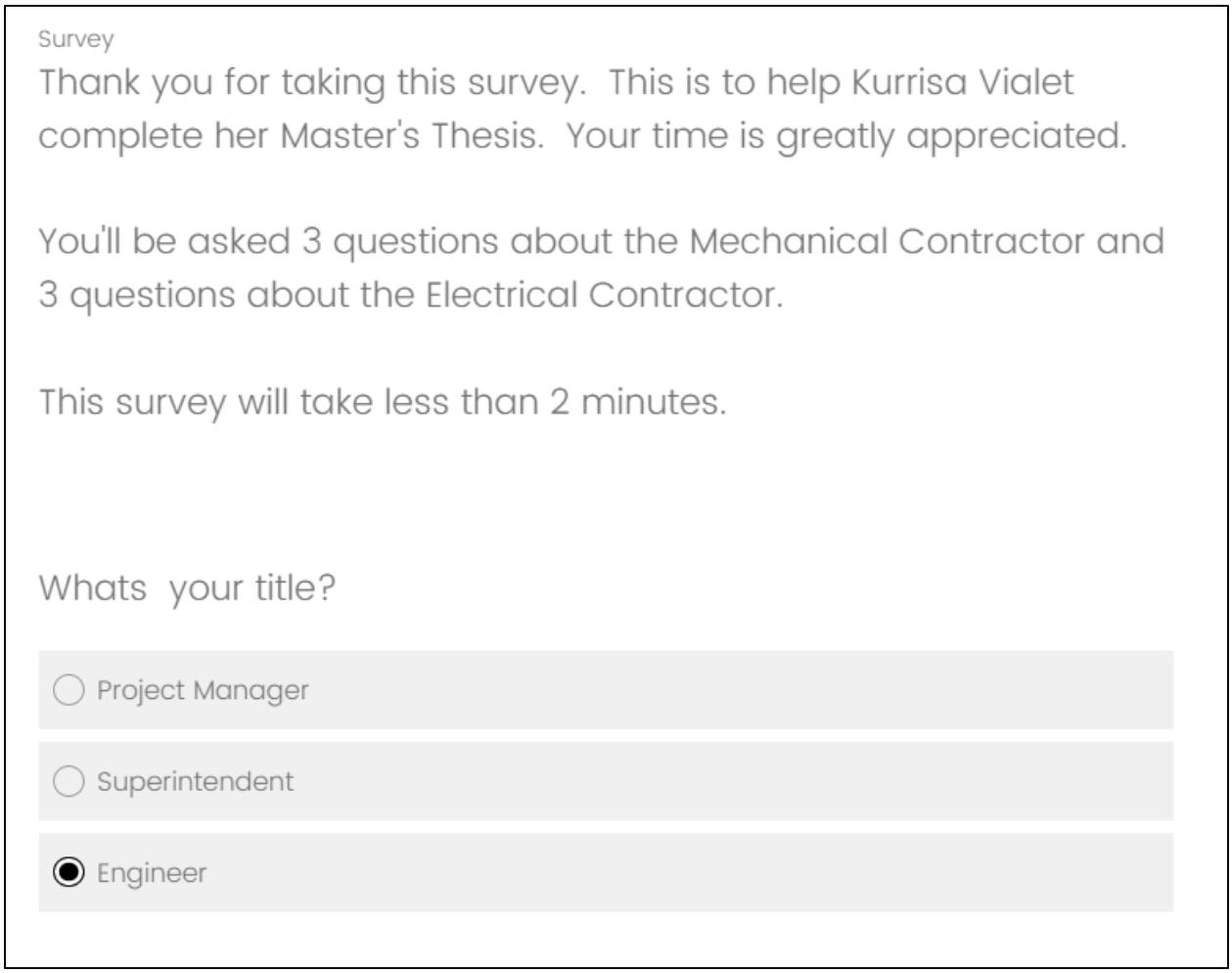

Figure 8: Survey Introduction

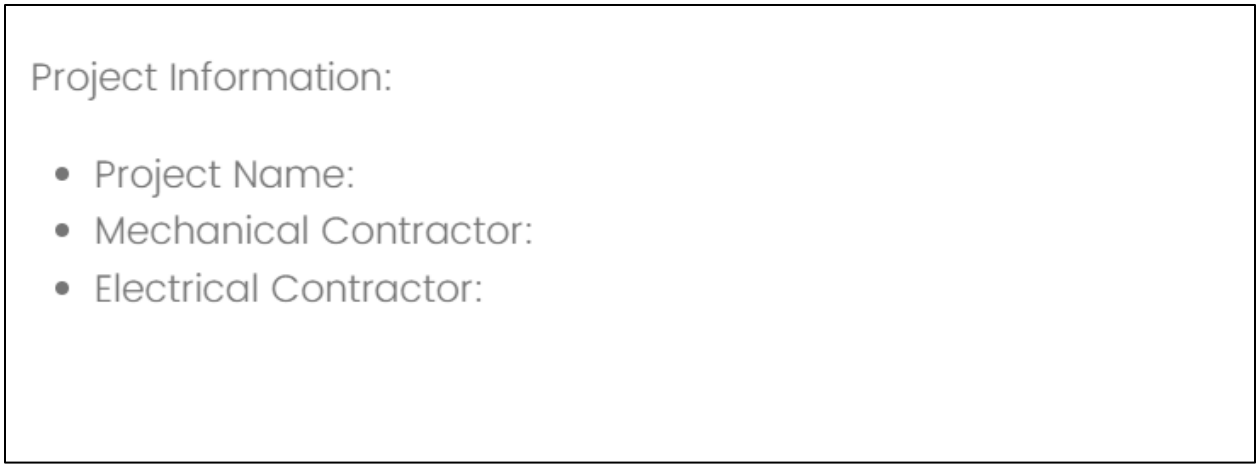

Figure 9: Project Information- Auto filled on Qualtrics

Survey

Please rate your level of agreement with the following statements.

Company:_

Project Name:_

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
Compliance with Safety Rules to include PPE and Ladders last	◯	◯	◯	◯	◯
JHA and PTPS were Quality	◯	◯	◯	◯	◯
Attendance at Stretch and Flex	◯	◯	◯	◯	◯
Turned in submittals on a timely basis	◯	◯	◯	◯	◯
Stayed up to date with drawing revisions	◯	◯	◯	◯	◯
Identified constraints ahead of schedule	◯	◯	◯	◯	◯

Figure 10: Survey- Engineering Questions

Survey

Please rate your level of agreement with the following statements.

Company:_

Project Name:_

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
Compliance with Safety Rules to include PPE and Ladders last	◯	◯	◯	◯	◯
JHA and PTPS were Quality	◯	◯	◯	◯	◯
Attendance at Stretch and Flex	◯	◯	◯	◯	◯
Submitted change orders and pay apps on a timely basis	◯	◯	◯	◯	◯
submitted change orders and pay apps were fair	◯	◯	◯	◯	◯
Project Manager kept a good relation with Turner	◯	◯	◯	◯	◯

Figure 11: Survey- Project Manager Questions

Survey

Please rate your level of agreement with the following statements.

Company:

Project Name:_

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
Compliance with Safety Rules to include PPE and Ladders last	◯	◯	◯	◯	◯
JHA and PTPS were Quality	◯	◯	◯	◯	◯
Attendance at Stretch and Flex	◯	◯	◯	◯	◯
Installed quality work	◯	◯	◯	◯	◯
Managed and maintained man power well throughout project	◯	◯	◯	◯	◯
Meet scheduled milestones and stated up to date with WWP commitments	◯	◯	◯	◯	◯

Figure 12: Survey- Superintendent Questions

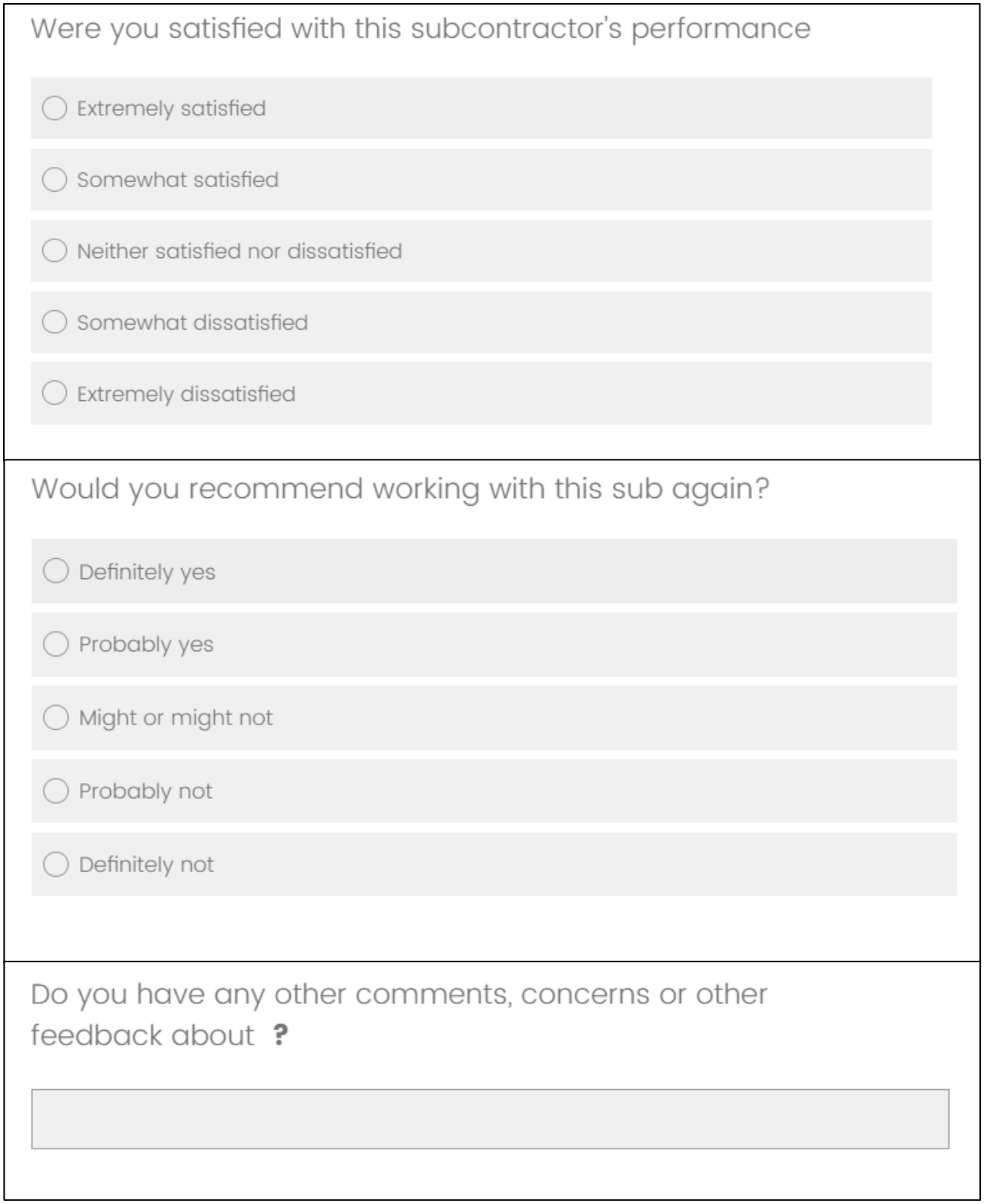

Figure 13: Survey - Future Work Questions