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Identifying private construction project owner inefficiencies that affect project goals

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Identifying private construction project owner inefficiencies that affect project goals

by

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NOMENCLATURE

ICC	International Code Council
AISC	American Institute of Steel Construction
ACI	American Concrete Institute
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
BIM	Building Information Modeling
DOT	Department of Transportation
PPF	Project Performance Factor
OCB	Organizational Citizenship Behavior
PCB	Project Citizenship Behavior
CWB	Counterproductive Work Behavior
HVAC	Heating, Ventilating, and Air Conditioning
OPR	Owner Project Requirements
COAA	Construction Owners Association of America
DBIA	Design-Build Institute of America
AIA	American Institute of Architects
RFI	Request for Information
Subs	Subcontractors

ABSTRACT

Construction project owners play a critical role in the pre-construction, construction and post-construction phases of a construction project. Their role on the team has not been properly analyzed to inform owner employers of the shortcomings project owners may display during a project. In order to identify these inefficiencies, project teammates have been asked to evaluate owners' responsibilities and actions, specifically those that display a need for improvement.

Designers and contractors were asked to participate in this research study. The study began with a series of two surveys, followed up by a comprehensive interview. The surveys asked the designers and contractors to identify, define, and label the frequency of project owner areas of improvement, as they relate to the four construction project goals: quick schedule, low cost, high quality, and effective citizenship behavior. The interviews helped explain specific inefficiency incidents to gather realistic understandings of how they affect a construction project. Industry case studies were written, and a team member satisfaction survey was created to provide tools for project owner employers to use in their education and training efforts.

The most frequent owner inefficiencies that occur on construction projects include making various changes to the original scope and design, unrealistic or compressed schedules, ill-defined project scopes, insufficient or incomplete budgets, lack of proper communication with team members, missed deadlines or delaying responses, lack of trust among team members, and focusing only on the initial cost when choosing products and equipment for a project.

CHAPTER 1. INTRODUCTION

There appears to be an immense amount of research on construction project managers in relation to their project skills, roles and responsibilities, areas of improvement, and how their roles vary on different types of projects. Robert Goodwin (1993) discusses specific skills required to be an effective project manager and digs into the essential conceptual, human, negotiation and technical skills required. Arditi and Alavipour (2016) have also conducted a recent research study, comparing the results to a similar study performed ten years prior regarding the roles and responsibilities of a typical project manager in construction. Even a mathematical application was developed to determine the skill level of project managers; due to the determination that without a tool checking the competency of project managers, it would be difficult to pinpoint potential areas of improvement for them (Hanna et.al, 2012). These examples are just a few of the countless studies performed on project managers.

While it may be said that project managers are the central members of a construction team and the glue that holds all members together, project owners create the concept and initiate the project process. This includes selecting the remaining team members, who design and construct the project. Owners assist with the design process in order to achieve the proper layout and function, aid with the construction process to monitor quality, and make on-site adjustments. Owners play a very important role in the construction project team. Owners should be involved in all steps of the project, and research attention should be focused on improving owners' practices for more successful project outcomes. That being said, there is little, if any, research analyzing the owner's role and identifying areas of improvement to improve this position.

There are three primary goals that a project owner aims to achieve during a construction project, which including having a low cost, fast schedule, and high quality. One way for a project's cost to potentially be lowered is when the owner is knowledgeable about the project's engineering and architecture processes, allowing the design to be value engineered (Clark, 2005). Delays in construction have numerous impacts on a project including equipment, workforce, and material availability; move in dates; team dynamics; and overtime work. Poor communication can keep an owner from properly monitoring the quality and expectations of the project. Each of these effects lead to an overarching idea that time is money, specifically the owner's money. Owners can affect the outcome of their goals depending on their own capabilities and technical skill sets. However, this research study has added a fourth primary goal for a construction project, which is designed for the entire project team: project citizenship behavior. This citizenship behavior puts an emphasis on practicing team goals, rather than focusing specifically on individual goals.

Construction project owners show room for improvement in their technical skills and common practices, specifically in construction management, which cause clear inefficiencies that hinder project success (Assaf, 2006; Clark 2005). These inefficiencies result in delays to the project, cost overages, poor quality of work, and a frustrated project team. The owner holds the ultimate role in making major design, functionality, legal, and aesthetical decisions. So, how can a construction project owner become better equipped to assist with project success? Contractors and designers have firsthand knowledge regarding how owners could do a better job contributing to the project in a positive way to help eliminate goal-hindering issues. By improving the owner's

contribution to the project, all members of the team can save time, money, produce quality results, and build relationships for potential future work. This is not to say that only project owners have room for improvement, but rather all team members have room to grow; this study will only begin the process by looking at one team member.

This research focuses on owner's roles and responsibilities, particularly those that currently prove challenging for other team members, according to the perspective of the contractor and designer. It is understood that the construction industry is very broad and includes multiple sectors, so for the purpose of finding a general understanding of owners that hold similar roles, this research will analyze the private sector of construction projects producing building structures.

Purpose Statement

The purpose of this mixed methods study is to discover the inefficiencies of construction project owners, in order to recognize the areas of improvement required to produce more successful project. Once these are identified, project client companies can use the newly developed data to further their education and training to produce better-equipped owners to lead construction project teams.

Definition of Terms

This research falls in the construction, more specifically construction management, industry. Industry specific lingo and terms will be used to discuss the research study; these terms are defined for reader convenience.

General Contractor: General contractors provide management and supervision of a construction project, while also contributing to the subcontractor and supplier hiring and management process (Dey, 2014).

Construction Manager: "The duties and responsibilities of a construction manager are identical with the general contractor. However, the CM is not involved directly on the jobsite where the general labors or other trades work" (Dey, 2014). Construction managers are typically involved early in a project and can be hired by either the project owner or the general contractor.

Project Manager: The lead representative for the general contractor or construction manager. Typically guides the construction project team.

Private Sector: The owner, or client, company is operated via private funds. The owner is not employed by or operated by a government employer.

Building Projects: Construction projects that focus on a specific building structure. The building can be used for any purpose including commercial, educational, residential, medical etc.

Educate/Education: Not specifically related to school or university settings. Education can refer to company trainings, external courses, mentorship programs, etc.

Inefficiency: Failure to operate in the most productive manner. A role or responsibility that shows a need for improvement.

Contractor: Group of individuals or companies relating to general contracting, construction management, subcontractors and suppliers.

Designer: Group of individuals or companies relating to architecture and engineering.

Critical Path: Tasks on the construction schedule whose duration cannot be extended without delaying the project completion date.

Owner Rep: Owner rep stands for owner representative, or someone hired by the owner to perform specialized work for the project such as a specialist in construction, finance, or management. An owner rep can also be a member of the owner's team.

Research Questions

Research questions are formed to narrow, or predict, the outcomes of the purpose for the study (Creswell, 2014). This experiment will focus on three central questions. These questions are respectively correlated to the three phases in the project methodology. These central questions are the following:

1. According to designers and contractors, what inefficiencies do owners possess that may possibly obstruct or impede the path to achieving each of the four project goals: quick schedule, low cost, high quality, present citizenship behavior?
2. What are the most commonly identified inefficiencies for each of the four project related goals and how frequently do they occur?
3. How do these inefficiencies specifically affect a project's ability to achieve its goals?

Secondary questions will be discussed in the Chapter 3: Point of Departure.

CHAPTER 2. LITERATURE REVIEW

A literature review provides a foundation for the research study. First, an overview of the entire private sector construction, specifically the real estate project process is presented to understand where specific project tasks initiate and conclude. Project team roles are described to distinguish relationships between team members and project tasks. The research study's goal is to produce owner roles to be improved upon relating to project goals. This literature review will provide a comprehensive discussion on project goals and examples of why goals are not always achieved as intended.

Phases of a Construction Project

Phases of a construction project may differ depending on the type of project at hand. Specifically, this outline concentrates on private sector, building structure projects. Often times while examining a new construction project, common phases may include ground breaking, building the structural frame, installing the exterior facade, and placing the interior finishes. In reality, these tasks are not considered phases of a project as a whole, but rather subcategories in the all-consuming construction phase of a project. Projects expand to far more extensive categories reaching from the very first thought of concept, to the delivery/turnover of a successful project to the owner. The process requires extensive support from a variety of parties in "areas as financial organizations, governmental agencies, engineers, architects, lawyers, insurance and surety companies, contractors, material manufacturers and suppliers, and building tradesmen" (Clough, Sears, & Sears, 2000, pp. 2). The addition of these project players entails added steps and sometimes barriers that can extend the duration of the project schedule. Sometimes the non-physical construction phases can double or triple a project length, depending on the

complexity and citizenship behavior of the various parties. It is essential to understand each phase of a project and connect responsible parties to project tasks.

A construction project can be split into three main phases: pre-construction, construction, and post-construction (Klinger & Susong, 2006). Each of the three phases has various sub-phases called 'stages' that breakdown the project into similar tasked categories. Figure 1 provides a visual description of the three phases and eight stages of a construction project.

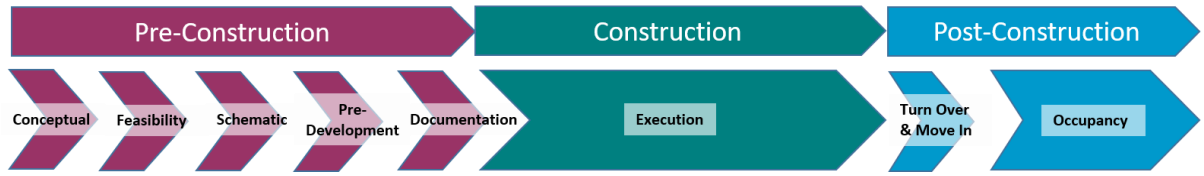

Figure 1: Phases and stages of a construction project (Adopted from Smith, 2018)

Pre-Construction

The pre-construction phase is an all-encompassing time period between the initial speculations of a potential project, to the day when workers first break ground on the site. This phase is broken into five stages that focus around the 'who', 'what', 'when', 'where' and 'how', needed to perform work for the project.

Figure 2: Pre-construction stages

Conceptual stage

The conceptual stage is the first stage for the total real estate project. This stage stems from an individual, group of individuals or a company in desire of a new space or

additional space for a specific function or task. This person, group of people, or company is called the 'owner'. The need for the potential project sparks the concept, or vision, of the design (Smith, 2018). This stage identifies the requirements of the end occupant at a macro level; there are not many specific details at this point (Abdul-Kadir & Price, 1995). Tasks included in the conceptual stage center around the project owner, while he or she defines the scope and may give very rough estimates of potential cost ranges and a requested timeline (Abdul-Kadir & Price, 1995). At this time, the owner may make early contact with an architect to provide these initial project intentions and receive feedback to gain perspective on scope definitions. The owner, and any owner consultants, will begin to think about what type of project delivery and procurement methods will be used. These methods will define the format of the project, along with communication streams.

Delivery methods

A project delivery method is a complete outline of the design and construction process for a particular project (Shane, 2018). The chosen delivery method will provide a framework for the contractual partnerships and information tunnels. There are three commonly used delivery methods: design-bid-build, design-build, and construction manager. Each method provides certain advantages and disadvantages, which the project owner must weigh to choose the appropriate framework for the given project.

In the design-bid-build delivery method, the project owner enters into a contract with an architect and engineer. These designers produce plan sets and a specification book, which will be used by the owner to bid out the project to a construction company (Hale et al., 2009). The owner then enters into a separate contractual relationship with the prime contractor, who then hires subcontractors to perform various trade work.

In contrast, the design-build delivery method eliminates the separation of design and construction contracts. The owner enters into a contract with one firm who is considered a 'design-builder', where the company takes on both the design and construction roles. The company may also subcontract out missing design or construction roles themselves to supplement their contract with the owner (Klinger & Susong, 2006). Either way, the owner is only bound to one major contract. A significant advantage to this method over design-bid-build is the streamlined communication between the designers and the prime contractor, since they would most likely operate in the same company. The ease of flow for communication, and perhaps the incentive to better cooperate, may eliminate potential issues otherwise dealt with by the owner. To counter this point, the streamlined communication may also give opportunity to cover problems or withhold information that the design-builder may not want the owner to be aware of.

Oftentimes, design-bid-build projects have a longer project schedule compared to design-build, due to the added steps required to bring all project team members onboard, and the inability to begin construction until design is fully complete. By saving time on the project schedule, this proves as an advantage to the design-build method to save on project costs (Shane, 2018). As for the project owner's role in the delivery method process, experience level will play a key role. Design-bid-build projects require owners to deliver complete and accurate plans to the bidding contractors, implying the contractor has no input into the project design (Shane, 2018). If the owner would like the designer and contractor to work together on design, as in design-build, the owner may be able to take a backseat role in the design and logistics development periods.

The final common project delivery method involves a construction manager. There can be two iterations of the construction manager's role. One has the construction manager at risk, meaning they are responsible for contracting with the project builder. The other has the construction manager acting purely as a construction consultant for the project (Shane, 2018). Again, depending on the type of project, and the owner's expertise in construction, the project delivery method will help guide the owner through the framework of the project.

Feasibility stage

Once the potential project has been defined, more members of the project team become involved. The owner will reach out to financial analysts and lenders to gauge the interest of project funding. The owner must be experienced enough to take on the financial risk and burden of the project. However, at this stage, no final contracts or funding agreements will be made. The architect may provide generic models to the owner to confirm both parties are on the same track. In some cases, estimators or pre-construction specialists may be hired to create a reasonable price range to verify the funding will support the previous scope defined.

A major aspect of this stage is written right in the name: feasibility. Can this project realistically occur? Can this scope be approved (Smith, 2018)? The approval will come from a variety of organizations. One very essential approval is from local councils or governments. There are often many zonal requirements that new development projects must follow. The local government can quickly shut down a project concept by declaring the scope is not feasible in the desired location. It is important to contact local offices and follow their guidelines. In general, project teams will need to submit initial

site plans and building plans to the local jurisdiction for approval, after approval the team may apply for the building permit (Brouwer, 2016). These steps make take several months for the plans and forms to work their way through the process, however it may not be financially smart to continue with the pre-construction stages without the feasibility approval. In general, the feasibility stage is used to "provide the [owner] with an appraisal and recommendation in order that he/she may determine the form in which the project is to proceed, enduring that it is functionally, technically and financially feasible" (Abdul-Kadir & Price, 1995, pp. 388).

Schematic stage

The schematic stage targets the project outcomes to determine if the scope and cost is worth the owner's risk. Financial expertise may be heavily used in this stage to determine the project's return on investment, future leasing values, yearly budgets, and analyzing interest rates offered on project loans. The question of 'how will the project perform?' must be answered; if the response is poor, the owner may reconsider moving forward with the project process (Smith, 2018). Each stage in the process adds a greater financial commitment. It is critical to accurately forecast the project financial outcome, as to not lose money or risk being unable to pay off the construction loans. This is the last stage to make major decisions to move forward or not, in order to avoid major economic loss.

Pre-development stage

Pre-development is a broad term, and this stage includes a wide variety of tasks. This stage requires considerable design work, with the final plans producing the bid documents. These final design documents allow general contractors and subcontractors

to bid on the project scope. A request for proposal will be distributed to potential bidders with information on how to bid and what requirements need to be included. Design does not need to be fully complete, but close enough to ensure bids will not be dramatically altered per the final design. Throughout the pre-development stage, all potential members of the project's team will become involved. Major partnerships are identified and significant financing is required (Smith, 2018). If the project involved a commercial property, an owner's role will expand to reaching out to potential building tenants for pre-leasing spaces. This gauges a perspective of how interested businesses are in occupying the new space. Deposits will be submitted as a symbol of commitment.

Ryan Companies, a development and design-build firm, expressed that as a general rule of thumb, the company will not move forward with a project without at least a 75% chance of success. This value then dictates their pre-leasing value of at least 50% (Smith, 2018). That implies that prior to moving closer to the construction phase, the project must have at least 50% of its leasable space legally committed to by a future tenant. Generally, individuals and businesses do not place deposits, without intent to sign future contracts, which brings financial security to the development company.

Procurement methods

When the owner is ready to send out a request for proposals, the next step would be to evaluate potential options for selecting the contract partners; these are called procurement methods. There are three types of procurement methods commonly used: low bid, qualification based, and best value. Each name gives away the definition of the method. For low bid, the owner has determined that cost is the most crucial aspect of a contractor's bid. The lowest bidder, regardless of the company's background, will be

awarded the contract for the project. In contrast, qualification based method holds high standards to the type of contractor behind the bid. The owner must dedicate time to research the bids by looking at all bidders' previous work, ethical norms, prior experience with the owner, and the company's ability to responsibly complete the work (Shane, 2018). In essence, a bidder's qualifications will win them the award for a project contract. The third procurement method is best value. This method takes into account both a company's bid price and their qualifications to complete the project scope. To choose a proper procurement method for a project, an owner must prioritize project resources and deliverables.

Contract types

In the request for proposal, owners must clarify what type of contract will be used for the given project. This alerts proposers to format their prices in an easily comparable style for an owner to review and analyze. Construction contracts can vary heavily on owner preference, but generally follow three known options. First would be a lump sum contract, in which the bidder provides one price to represent a specified amount of project scope (Shane, 2018). Generally, the contractor would associate the entire scope on the project plan sets and specification book, and provide one final project price. This could also be true for subcontractors bidding the project, but they would need to specify which scope division their price tag represents. The contractor holds the primary risk for the project, as they are responsible for footing the bill if the project costs more than expected, or they miscalculated scope that they included in their bid (Shane, 2018). However they also may have financial gain if they complete the project under the lump sum price.

The second contract type is unit price. A contractor would provide a specific price for each 'unit' on the project. Units could be split into various work such as $/sf of carpet, $/toilet accessory, $/cf of concrete, etc. This implies less risk on the contractor, and more on the owner, as the owner is responsible for any significant issues that arise, that may not be specified in the plan sets. The contractor still takes on some risk, as they are responsible for the accuracy of the unit price they budgeted.

The final contract type is cost plus, which can be used in two formations: traditional cost plus, and cost plus guaranteed maximum price. The contractor will bill the owner for all actual project costs, while also including an additional fee (Shane, 2018). In this sense, the owner essential receives what they pay for, and the contractor reaps an agreed upon fee. In the guaranteed maximum price scenario, the same rules apply with the exception of a maximum project cost that they contractor cannot bill the owner over. This gives the owner a bit more security in that the project costs will not exceed the maximum, in the event that the contractor makes unwise financial decisions. The contractor would then have to pay for the remaining costs.

Deciding on a contract type involves the owner aiming to take on a specific amount of financial risk on the project. Financial risk could be a positive outcome if the project is performed well and few problems arise, the owner may save on originally anticipated costs. However, the risk could exude a negative result, and the owner could end up paying more than originally budgeted.

Documentation stage

Documentation is the final stage in the pre-construction phase. This stage includes making decisions by identifying final project team members and signing official project

contracts (Smith, 2018). Lawyers become heavily involved by reviewing all contracts and supplemental documents for potential risks and responsibility clauses. The chosen contractor would hire on all subcontractors to perform trade work. Prior to the start of construction, all design documents need to be completed, and all project team members need to review updated scopes of work.

An owner needs to verify that all land purchase documents are finalized, to allow construction to take place. There is typically a breaking ground ceremony, which involves all major project team members. This ceremony can be used as a marketing campaign for the future building, by inviting the local community to become involved, and get people excited for the future space. If the project is a commercial or residential project, the owner will need receive signed leases for future tenants. This process will extend throughout the construction phase, to continue leasing the future units. The breaking ground ceremony will conclude this stage and open the door to the construction phase.

Construction

Now that all pre-construction stages are completed, all partnerships are defined, contracts are signed, and direction is configured, mobilization to the site may occur. Heavy equipment may be transported to the site, temporary offices for contractor and subcontractor workers will be secured and safety boundaries for the community will be outlined (Klinger & Susong, 2006). Mobilization is a cost that will be included in project bids, as they are typically a significant investment for companies (Klinger & Susong, 2006). Once equipment and material is located on site, construction may begin.

Figure 3: Construction stage

Execution stage

The execution stage is where the physical delivery occurs on site. Prior to each trade work company beginning work on site, the general contractor will host a pre-construction meeting for that trade. For example, approximately 2-4 weeks before roof work begins, the contractor, roof subcontractor, architect, and engineer will need to meet and verify all scope items to be constructed. This gives all parties a chance to ask questions, meet supervisors, and verify design work and materials. Once all questions are answered and all team members feel comfortable with the outlined scope, work may begin. This will continue to occur throughout the execution stage of the project. The most hands-on project members for the construction phase are the contractors and designers. The owner may be used as a resource for clarifications, but ideally the majority of the owner's decision-making period is complete by the construction phase.

Major milestones in the execution stage include the topping out ceremony, becoming weather tight, and completing interior finishes (Klinger & Susong, 2006). A topping out ceremony, similar to the breaking ground ceremony, involves all project team members and can be used to help market the project to the public. The event implies the topping off of the final structural component for the vertical construction of the project. For example, this could be setting the final steel beam on top of the building, or

placing the top floor of the concrete slabs. When a project becomes weather tight, this signifies the project to have a completed roof and exterior facade, including all window and exterior door installation (Klinger & Susong, 2006). Lastly, the construction phase ends with the conclusion of all interior finishes, allowing the project to be functionally and aesthetically complete.

Post-Construction

The post-construction phase includes the final turnover of the project to the owner, however it extends through the lifecycle of the project. The occupancy of space involves maintenance and upkeep, which will last for the remainder of the building or space's life, or until the owner chooses to sell the project.

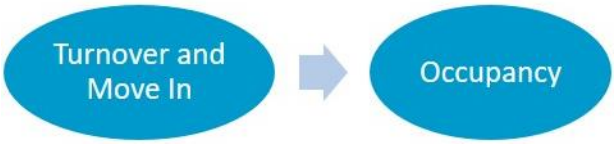

Figure 4: Post-construction stages

Turnover and move in stage

The most important aspect of a project turnover phase from a feasibility point of view, is the sign off, or approval from all appropriate city inspectors (Smith, 2018). Certain subcontractor work will require significant testing and inspection measures. Major trades requiring these practices are mechanical, electrical and plumbing contractors. Review of work on site by these inspectors can truly make or break a project turnover, which is why it is important to make connections to inspectors early on, to ensure proper guidelines are followed and no surprises are presented at the very end. The last and final inspection concludes with a Certification of Occupancy. This

certification allows the space to be used by the general public and suggests that the site is safe to use without the need of personal safety equipment. Once the certificate is achieved, the project may be handed over from the contractor's responsibility to the owner's responsibility.

Owners and architects require punchlist walkthroughs near the end of the construction phase (Smith, 2018). A punchlist walkthrough involves the contractor, architect, engineer, owner, and any other interested stakeholders, physically walking around every possible space on the project. During this walk, each party points out places that are incomplete or need to be adjusted for quality purposes. Oftentimes, this includes paint touch up and fixing drywall dents, but it can be as extreme as incorrect placement of bathroom accessories, or poor quality tile work that needs to be replaced. A resolved punchlist ensures that the work performed is adequately up to the owner and designer standards.

The contractor is required to produce, or turnover, certain documents to the owner prior to project completion. These documents are bundled into an 'Operations and Maintenance Manual' (O&M). The O&M manual includes warranties for material used and work completed, product specifications used for future maintenance, and operation guidelines for equipment installed on site (Smith, 2018). Typically, the owner obtains a copy of these documents and also gives a copy to the company who will act at the property manager for future occupants.

In the final step of the turnover stage, the owner will allow building occupants and tenants to move their equipment and furniture into the space (Smith, 2018). The

turnover and move in stage's purpose is to educate the owner of all building operations, so the contractor can soon step away from holding the building's upkeep responsibility.

Occupancy stage

The last stage in the entire real estate development project is occupancy. The owner will hire a property manager to maintain the building operations. The owner will also begin to collect possible rent and translate those incoming funds into construction loan payments (Smith, 2018). The occupancy stage will last the length of the building or project life cycle. The building will require maintenance to retain safety and health measures. By reaching this stage, the project has been completed for building occupants to enjoy.

Construction Project Team Roles

The previous section regarding project phases identifies numerous entities that could all be considered part of the project team. Each one has a commitment to the team and is necessary to deliver a final successful project. For this specific research study, the project team will be simplified to three main contributors: owner, designer, and contractor. These three parties will each be a combination of similarly tasked team members. All three contributors will be fully described, along with identifying specific responsibilities.

Owner

This research study focuses on the owner's role. The term 'owner' must then be properly classified. Public project owners are "typically agencies of federal, state or local government" (Klinger & Susong, 2006, pp. 56). While private project owners are

"individuals, businesses, partnerships or any combination thereof" (Klinger & Susong, 2006, pp. 56). This discussion will target private project owners.

There are three possible roles that the project owner could represent. The first being the individual or company that legally owns the property, and they plan to retain the property at project completion. An example of this could be a private company wishing to expand their warehouse to the neighboring property. The company would purchase the land and then use the building once the project is completed. Another example could be a private developer, who specializes in creating condominium units. The private developer would purchase the land and then own the multi-family building that is constructed. Although the private developer may not be using the building themselves to live or work in, they may still own and operate it.

The next option is for the owner to be a development company purchasing the land and funding the construction, with the intent to sell the project at completion. In this case, developers would specialize in turning over empty land and creating projects that other entities wish to own and operate. The final option is for the owner to be the final building occupant, while having no ownership rights to the land or building. The project would most likely be designed specifically for this owner, however the project owner would pay a contractual lease to the property possessor, to occupy and use the space. This case would occur when an owner does not have the capital to construct the project, or does not want to take on the financial risk of owning the property. A separate private company may own the land, with no preference on design or function, but has the capital to fund the project and is interested in reaping the rewards of the leasing agreement. An example could be a large retailer in need of a new warehouse. The retailer may wish to

only rent the property. The company that owns the land would allow the project to be designed based on the retailer's needs. Most likely there would be a long-term contract in place to provide the property owner with financial security.

Now that the term 'owner' has been defined, it is important to understand the owner's roles and responsibilities. The project owner is the legal representative and initial member of the project team (American Society of Civil Engineers, 2012). The owner chooses the remaining project team based on the project's needs. Ideally, the owner is researching contractor and designer expertise to find the best possible fit in correlation to the project goals. Of course, each project has a unique set of goals, but typically they consist of having low cost, quick schedules and high quality of work (Clark, 2005). The owner initiates the project, bringing it into existence. All projects are conceived by the presence of a 'need' of space and function. The first role of the owner is to determine what the purpose of the project is, and how the project will be used. For example, the owner could be Iowa State University. A specific college may show a need for a new building on campus, due to the rise in student enrollment. The university would not consider a project without properly identifying the need and justifying associated costs.

The owner may be a local hospital, where the hospital representative is aware of the patient and employee demand to build an addition to an existing cardiology complex. If the owner is a private developer, he or she may come across some highly sought after land for sale, on which they can build a new apartment complex to lease out in an overpopulated and under-housed neighborhood. For some owners, "their company's new construction project may represent one of the largest corporate investments they

will ever make, and it is one in which it is wise to proceed carefully and systematically" (Levy, 2010, pp. 3). Projects are not built without intention; the concept is generated from the owner's necessity for having new or additional space.

Once the project is selected and the intent is perceived, the owner's role does not end there. Major decisions need to be made in regards to project delivery system, procurement method, and contract type (Levy, 2010b). These decisions help identify the remaining team members for the project and their relationships with the owner. Oftentimes owners may not be aware of the benefits and faults of each delivery, procurement and contract option. This can greatly influence the project's framework and can impact the success of project goals.

According to the American Society of Civil Engineers (2012), "the owner should be familiar with basic project management concepts and practices, such as preliminary planning, design, life-cycle cost analysis, peer review, alternative studies, value engineering, construction, contract administration, and the shop drawing review and approval process" (pp. 9). Owners are expected to contribute to the process throughout the design phase and construction phase, adding valuable opinions and approvals to the design and materials. Leaving the design solely to the architect and engineer can have severe consequences related to costs and schedules. Architects are capable of designs very unique and aesthetically pleasing results, however if the owner does not properly communicate his or her intentions, the design may quickly swell out of cost proportion.

Levy (2010a) expands his guidebook to discuss the owner's role in the design process, and states, "Some owners may not have experience in interpreting two-dimensional designs and all those lines on the drawing, and if that is the case, it is best to

ask the architect to explain those arcane symbols and lines" (pg.42). This statement suggests that the owner may be unable to read 2D construction drawings. Many design and construction firms have realized this inefficiency and have taken steps to reduce issues relating to the inability to interpret 2D drawings, by investing in high quality 3D modeling software. These programs allow project team members to virtually walk through the building and get a better feel for project outcomes. This can help identify design flaws or dissatisfaction early in the project.

Communication is a vital element during a construction project. Construction owners are central to the communication band, and act as the role model for other members. Owners will be better satisfied with a project if they have frequent and effective communication with all people in the team (Clark, 2005). Communication efforts should be applied to every single task team members take part in during a project. Specifically for the owner, communication can mean responding to questions in an appropriate amount of time; reviewing and approving submittals with effective notes if adjustments are needed, and paying contractors and designers on time, letting them know if there will be issues or delays.

Designer

For the purpose of simplification, the term 'designer' will be considered a combination of the project's entire design team. For the role of the architect, the term will be a combination of all representatives who contribute to the aesthetics and functional design. The positions include architect, interior designer, landscaper, lighting designer, acoustical designer and any art or finishing consultants. For the engineering role, this position will be a combination of all engineering work required to be compliant with all

required codes. People who execute civil, structural, mechanical, electrical, geotechnical and environmental plans would all be included (Klinger & Susong, 2006).

Architect

An architect is often the first partner brought onto the project by the owner. The architect aids the owner in many of the pre-construction stages. Starting in the conceptual stage, an architect may be approached to provide concept drawings that show very broad understandings of the owner's vision (Smith, 2018). The majority of the architect's work takes place throughout the pre-construction phase, specifically in the pre-development stage. This is where the bulk of the project's plan sets and the specification book is established.

It was not until the turn of the 20th century that the architect's role changed from being the sole provider of design input, to the leader of a well-managed team of experts behind a project design (McBride, 2013). As buildings became more complex, it was challenging to keep up with the demand of design requests by the owner. Technology played a large part in the advanced needs of a building occupant. Although, the more advanced materials, equipment, and design options that become available, this increases the amount of safety demands for the occupants.

Today, three building and safety codes rule the industry: The *International Building Code*, the *International Residential Code*, and the *International Energy Conservation Code* (Eisenberg, 2006). The International Code Council (ICC) produces these codes. The *International Building Code* is a "model code that provides minimum requirements to safeguard the public health, safety and general welfare of the occupants of a new and existing building and structures" ("Effective Use of the International

Building Code" 2018). This building code describes requirements that are to be followed during the design of a construction project. It is expected that an architect, and supplemental designers, understand and follow all requirements outlined by necessary codes. Unfortunately, poor attention to safety codes can result in major cost and schedule impacts, as final building inspectors will require all codes to be followed correctly to achieve a certificate of occupancy.

An architect's central role for the construction project is to provide full and accurate plan sets and specifications for a contractor to use, to build the final result. The architect needs to fully grasp the owner's vision, and present it in a visual matter. David Chappell and Michael Dunn (2015) have created an all-inclusive guide to represent an architect's career from start to finish. In the *Architect in Practice*, Chappell and Dunn have outlined a seven stage plan for architects to follow for a construction project. Table 1 provides a summary of these stages from the designer's role; these are not to be confused with the three major phases and eight supplementary stages outlined for an entire real estate project, as mentioned previously.

The architect has many levels of design, each of which add more time and effort, leading to the costly impact of design changes made in later stages of the project. Architects must review the design with the owner, often to eliminate surprises or design conflicts. Generally, the architect is the lead designer for the project and what he or she draws will significantly impact the engineering portion of the project.

Table 1: Architect design stages (Adopted from Chappell and Dunn, 2015, pp.201)

Stages	Descriptions
Stage 0 - Strategic Definition	A document containing the key requirements of the project and a summary of the rationale behind the project are drawn up.
Stage 1 - Preparation and Brief	Feasibility studies, project outline, budget, project and quality objectives and what degree of sustainability is desired.
Stage 2 - Concept Design	Outline proposals for all aspects of design and construction, initial costs, consideration of sustainability, construction, and maintenance.
Stage 3 - Developed Design	Developing the design of the project alongside the constructional aspects and costs
Stage 4 - Technical Design	Design completion
Stage 5 – Construction	Mobilization and construction of the project
Stage 6 - Handover and Close Out	Completion of all building contract procedures
Stage 7 - In Use	Evaluation

Engineer

Each engineer for a construction project specializes in specific areas of technical requirements. An engineer's primary role is to protect the safety of the occupants of the building. The architect's drawings may visually represent the owner's requests, but the engineer will impact that vision by dictating components such as structural steel sizes, concrete column locations, or mechanical duct locations. A common conflict between an architect and engineer pertains to the location of structural columns in a building, as the engineer may want to design for efficiency, but the architect will design for functionality. For example, it may be most cost efficient, in terms of concrete costs, to have a building column located every 30 feet on center; however, this may place columns right in the middle of rooms that the architect did not plan to occupy any columns.

Similar to architects, engineers need to follow various codes and standards in order to produce a successful project. Mechanical, electrical, and plumbing designers will follow standards set by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). The purpose of this society was "to provide the engineer, the architect and contractor alike, with a useful and reliable reference data book relating to the art of heating and ventilating" ("A Brief History Of The ASHRAE Handbook" n.d.). Structural engineers typically work with steel and concrete, but there are codes indicating requirements for all types of possible materials to be used. The American Institute of Steel Construction (AISC) published *Code of Standard Practice for Steel Buildings and Bridges*, and the American Concrete Institute (ACI) published the *Building Code Requirements for Structural Concrete* (Schmidt, 2016). Both publications outline structural requirements to be followed to ensure occupant safety and longevity of the structure.

An owner may hire a design firm with both architects and engineers in house; otherwise they can have separate contracts. An architect's and engineer's purpose follow similar suit when it comes to roles and responsibilities on a project. Engineers will follow the architect's design stages, working alongside each other to coordinate components in the building plans.

Contractor

The term 'contractor' will be considered a group consisting of the general contractor, construction manager, and any subcontractors or suppliers that may contribute to the construction portion of the project. According to Gransberg (2002), the contractor's role begins after the award of the construction contract, and is completed

after project closeout. Gransberg's specific outline of the involvement of the contractor is described as followed: It is the responsibility of the project manager, within the contractor, to stay as involved as possible during any available pre-construction stages, to fully understand the project scope, in order to execute the project as originally intended. Small and medium sized projects have periodic visits to the site, whereas large projects may have a project manager on site fulltime to keep up with the demand of the project needs. Each week, the contractor is responsible for hosting meetings with subcontractors on site. Slightly less regularly, the contractor will hold design and owner meetings to ensure all major project team members are connecting on project events. Essentially, the contractor's role is to be the central ambassador for communication between all other parties involved. High communication between the project team is required to eliminate undesired surprises that negatively affect project goals.

A contractor's objective is to simply fulfill the needs of the owner in a favorable cost and schedule fashion (Mascari, 1992). To achieve the owner's desired outcome, many members of the contractor's team use their expertise to fill specific roles. Project executive, project manager, project engineer, and superintendent are some of the most common contractor roles (Klinger & Susong, 2006). Project managers are typically considered the central representative for not only the contractor's team, but also the entire construction project team.

Gransberg (2002) also mentions some specific tasks that are standard for contractors to perform for a project. Construction projects have wide range of documentation that can be challenging to manage. Document control is essential for contractors to maintain, as the documents themselves hold essential design and

specification requirements that subcontractors will need to construct their scope of work. Types of documents include partnership contracts; purchase orders; bid documents including estimate takeoffs, project schedules and look ahead schedules; superintendent journals; meeting minutes; change orders and change order logs; plans sets; shop drawings; submittals; specification books; job cost reports; site reports and photos; and more (Last, n.d.).

Near the completion of a construction project, contractors will create an Operation and Maintenance Manual, with all necessary information needed for a project owner to manage the building through its lifecycle. The O&M manual will be generated via many of the above mentioned documents with the help of subcontractors, who supply details regarding their work performed. Before a contractor officially leaves the site, the company has a responsibility to ensure proper training to the owner and future property manager of the project. This training would mostly revolve around processes for security of the building and operation of equipment on site.

Construction Project Goals

In reference to the integral real estate project, intended goals will vary depending on the project phase and the perspective of the team members. The goals can be combined into two central ideas: project process goals, and project outcome goals. Goals impacting the project process pertain to primarily the pre-construction and construction phases. These phases follow a complex process, which involve the construction project team and the creation and execution of the project. The goals of this time period involve the schedule or timeline of the work needed to complete the project; the cost up until project turnover; the quality of the design, materials and craftsmanship; and lastly the

citizenship behavior which relates to the level of professionalism and trust built within the team. These are shared goals that all parties in the process aim to achieve.

On the other hand, there are goals that the owner specifically has, in reference to the project outcome and project lifecycle. Essentially, the owner creates the project to make money or fill a need, or both. Designers, contractors, legal experts, and consultants tend to remove themselves from the project after the turnover stage. Therefore, owners are on their own to manage and maintain the building, however they will most likely hire a property management team.

This research aims in the direction of the owner and his or her skills and responsibilities relating to the project team within the project process. It is necessary to understand the definition and significance of these goals as they relate to the development venture. Fundamentally, "the three primary goals of a project [are] cost (preferably low), quality (preferably high) and schedule (preferably fast). Owners desire all three. Conventional wisdom is that an owner can only achieve two of these three goals, and must be willing to sacrifice the third" (Clark, 2005, pp.4). For example, if an owner's priority list began with cost and quality, then overtime work may not be an option. The cost goal would prefer all work to be done during normal working hours, causing the project to last longer than needed, sacrificing project schedule. However, in general, these three attributes are all owners' goals, no matter what type of project. Saving time, money and having high quality outcomes are universal desires.

A fourth central goal is added for this research purpose. Project citizenship behavior provides a sense of unity and trust among team members. The citizenship behavior promotes team members to act in a way that will better attribute to the teams

goals and not individual goals. Project citizenship behavior would imply all team members jointly desire each other to save on time and cost, and produce high quality results.

Supplemental goals may also apply to construction projects such as providing sufficient support to the design and construction professionals, avoiding lawsuits and other legal issues, maintaining a consistent project scope, and retaining a high level of communication (Levy, 2010a). On top of these, each individual project may have specific goals pertaining to the final outcomes of the projects.

Schedule

The two dominant goals for a construction project are cost and schedule (Kog et al., 1999). These two components are the most visible, and project teams continually discuss the targeted outcomes. A construction schedule is characterized as a "plan of attack or strategy" in relation to sequencing, methods, and resource levels for the project (Russell & Udaipurwala, 2000, pp. 928). Assessing a project purely by the bid package can be quite challenging, as there are inevitable inconsistencies in the construction industry. Every project can be considered unique, even if two projects have the exact same floor plan. Location plays a significant impact on schedule durations, which makes it difficult to apply historic data to all scheduling practices. Oftentimes, contractors will request predicted timelines, or lead times, for specific products and tasks. In fact, the contractor's estimates are not only built on his or her own prior knowledge, but also doubling up on a supplier or subcontractor lead times (US5918219A, 1999). The contractor may be unaware of how the supplier or subcontractor landed on a certain number, but there is an unavoidable level of trust that must be obtained.

The purpose of a construction schedule is to allow all affiliates of a project team to properly plan ahead for current and future business ventures. Following the concept that time is money, "project owners are increasingly placing greater demands on contractors to complete projects in record time" (Kog et al., 1999, pp. 351). Once a projected schedule is set, all parties begin to plan future projects, contracts and other responsibilities. Contractor and designer's incentive is to follow as close to the original schedule as possible, to accurately allocate their company resources. Each project requires specific employee time and it is important to schedule employee time often months if not years in advance. A construction schedule allows companies to anticipate how long certain employees will be tied up on specific projects. Construction project owners have a separate argument for wishing to stay on schedule. Owners are responsible for repaying loans, beginning to intake occupant rent, generally making money off of their project to pay off their debts, and start to gain profit. An owner will suffer the loss of projected profits if construction project schedule becomes unattainable (Kog et al., 1999).

Hendrickson (2000) outlined a comprehensive portrayal of construction planning and the detailed process for creating a final schedule. To begin, the scheduler must look at the project outcome, and the mission is to sequence steps that lead to the end result. Typically, similar groupings of work on site are called 'tasks' or 'activities'. These tasks could be "paint level three interior walls", "place carpet in offices on level one", or "brick west side of exterior wall". In order to determine a final duration of these tasks, historical data is often referenced. Repetition of tasks allows for a unified agreement of the 'typical' duration of a task. Computer aided programs are often used to store major datasets

where every common construction activity can be searched. In essence, previous construction timelines often allude to future construction timelines. Also outlined in Hendrickson's discussion is the importance of discovering the project's critical path. The critical path is the group of tasks in which any delay to said tasks would result in a delay to the entire project schedule. These tasks require the most significant scheduling management.

In regard to the sequence of all project tasks, their relationships often come naturally. Certain tasks cannot occur without other tasks finishing first. For example, structural work on site must be completed in order to place walls, lay carpet, and place aesthetical components. Project schedulers have substantial technical experience working on projects to gain insight on proper sequencing. If a project has a unique aspect to it, where a project scheduler may be puzzled as to the task duration, it is acceptable to contact the subcontractor, or trade worker, and request a presumed duration for the specific task.

Multiple research examinations have gone into the study of construction schedules, specifically what aspects make a good schedule, and reasons as to why schedules are often delayed. This section of the literature review focuses on interpretations of the positive and original creation components of a schedule, causes of missed goals will be discussed later on. Kog et al. (1999) performs a study diving into the key determinants that impact a construction schedule's performance. They list five distinct determinants that the authors feel are most significant. The first key determinant is frequency of meetings between the project manager and other project personnel. Common practice consists of weekly or bi-weekly meetings with the owner, designer,

subcontractors, and internal staff. The results have a positive correlation between meeting frequency and schedule success. However a notable observation shows the correlation is only positive if the number of meetings and number of other project personnel is positive and both values are high. Meaning, if contractors only make frequent contact with subcontractors and little to no contact with owners, this may result in an unsuccessful construction schedule.

The next three determinants specifically entail to designers and contractors: monetary incentives provided to the designer, project manager experience on projects with similar scopes, and time devoted by the project manager to the specific project. There is a positive correlation for all three of these determines in relation to the success of a project schedule.

The most significant, and relative, determinant in relation to this research study is the implementation of a constructability program. A direct impact from the responsibilities of owners and designers is the "lack of integration of construction knowledge into the design process; [it] has been cited as the main culprit that hinders the 'ability' to construct, and consequently results in project budget and schedule overruns" (Kog et al., 1999, pp. 355). Project owners must work closely with designers to ensure all requested visions and outcomes are possible on a constructability outlook. Bringing a contractor on earlier in the design phase can help eliminate these issues (Smith, 2018).

In essence, the project schedule is created by the contractor based on the designer's plan, but requires significant input from all project team members. The owner sets boundaries; these boundaries need to be feasible and attainable, as to not cause

unavoidable conflict during the construction phase. Likewise, designers and contractors need to supply realistic schedules and not make false promises in order to win project awards. Accurate construction schedules will provide positive impacts on all parties involved.

Cost

The definition of cost for a real estate development can vary depending on the perspective of the project team member. For an owner, the cost would include all payments made during the pre-construction and construction phases, while also adding in the post-construction phases regarding future maintenance and general operation of the building. The contractor is mainly concerned with the cost of the construction phase for a project. Typically, this is the phase that contractors are most responsible for, pertaining to cost control. The designer is a bit distanced from the direct cost of the project, as they are commonly connected based on their time spent working on a project, or they may have a design fee defined by the contract. However, the designers have the most power to dictate high or low cost for all project phases contingent upon their drawn design. Ideally, designers and owners would be in constant communication in pre-construction, so an owner can input their own ideas, or rules, related to cost items.

Early contractor involvement in a project has proven to contribute to construction cost savings (Rahman & Alhassan, 2012). When contractors are involved in the pre-construction phase, they can offer their expertise in reference to constructability and value engineering. This results in minimized rework, improving team trust, and reducing scope definition errors.

Hendrickson (2000) provided a report on construction project costs and budgeting. He provides a breakdown of several common costs for a new development project. Table 2 associates these costs with affiliated construction phases. Ryan Companies performed a study on the project lifecycle cost for their real estate development projects. The company determined that the pre-construction and construction phases only amount to 30% of the overall project lifecycle cost (Smith, 2018).

Table 2: Common costs in construction phases (Adopted from Hendrickson, 2000)

Pre-Construction	**Construction**	**Post-Construction**
• Land acquisition • Planning and feasibility studies • Architectural and engineering fees • Legal fees • Overhead	• Construction material, equipment and labor • Field supervision • Construction financing • Insurance and taxes during construction • Inspections and testing • Overhead	• Furnishings • Land rent (if applicable) • Operation staff • Renovations • Insurance and taxes • Utilities

To identify the cost of construction for a project, the owner will first need to identify a budget range. This range will inform the designer what materials can be used, along with defining the size and complexity of the project, in order to be financially feasible. Although designers typically do not provide full project estimates, they have enough experience to understand general costs of products. According to the Association for the Advancement of Cost Engineering, there are five classes of cost estimating for a project (AACE, 2016). Class 5 begins with the concept screening, where the owner lists specific deliverables required for the project, along with a general vision of appearance.

Class 4 factors in specific parameters and equipment. Class 3 is semi-detailed, and will be used to determine an initial project estimate to be approved by the owner. Class 2 can be an original bid by a contractor on the condition that design has not yet been completed, while Class 1 is the final bid with a full bid package. As the classes move down in numerical order, the accuracy of the price will move closer to the final construction costs.

Similar to the scheduling process, a contractor will use historical data to determine the price of the construction bid. A bid package is released from the owner and designer to the potential contractors. Contractor estimators will perform quantity takeoffs for all materials and insert corresponding labor hours needed to complete the work. Together, these values will provide an estimate for the project. The book *Principles of Applied Civil Engineering Design (*Choi, 2004) presents a chapter on quantity estimates, which is correlated to the process of estimating a bid package. To perform a quantity takeoff, one must first identify types of quantities. Length measurements would coincide with items such as pipes, fences, guardrail, and pilings. Measurements of area in square foot or square yard apply to scopes with walls, pavement, precast concrete panels, or fabrics. Items such as formed and unformed concrete, and earth fill would be measured by volume, often in cubic yard. Lastly, items that cannot be measured by length, area, or volume are often quantified by count. For example, bathroom accessories such as sinks, toilets, and soap and paper towel dispensers are calculated by the quantity of each item included in a project.

Each contractor may have their own historical data hub to reference prices, but there are also nationally known standards to aid in the estimating process. RSMeans is a product from a company called Gordian, which offers localized costs for construction

tasks in relation to products and labor. The dataset applies to over 970 locations across North America, offering real costs of products in each location ("RSMeans Data Online," n.d.). Sage Estimating is software that many contracting companies use to perform their estimating process. The program invites estimating data to collaborate with building information modeling (BIM), to help make the estimating process faster for contractors ("Sage Estimating," n.d.). Together, these pricing datasets and estimating tools are used to determine the prices for every component of the proposed project.

To advance a project estimate to a hard bid, contractors will need to involve specific subcontractors and suppliers that specialize in each trade. For instance, a general contractor may estimate the walls for a project based on generic square footage and material prices, while a drywall subcontractor will provide a more detailed estimate understanding the added labor costs of walls over 10 feet tall, or the material cost savings from a new known supplier.

There are other considerations to take into account when determining a final hard bid price, other than reviewing the bid package from the designer. Construction often has unpredictable circumstances when it comes to weather, site conditions, safety, security and environmental practices (Woolsey, 2017). Contractors will add various costs due to these conditions on top of original quantity takeoffs, along with their own employee time spent in estimating, project management and field supervision.

Quality

Eight attributes are used to define quality: performance, features, reliability, conformance, durability, serviceability, aesthetics, and perceived quality (Mitra, 2016). Quality may seem like a self-explanatory goal, but it's not just about the end result,

rather how quality impacts both cost and schedule. High quality is oftentimes a universal goal, however quality is positively correlated with price. For example, an owner of an apartment development may aim for high quality, yet may not have proper funds to support items such as durable and aesthetically pleasing wood flooring. Instead, the owner opts for the false appearance of the wood floor by choosing a luxury vinyl tile (LVT). LVT flooring can have a similar image of wood, while only having one-fourth of the cost. In essence, the owner had to give up some level of quality, by choosing LTV over real wood, in order to save on cost.

There are two primary areas in which a project team can monitor and achieve quality in a project. The first is in reference to the quality of the team members, while the second is for quality control in the construction phase. Since owners are the initial members of the project team, they have the power to choose a designer and contractor. This decision is typically made using procurements methods of low bid, qualification based, and best value. Owners must decide where quality fits in their project priority list to determine the designer and contractor. In *Construction Project Management,* Barnes (1988) indicates, "quality is not achieved simply by writing a specification" (pp.71). Meaning, no matter how well a project specification book, or set of requirements is written, quality will depend on the dedication and performance of the project team.

The Department of Transportation (DOT) is often stigmatized in valuing poor craftsmanship by selecting low bid contractors, yet the DOT is making an effort to remove that stigma. Edward Minchin and Gary Smith (2005) developed a model for the DOT to use ensure proper selection of contractors in terms of quality for their projects. The model uses project management factors, along with materials and workmanship factors

from prior projects. Each of the factors are subcategorized and rated to determine an overall project performance factor (PPF). The final company performance rating is determined using the PPF according to the number of projects during the rating periods. This value is used to compare contractors against each other in terms of quality. Contractors may follow a similar process in awarding contracts to subcontractors.

Quality control during construction involves all members of the project team, but is primarily lead by the contractor since they operate most day-to-day activities. According to Barnes (1998), poor quality control results in the downward adjustment of the project deliverables. An example can be shown with a tile flooring subcontractor preparing measurements for a bathroom floor. The subcontractor wants to verify his tile plan by taking measurements on site, but notices the half-wall for the end of the sink counter is slightly angled. So, he cuts his tile with a slight angle to match the base of the wall. The next week, the sink countertop has arrived on site and is ready to be set, yet it won't fit properly between the walls, since one wall has a slight angle. If the tile contractor were insinuating quality control, he would have alerted the general contractor of the drywall mistake right away; instead there were multiple mistakes built on top of each other. This type of event occurs on many project sites, causing risk to the level of project quality.

All team members have a role in project quality. Table 3 breaks down the primary responsible team members for certain aspects of quality for a project. The owner should meet with the designers and contractors to determine a quality control plan prior to each member's work. Levels of quality need to be understood and reiterated if they are already

outlined in the project specifications. Quality is a continuous process that is involved in every aspect of the project process; improvement can always be made (Mitra, 2016).

Table 3: Responsibility breakdown for project quality

Component of Project Quality	**Responsible Team Member**
Quality of Team	Owner
Quality of Design	Owner, Designer
Quality of Conformance (material selection)	Owner, Designer
Quality of Performance	Contractor, Subcontractor

Project Citizenship Behavior

Organ et al. (2005) wrote a book called *Organizational Citizenship Behavior*, in which they define organizational citizenship behavior (OCB) as "individual behavior that is discretionary, not directly or explicitly recognized by the formal reward system, and in the aggregate promotes the efficient and effective functioning of the organization" (pp. 8). The term 'discretionary' refers to a behavior that is not necessarily listed in the person's job description; instead it is a choice the person can choose to act upon. In reference to the next section of the definition, the behavior is seen as a positive influence as it promotes 'efficiency' and 'effectiveness'.

This same concept is varied slightly for the definition of project citizenship behavior (PCB). Since projects are not quite comparable to full organizations, the essential difference is permanence. Projects are considered temporary, while organizations are permanent. These temporary projects have different environments than organizations. Project teams are "dependent on the will, commitment and ability of individuals for their creation, development and termination" (Lundin & Söderholm,

1995, pp. 441). Lundin and Söderholm (1995) outline three characteristics of a temporary project. The first is that the team is formed around a task or goal, which in this case would be the completion and success of the construction project. The second is that team participation and roles are defined prior to the project, where in construction projects each team member enters knowing whether they will be the owner, designer, or contractor. The more challenging aspect is to determine proper communication and leadership roles within the team, before the project starts. The third characteristic is that each individual on the team has separate loyalty, showing where they came from prior to the project, and where they will go back after the project. In construction, a project team is dedicated to the completion of the given project, yet most central team members are from separate companies. This results in split allegiances, which team members must learn to balance.

This third characteristic holds great weight in the definition of project citizenship behavior. Each team member must devote themselves to the project team, not only their individual company. The project has goals, which team members need to verify and define at the beginning of the project. Project citizenship behavior implies each individual's time and effort invested in the project greatly improves a team's project goals, and the willingness to help other members of the project succeed (Aronson & Lechler, 2009). Essentially, team members focus on group goals instead of individual goals. For instance, an owner expressing PCB might be willing to negotiate change order requests from the contractor; while an owner not indicating PCB might refuse to review change orders in attempt to ignore added project costs. PCB suggests team members

work together to solve project issues instead of placing blame or choosing to be difficult to work together.

Gransberg (2002) has written remarks on a project team, which apply well to PCB. His first comment surrounds the idea that a "well planned" and "well executed" partnership results in improved trust and respect between project team members during the challenging construction phase. Also, he believes heavy communication between owners, designers and contractors will help eliminate unexpected 'surprises' during the construction phase as well.

Each team member has his or her own scale and level of expression for PCB. The extent to which a team member may put team goals ahead of personal goals has been called a moral obligation and it refers to a person's work ethic, personal values, or job involvement (Organ, Podsakoff, & MacKenzie, 2005). Team goals, as discussed in this research study include project schedule, cost, quality, and project citizenship behavior. Individual goals for team members will most likely not all surround project success, but may be achieved through project success. For example, designers and design companies aim to make money via profit through a contract. The less overtime the designer puts into the project, the greater the possibility of returning high profits for the company; less time towards one project, means more time towards another project. However, if the project suffers from the reduced design time, the project goals become at risk. The designer company may also put their returned profit at risk, since they did not prioritize project team goals.

Causes of Missed Project Goals

The causes for missing targets on project goals can come from a multitude of sources. Causes can range from simple administrative errors, to weather, to poor management and communication, to inability to perform job tasks correctly. To provide a more consistent and realistic research study, only causes that connect to the four project goals of schedule, cost, quality, and project citizenship behavior will be considered. Specifically, the causes of missed goals directly connected to the three central members of the project team, even narrower, missed goals caused by the owner. Items such as weather will always be unpredictable and a project team member will not have the ability to control it, so it will not need to be identified in this study. Also important to mention, is that these causes of missed goals are frequent throughout construction projects, not unique or abnormal, so they can be applied at a larger scale.

Schedule

The outcome of a successful project schedule would entail that the project ended on or before the originally agreed upon completion date. If the project schedule goal was missed, this would result in the project finishing after the agreed upon completion date. A construction schedule delay would most likely result in extended time needed to complete a task or the entire project (Stumpf, 2000). In this section, a few causes will be discussed in depth, while the rest will be mentioned as contributors to project delay.

For a research study in Saudi Arabia, a survey was sent out to 23 contractors, 19 consultants and 15 owners to determine which events cause the most delays on a project (Assaf & Al-Hejji, 2006). Not surprisingly, each entity pushed blame on other team members. The owners believed the contractors were the root cause in most delays, while

contractors believe owners were to blame. Oftentimes, all team members are at fault for some type of construction delay. The journal did not identify the perspective of the critic, for categorizing the causes into various responsible parties; meaning for each delay caused by the owner, there is no identification as to which party felt most strongly about the specific cause. Table 4 provides a summary of the journal's research results.

Table 4: Common causes of delay by responsible party (Adopted from Assaf & Al-Hejji, 2006)

Causes of delay due to owner	• Late in revising and approving design documents • Delay to furnish and deliver the site to the contractor • Delay in approving shop drawings and sample materials • Change orders during construction • Slowness in decision making process • Poor communication and coordination • Conflicts between joint-ownership of the project • Unavailability of incentives • Suspension of work • Delay in progress payments
Causes of delay due to designer	• Mistakes and discrepancies in design documents • Delays in producing design documents • Unclear and inadequate details in drawings • Complexity of project design • Insufficient data collection and survey before design • Misunderstanding of owner's requirements • Inadequate design team experience • Non-use of advanced engineering design software
Causes of delay due to contractor	• Conflicts in subcontractor schedule • Rework due to errors in construction • Poor site management and supervision • Poor communication and coordination • Ineffective planning and scheduling • Improper construction methods • Delays in subcontractor work • Inadequate work • Frequent change in subcontractor due to inefficient work • Delay in site mobilization

In 1998, Mezher and Tawil conducted research to find major causes of construction delays in Lebanon. They identified 64 causes of delay and grouped them into ten categories including material, manpower, equipment, financing, changes, government relations, project management, site conditions, environment, and contractual relationships. The project team members labeled which categories they believed to have the greatest significance in relation to project schedule delay. Owners believed project financing and planning subcontractor schedules were the most significant causes of delay to a project. Designers noted poor project management and submittal review as major delay causes. Finally, contractors chose contractual relationships and design change by owners as their most significant delay causes.

Next, a breakdown of a selection of owner related project delays if provided to further understand their meaning, and the owner's role. Prior to construction by a distinct trade, contractors supervise the submittal review process. In this process, subcontractors will provide detailed information and drawings related to their specific work. These documents and drawings are called submittals and are reviewed by contractors, and then move to designers and owners for final approval. Oftentimes, a good rule of thumb is that average sized submittals should take a maximum of two weeks to move to the next review phase. In some cases, these submittals can be held up by any member of the project team (Stumpf, 2000). Owners can cause major delay in this process if they choose not to keep up with the demanded review by the contractor. Oftentimes, owners will not review these documents within an appropriate time period (Assaf & Al-Hejji, 2006). Without final approval of the submittals, subcontractors cannot

begin work on site. Submittal approval takes great time and attention to detail, which can make them a hindrance on the team since there are usually tens if not hundreds of submittals per each project.

Site conditions play a mysterious role in a construction project. Tests and surveys can be conducted prior to construction to determine soils characteristics, however unexpected conditions may unroll once excavation has begun (Stumpf, 2000). The contractor may discover a large boulder half the size of the excavation site. This may be considered an unforeseen condition, however first the contractor would want to verify all site tests were performed properly and that the designers and owner did full due diligence when researching the project site.

Change orders occur when an owner or designer makes an adjustment to the original scope after contracts have been finalized. This means the owner requests, or the designer has determined a need, to alter original drawings. An owner may desire to split one large room into two smaller rooms, after original design documents have been approved. The contractor must submit a price for this request, called a change order request, as an isolated cost and present it to the owner for review and approval. This process takes time, and dependent upon the request's size and complexity, the process can take up to multiple weeks if not months for the full process to pan out. If the change order request is related to an item on the critical path for construction, this can cause project delays. In one research study, change orders were deemed the most common cause of delay on a construction project (Assaf & Al-Hejji, 2006). Table 5 summarizes many potential schedule delays caused by the construction project owner.

Table 5: Summary of potential schedule delays caused by the project owner

Schedule Delays Caused by the Owner
• Joint ownership • Change orders • Financing • Rework • Submittal approval • Differing site conditions • Change in design • Design error (from hiring poor designer) • Payment schedules • Material shortage • Communication with team • Contract interpretation • Suspension of work

Cost

Failure to meet the cost goal for a construction project would indicate that the project had cost overruns, or that cost was more than originally planned. Cost variations affect project team members differently, than do missed schedule targets. In scheduling, delays to project completion will most likely affect owners, designers and contractors, all in a similar negative fashion. More time in labor hours spent on the project doesn't necessarily mean all parties are compensated appropriately, which is why they can typically all agree finishing a project on time is for the good of the group. On the other hand, project cost is specifically related to each team member, since they each have their own budgets. Oftentimes, this can be determined by the chosen contact type, which lists each entity's risk in terms of cost. Also, as previously discussed, the cost for a real estate project does not end at project turnover. Lifecycle costs can add far more financial commitments than construction. For simplistic reasoning it is assumed the project cost

goal will start at the design work in pre-construction, and go through the construction phase. Further, another assumption is that all team members wish for each other to make appropriate profit. Profit would be reduced in all parties, if the originally anticipated budget is not followed. When a budget is not met, there are factors that take place corrupting the original estimate. Some of these factors are similar to the ones mentioned in the scheduling section, however there are new ideas presented as well.

When a project has negatively missed its goal related to cost, these cost overruns are presented through change orders and claims (Jahren & Ashe, 1990). Jahren and Ashe (1990) determined that there is a non-statistical relationship between size of the project, and projected cost overruns. Rosenfeld (2014) understood that there is vast research in cost overrun causes across many countries. He combined other researcher's results to identify 146 initial causes, which he then modified and narrowed to the 15 universally believed root causes of overruns. He conducted a survey with 195 respondents choosing their top five most influential causes for construction cost overruns out of the 15 universal causes. The respondents were primarily project managers and designers, specifically engineers. Table 6 provides a summary of the overrun causes in order of highest significance ranking.

Table 6: Root causes of construction cost overruns (Adopted from Rosenfeld, 2014)

Root Causes of Construction Cost Overruns
1. Premature tender documents (bid packages, contracts, legal documents, etc.) 2. Too many changes in owner's requirements or definitions 3. Contract winning price was unrealistically low 4. Unclear, unambiguous, and contradicting terms of pre-construction documents 5. Insufficient, unstandardized owner's brief 6. Too small of a design budget 7. Insufficient information about ground conditions 8. Late start of the planning process, with too low of a budget 9. Shortage in high-quality management personnel 10. Unbalanced distribution of risk between owner and contractor 11. Culture of conflicts and lack of trust 12. Lack of standard requirements from designer, poor enforced professional liability 13. Unconstructable design 14. Unclear division of responsibilities for professional management 15. Force majeure (strikes/weather/regulation change/accidents, etc.)

A thought-provoking outcome shows that many of these causes could be grouped into either incomplete pre-construction planning, or insufficient initial budgets. A study performed in Nigeria concluded that one of the top three explanations for cost overruns was due to inadequate pre-planning (M. Dlakwa & F. Culpin, 1990). There can be such a rush in pre-construction, frankly due to the high price of sitting on empty or abandoned land. The owner and designer have not had enough time or effort to accurately complete design plans to the extent that each party feels 100% confident in the project outcome, prior to the start of construction. In many occasions, construction may start on certain aspects such as the foundation and structural components before the designer has even begun to finish the interior. Improper planning and completeness of pre-construction

documents result in confusion and frustration in the construction phase, often with negative cost impacts.

In a research study conducted among architects, surveyors, engineers, and builders, the number one and two causes of cost overruns was inflationary increase in material cost and underestimating of project cost (Odediran, Adeyinka, & Eghenure, 2012). Insufficient initial budgets can be largely related to contract factors. In the case of a low bid contract award, "some contractors will go to all lengths (omitting the realistic figure that may cost the total project completion) just to win [...], without acknowledging the consequences of their actions" (Karunakaran et al., 2018). For some owners, the lowest bid is not always the best choice. Yet, even for qualifications based or best value contracts, estimators are still consistently pressured to win contract awards for the contracting company.

Knowing that cost is extremely important to most owners, it is vital that estimators provide very competitive bids. There is usually little room available for slack costs, which may cause problems when awarding subcontractor work. An estimator's job is to provide the best guess on a final project price, unfortunately items like unforeseen labor increases or hiked material costs can make or break a contractor down the road. Estimators and pre-construction managers are tasked with selling their company's worth in bid interviews (Sogla & Ekstrand, 2018). Sogla and Ekstrand (2018) explained how they have very challenging jobs, as they try to find a balance between pleasing their construction management team, who has to pay for proper labor and materials, while also pleasing an owner team in order to win the contract award.

Clark (2005) tells a story about what issues are important to him as an owner, while looking back at his work as a licensed professional structural engineer. Clark's experience is fascinating as he views cost, schedule and quantity from various perspectives. His most impactful lesson is on the cost of a construction project. "Most owners do not fully understand the profession of engineering design" (Clark, 2005, pp. 1), which causes a sense of ignorance when it comes to engineering design time and value engineering. Clark explained for one of his projects, the owner was so focused on labor costs that he unknowingly was paying higher material costs in return. Clark knew the owner was looking for a low cost on the engineering design bid. Clark devoted only a small quantity of design hours in his bid, and won the contract. This limitation of hours caused Clark to be very conservative in his steel design, since he did not budget significant design hours, which did not allow him to find the most economical solution. The owner ended up paying more money in added steel (material cost), than he would have if he allocated more money in the design phase (Clark, 2005). The lack of understanding of what engineering design consists of, caused the owner to pay a higher project cost without even realizing the consequences.

Quality

Poor project quality in the construction phase results in "rework, material waste, and other avoidable loss of profits" (Jafari & Love, 2013, pp. 1224). To further illustrate, "the term 'rework' has been related to other terms such as 'quality deviations', 'non-conformance', 'defects', and 'quality failure' (Hegazy, Said, & Kassab, 2011, pp. 1051). A research study in Alberta determined five main causes contributing to construction field rework being required on a project. These five causes are engineering and reviews,

human resource capability, construction planning and scheduling, leadership and communications, and material and supply (Fayek, Dissanayake, & Campero, 2004). Out of these five causes, engineering and review caused more than 50% of the rework, both in terms of frequency of occurrence and monetary value. Engineering and review can be described by four project events: late design changes, poor document control, scope changes, and errors and omissions in design.

Another study was performed to analyze the causes of rework for construction projects in China (Ye et al., 2015). The results found similar notions from the previously mentioned study, with the addition of poor material choices. Material choices are made in a joint effort by both owners and designers. A less significant cause mentioned, yet still viable, was the rework by contractors due to initially poor workmanship. As a final reiteration for the root causes of missed quality goals on a project, Hegazy, Said, and Kassab (2011) discover a similar trend. Their identified causes include errors, omissions, failures, damages, poor leadership, poor communication, and ineffective decision-making.

Quality is an important visual factor for the owner and future occupants, when turning over the project. Poor quality is never a project goal. Ideally, the goal would always be the best, or high quality. As previously discussed, quality comes at a price, which the owner would need to determine at the beginning of the project. Rework and other quality failures are not a part of the original quality level chosen by the owner. These causes of rework can all be traced back to certain members of the project team. Often, the blame is not immediately admitted, and the arguments of fault take place.

Project Citizenship Behavior

Considering the definition of citizenship behavior as each team member's drive or initiative to prioritize team goals in contrary to individual goals, nonexistent citizenship behavior would imply team members are out to achieve their own goals only. Where individual goals disjoin team goals, certain individuals 'win' while others 'lose'. For example, a designer may take an extra two months to review certain submittal documents, in the meantime, the designer is able to work on many other projects that his or her company is making money on as well. Due to this delay, the contractor is unable to schedule subcontractors at the originally intended time, causing overtime costs to become a necessity. The designer was able to do what is best for his or her company, while the contractor suffered the cost loss.

Smith, Organ and Near (1983) identified twelve items that would adequately represent citizenship behavior. To show concrete examples of how citizenship behavior may blatantly be missing from a project, the opposite of the twelve behaviors has also been described in Table 7.

An important relationship to discuss is between project citizenship behavior and counterproductive work behavior (CWB), or behavior that intentionally hurts the team. It is not reasonable to imply that a team member will either portray PCB or CWB in all project tasks, there are far too many factors influencing each event (Spector, Bauer, & Fox, 2010). These factors can be stress level, project constraints, job satisfaction, and workload. Essentially, a team member portraying PCB would consistently put team goals first, yet they are not expected to completely ignore their own personal goals. Likewise,

if a team member is not depicting PCB that does not mean they are inevitably showing CWB performance.

Table 7: Human behaviors that exemplify citizenship behavior, along with opposite behavioral actions (Adopted from Smith, Organ and Near, 1983)

Citizenship Behavior Factors	**Missing Citizenship Behavior**
Helps others who have been absent	Upset with teammate if work is incomplete during absence
Punctuality	Frequently late for team meetings
Volunteers for things that are not required	Resistance to contribute to additional team needs
Orients new people even though it is not required	Refuses to train and include new team members
Attendance at work is above the norm	Frequently absent from team meetings
Helps others who have heavy work loads	Will not aid teammates with heavy work loads
Gives advance notice if unable to come to work	Does not provide notice if having to miss a team meeting
Does not take unnecessary time off work	Absent from important team events
Assists supervisor with his or her work	Will not aid teammates in work
Makes innovative suggestions to improve department	Does not contribute ideas or guide team
Does not take extra breaks	Frequently leaves team meetings or events early
Attend functions not required but that help the [project] image	Does not aid in marking the team project

Clark's (2006) story regarding his position as a project owner while looking back at his time spent as a structural engineer also applies well in relation to project citizenship behavior. Clark explains that the owner unknowingly made a mistake by choosing a low bid for engineering design, causing them to pay higher material costs for construction. It is perceived that Clark new the owner was making a mistake, but made no effort to explain the cost differences to the owner. Instead, he knew he would win the contract award if he had the low bid. This is a prime example of poor citizenship behavior on a construction project. If Clark would have been concentrated on the project goals, he would have explained to the owner how higher design costs could save the overall project money.

CHAPTER 3. POINT OF DEPARTURE

Background regarding project phases, team member identities and roles, project goals, and causes of missed project goals have been described in depth; now it is important to connect these concepts to the purpose of this research study. This research not only focuses on the construction project team, but specifically targets the owner's abilities. Owner decisions, indecisions, and actions affect the goals of a construction project. There is some previous research indicating areas of improvement explicitly for owners, but it is not always clear which sources or opinions the data is coming from. As a point of departure, this paper has identified previous research connected to project owners, and it is believed further research on owners is required for enhanced construction success.

Previous Research Identifying Inefficiencies

Oftentimes, heating, ventilating, and air conditioning (HVAC) contractors need to ask for many clarifications during the design and bidding phase of a project due to the lack of complete information provided by the owner. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE, 2015) has developed a list of preliminary questions requesting information that an owner should include in the owner's project requirements (OPR) section of the bid documents. Various questions range from 'What is the intended use of the building?' to 'Does the owner have a dedicated security team?' Knowing this type of information before project design begins can guarantee items are included in the original scope, and not left behind to be brought up via change orders at a later date. Owners need to be exposed to an array of questions regarding the project goals and intended uses, in order to provide the contractors and

designers with proper information to complete the project on schedule and budget. Clearly, ASHRAE has had multiple experiences with missing or lack of information, that they felt inclined to create this list of questions to help solve problems and eliminate future obstacles.

Some owners identify and acknowledge their own inefficiencies. In order to achieve a more successful project, some owners recognize that they cannot fill all roles required of an owner for a project. First, they must choose which roles they are capable and incapable of completing. There are two types of approaches owner's use when developing their strategy for a project. The first is owner-led teams, in which the owner is very involved in multiple aspects of the project and can contribute valuably by using their past construction experience (Shorney-Darby, 2012). The owner takes the lead role when making major project decisions and is responsible for facilitating documents to contractors and designers when owner approval is requested.

The second approach is consultant-led teams, otherwise known as owner representatives (Shorney-Darby, 2012). This approach is chosen when the owner decides he or she needs more assistance to execute the project. Often the consultants specialize in finance, legal, construction management, interior design, design review and construction, and can provide guidance to the project where the owner may be lacking. Owner representatives do not come free of cost; high labor rates for consultant work add costs to the project. If the individual chosen to act as the owner of the project had experience or knowledge in the construction and design fields, the project could save on costs. Although, eliminating third party consultants may streamline the approval process and line of communication, as it is easier for project managers to communicate with one

sole owner. Listed here were a few distinct examples of previously identified owner inefficiencies for a construction project.

Gap in Research

Walking through definitions of construction terms and basic team roles can help an owner learn about construction and help them choose the best team for the project. Guidelines that authors like Levy (2010) outline are helpful for owners to get started in the project, but there is little research that follows up on whether owners are actually following basic roles and responsibilities set out for them. These expected factors such as roles, tasks, skills and responsibilities are not always followed properly during a construction project. Failure of owners to fulfill these factors consistently, are most noticed by the project team. The project team then suffers the consequences of missed goals and undergoes a very frustrating project process.

This research study aims to identify common owner inefficiencies. To make sure the results can be applied usefully into the construction industry, the results will be described as detailed as possible. These detailed and definitive responses will provide straightforward applications from research to industry roles. For example, previous research has identified a common cause of delay on a project due to owners comes from poor communication and coordination (Assaf & Al-Hejji, 2006). This is an extremely broad remark that does not allow for obvious actions or specific tasks that owners could improve on in their daily work. The goal is to see where the poor communication occurred; for example, possibly making new design decisions without first including the contractor in the discussion.

To further provide new data to the current literature, this research will identify these inefficiencies from the contractor and designer points of view. These two roles, which have previously been diagnosed, are greatly impacted and influenced by the owner's role. Initially, the thought was to also include the owner's perspective in the data, however it was decided that in order to achieve the most candid responses, the owner data would not be included. In general, in all industries, people are not as willing to identify their own 'flaws' with the most accuracy. Although the responses from other parties may be harsher than intended due to previous project frustrations, the objective is for owners to be aware of their team member's real perceptions.

The intended transparent data will be unlike other previous research. Little to no construction research focuses solely on project owners, specifically from the designer and contractor points of view.

Research Question Intended Use

The purpose of identifying the current inefficiencies in construction project owners, is to provide specific areas requiring improvement to owner employers. These areas of improvement will initiate new and prioritized topics for continuing education courses offered to project owner representatives. Ideally, project owner companies will recognize these inefficiencies and begin to implement a change in training to focus on current industry needs.

To reiterate exactly how these inefficiencies will be identified, below is a list of the primary three research questions that will pave a path to finding research results.

1. According to designers and contractors, what inefficiencies do owners possess that may possibly obstruct or impede the path to achieving each of the four project goals: quick schedule, low cost, high quality, present citizenship behavior?
2. What are the most commonly identified inefficiencies for each of the four project related goals and how frequently do they occur?
3. How do these inefficiencies specifically affect a project's ability to achieve goals?

Secondary questions will help guide the researcher to find central question results, while also providing supplemental information.

a. What are the previously identified project owner inefficiencies?
b. Is there a difference in opinion or a joint agreement between designers and contractors in relation to owner inefficiencies?
c. What are examples of project owner inefficiencies shown in the current construction industry?
d. How can project owners identify their individual skills that are in need of improvement?

Figure 5 provides a diagram with all the research questions, and the proposed solution to answering each problem.

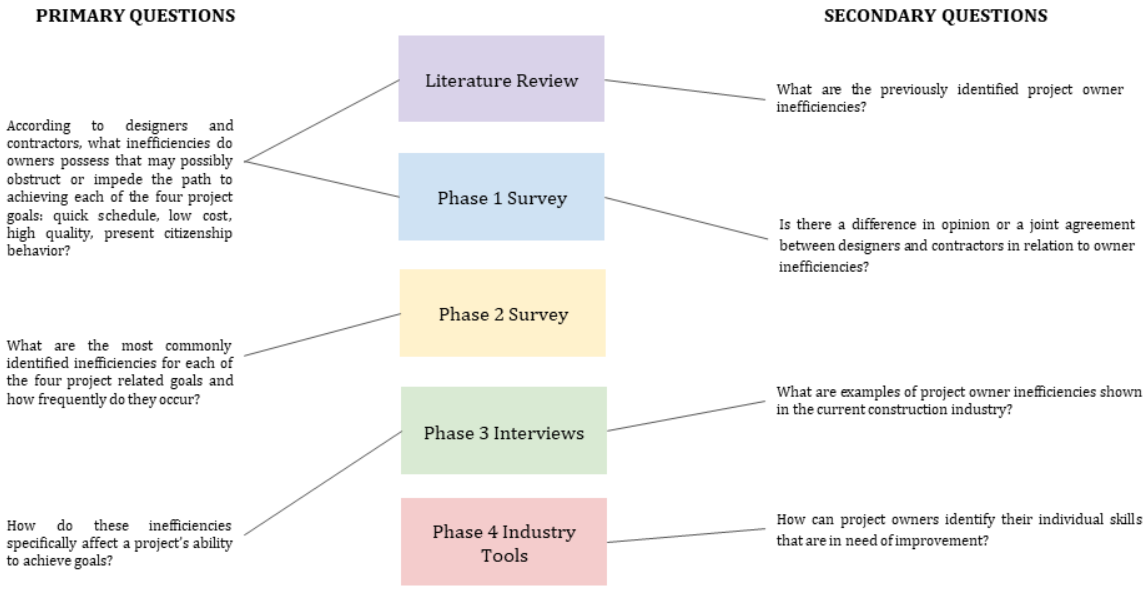

Figure 5: Research question diagram

The Construction Owners Association of America (COAA) has expressed interest in this research project. The association's mission is to "promote facility Owner leadership and continuous improvement in the planning, design, and construction process through education, collaboration, and information exchange" ("COAA - Mission," 2018). The board members of the association have indicated that there is always a need to identify areas of improvement in the construction industry. They will be analyzing the results of this study and determine how they can help aid in the education process using the "COAA way" of instruction and training.

This opportunity allows the research data to influence a national group of construction project owner leaders, who use the data to provide prioritized education to future owner representatives. As the results reach industry members, the goal is for the project team to experience positive progress in achieving project goals.

CHAPTER 4. METHODOLOGY

There are three standard approaches to conducting a research study: qualitative, quantitative and mixed methods. Qualitative studies answer questions like 'what', 'how' or 'why' an event or action occurs, while quantitative methods are better at determining 'who', 'how much' and 'when'. Mixed methods incorporate the use of both qualitative and quantitative measures to conduct research.

This study primarily uses qualitative measures, but will take an overall mixed methods investigation approach. Qualitative methods are used to understand and explain certain behaviors or patterns in groups (Creswell, 2014). To truly understand the project owner inefficiencies, it is invaluable to gain the thoughts and impressions from project designers and contractors. Quantitative methods will be used to determine the frequency of these areas on typical projects. To properly explain the chosen methodology, a summary of qualitative and quantitative methods will be provided along with an outline of the sample selection and a full briefing of the data collection and analysis process.

Qualitative Approach

Smith (2015) developed a practical guide combining concepts and step-by-step direction on how to perform qualitative research studies. This guide explains how qualitative measures are "generally engaged with exploring, describing and interpreting the personal and social experiences of the participant" (Smith, 2015, pp. 2). In this case, the participants will be the designers and contractors, and the data will come from these groups sharing their experiences with project owners. The researcher's task will be to

code and analyze the collected data, to look for patterns and consistencies within the responses.

Qualitative research will be the principal type of research conducted. The responses from the designers and contractors will come directly from their own opinions. Although the literature review has identified some, not necessarily specific, areas of improvement for owners, the majority of current data is from other countries' research, or the data reaches across multiple types of owners. This qualitative research will gain insight into what the designers and contractors from the United States experience, in relation to private, building construction project owners, from the point of view of the contractor and designer. Qualitative research is the most effective method to gain new and valuable information and insight from the project team members.

Qualitative Method Alternatives

There are five common qualitative research approaches: narrative, phenomenology, grounded theory, ethnography, and case studies ("Qualitative Approaches - Center for Innovation in Research and Teaching," n.d.). Table 8 was created by 'The Center for Innovation in Research and Teaching'; the figure provides four sections of explanation for each approach. The 'focus' describes a broad use of the approach, which helps a researcher associate the approach with desired topics. The 'data collection' and 'analysis' sections show how a typical researcher may gather and then explain the data according to each approach. Lastly, the 'written report form' section provides a guide of how the research results can be presented in a formal way to the readers. Each qualitative approach will be described, while also providing a potential look on how this particular research study might operate using each method.

Table 8: Types of qualitative research approaches and their characteristics (Adopted from The Center for Innovation in Research and Teaching)

	Narrative	Phenomenology	Grounded Theory	Ethnography	Case Study
Focus	Explores the life of an individual; tells their story	Attempts to understand or explain life experiences or a phenomena	Investigates process, action or interaction with goal of developing a theory "grounded" in observations	Describes and interprets an ethnic, cultural, or social group	Examines episodic event in a definable framework, develops in depth analysis single or multiple cases
Data Collection	Interviews and documents	Primarily through interviews, sometimes observation	Interviews with 20-30 individuals to gather enough data	Interviews, observations, and immersion into the cultural as an active participant	Documents of the case, archives, interviews, observations and physical artifacts
Data Analysis	Stories, review of historical content, development of themes	Study and describe experiences, examine meaning and context, look for themes, classify	Open, axial, and selective coding used to categorize the data and describe the implications of the categories	Describe and interpret findings by analysis data and developing themes	Develop a detailed analysis; identify themes; make assertions
Written Report Form	Detailed picture of person's life; often a chronology or biography	Report of 'essence' of the experience, description of the context of the experience or phenomena	Results in a theory, theoretical model, or figure that represents the phenomena	Description of the cultural behavior of a group	In depth study of a case that describes the case, its themes, and possible lessons learned

A sixth, and not as common, option for a research method is called qualitative survey research. This option will also be explained and discussed, as it is uncommon and may be useful since this project owner research may not be considered a typical qualitative study.

Narrative

Narrative research is typically conducted through interviews or observation, where the researcher studies the lives of the participants. In this study, the researcher could investigate the designer and contractor's interpretations of owner characteristics and inefficiencies. In particular, the research would study the role of the project owner, through the eyes of the designer and contractor. Continuous observation could be

performed to share in the experience of interacting with a project owner, and the participants would debrief to explain their thoughts and views after each interaction.

Narrative data can also be collected through documents. The documents can provide a historic background or basic facts to trigger new stories. Designers or contractors may come to interviews equipped with backup emails, signed drawings, submittals, or with any other documents that could help prove their point regarding a specific owner inefficiency. Documents can help add validity to an argument, rather than relying on opinions that have unavoidable bias.

Narrative studies grant the participants the opportunity to explain their thoughts in full detail and act as a storyteller instead of a typical interview respondent (Hollway & Jefferson, 2000). An advantage of using interviews, is that it allows the interviewer the opportunity to ask follow up questions if needed. For instance, if a contractor has a particularly interesting past experience with a project owner, the researcher will ask for him or her to provide more detail to help owner employers fully understand the inefficiency displayed. If a designer would like the owner to work on communication with the project team, the researcher can ask how specifically the communication can be improved. The researcher is able to listen and visually observe the emotion behind the story, which can help prove frustration with particular owner responsibilities.

Conducting this research topic in narrative form would limit the number of owners to be analyzed. Also, this project does not include a lot of the in depth feelings or relationships between the various team members which would be a main function of the narrative method.

Phenomenology

The phenomenology approach is quite complex and is generally used in psychology (delusions), anthropology (rituals), or sociology (fads) research (Giorgi, 1997). Typically, phenomenology research focuses around a specific phenomenon, or event, that has occurred. This type of research does not necessarily suit the purpose of identifying construction project owner inefficiencies. Inefficiencies are recurring matters that are common among the majority of the owners that designers and contractors work with. Perhaps if this research studied project owner skills before and after a particular event in the construction industry, then this type of method would be a good fit.

Grounded theory

Grounded theory is another method option for the project owner research study. It is one in which the researcher would perform multiple stages of data collection in order to create an assumption regarding a process or action as a whole, based on the participants responses (Creswell, 2014). Grounded theory begins with a central theme to study, but does not make aim at the specific results as a hypothesis. Instead, the researcher must "start with individual cases, incidents or experiences [...] to identify patterned relationships within [them]" (Charmaz, 1996). Charmaz (1996) also explains how the data collected must be coded into categories, and how the data collection and data analysis phases of research may occur simultaneously. In terms of this study, the researcher purposefully will not ask designers and contractors to verify or deny current universally known project owner inefficiencies, but rather would like them to create their own thoughts on the subject. These unprompted responses will guide the researcher to identify a new theory regarding project owners.

Although the goals of this study align similarly with the grounded theory process for starting with a blank slate to develop new ideas, there will be no universal theory developed to describe project owners.

Ethnography

Ethnography is a study tactic focusing on behaviors, actions, or languages of particular cultural or social groups (Creswell, 2014). In order to obtain data for ethnographic research, observations and interviews take place. These observations would aim to understand the natural setting and practices of the groups. An example could include following a protest process of a particular social activist group. However, this construction project owner research does not have an intent to identify project owners by their social or cultural class. Instead it will primarily focus on the term 'project owner' as an occupation, regardless of the owner's personal or social characteristics. Observations of owners during multiple construction projects would take an extension amount of time to accurately declare the observations apply to the universal project owner group. Frankly, this method would not be useful for this research study.

Case study

Case studies are typically designed around a specific activity or process, bounded by a specified period of time (Creswell, 2014). Researchers using case studies inspect each case looking for new and uncommon interactions and events; yet often find similar events between cases that they can use to develop generalizations (deMarrais & Lapan, 2003). A case study can most certainly apply to construction management research. Case studies are often used to go back and determine what went well or what went wrong on a construction project. These cases are all unique, but can generally provide lessons

learned for future projects that may have similar circumstances. Case studies could be used as supplemental data to show clear-cut examples of owner inefficiencies during a project.

Qualitative Survey

Rarely is a survey used to collect qualitative research data. However, Harrie Jansen (2010) wrote an extensive journal indicating that observation, interviews and document review are not the only three ways to obtain qualitative data. Open, or inductive, surveys are used to gather raw data pertaining to the relevant topic. The purpose of collecting this broad range of raw data in a qualitative way is to determine the diversity among the results and not to limit the responses to predetermined boundaries, as may be the case in quantitative surveys. On the other hand, pre-structured, or deductive, surveys can be used to focus data on fixed content.

In the project owner study, qualitative surveys could be used to gather the raw data based on experiences participants have related to project owner inefficiencies. The raw data could be collected from a broader range of participants rather than only 10-20 interviews, which may be considered normal in other qualitative studies. The data could be collected in an open format, meaning the participants are not provided with a narrowed topic to discuss and they are able to 'free write' about the topic. Another option would be for a pre-structured survey, where the topic at hand is narrowed based on the results from a literature review or initial interviews prior to conducting the survey.

Quantitative Approach

Quantitative research involves evaluating the relationship between two variables. The variables can be weight, performance, or time, which are measured on

sample subjects such as humans, animals, or biological features (Hopkins, 2000). In this case, project owners are identified as the sample subjects, and their performance would be considered the variable. The term 'performance' is broken down to purely focus on items owners could improve upon related to job tasks in connection to the project team. Designer and contractors will be identifying owner inefficiencies by internally comparing what they would consider to be 'good' vs. 'areas of improvement' for project owner actions, or non-actions.

Quantitative Method Alternatives

Quantitative methods typically entail placing numerical values on the data collected. In this case, the researcher will want to know not only 'what are the owner inefficiencies identified?' but also, 'how many respondents identified this as an inefficiency'? The numerical association adds support to research results, and help show the reader the magnitude of the responses. Without quantitative analysis, qualitative data can be misperceived, and false results might be implied to a greater population. Quantitative research methods can be grouped into either experimental or non-experimental designs. Each of these two alternatives will be described in detail.

Non-experimental

Creswell (2014) describes a few options of non-experimental research methods: surveys, causal comparative research and correlational design. He explains that surveys provide a "numeric description of trends, attitudes, or opinions of a population by studying a sample of that population" (Creswell, 2014, pp.13). Creswell has developed an entire checklist for designing a research survey. Many of these items include identifying the sample population, requiring a timeline for participants, and checking for

potential bias in questionnaires. There are many items to think about when creating a survey; will there be open or closed questions? Will the responses be multiple choice, rank items, or possibly use Likert Scales? Surveys can be very useful in order to identify designer and contractor opinions regarding project owners. Surveys can reach many people quickly, compared to other methods such as observational studies, where the researcher must be present at all events to collect the data.

Causal comparative research is used when the researcher wants to compare pre-existing groups of participants to understand the differences between the groups (Schenker & Rumrill, 2004). In the case of this project owner research, there is only one owner group established, which all members are considered to have the same pre-existing conditions: private industry owners working on building projects. A separate research study may compare various types of project owners, such as private vs. public, or infrastructure vs. heavy highway. These other studies may have interesting comparative results on project owner skills and responsibilities.

Correlation design is typically used in parallel to statistical analysis, where the researcher generates positive or negative correlations between variables (Creswell, 2014). This type of research tool might be used well in situations where a distinct set of ideal project owner characteristics were set, and a researcher wanted to correlate those characteristics with the ability to achieve project goals. For example, a possible result might include a project owner's strong ability to read and understand plan sets positively correlates with the project's schedule staying on track during the submittal process timeline. The assumption with the new research study, is that all inefficiencies identified have a negative correlation with achieving the associated project goal.

Delphi is another non-experimental method used to help make decisions. This method is used to determine a consensus among the opinions of an expert group of people (Dalkey & Helmer, 1963). A series of surveys are sent out to participants; most well-known is the Delphi ranking portion. The experts rank the particular options in the survey in order to determine the most important issues (Okoli & Pawlowski, 2004). Oftentimes in Delphi, participants are able to revise their original answers to survey questions, once they are shown the overall average of the group's response. This step is not always used, but can be performed if a researcher requires a very small degree of variation among the final results (Okoli & Pawlowski, 2004).

An additional decision-making method is called pairwise comparison. This comparison is used to compare multiple alternatives, however it can be broken down into simply comparing one choice versus another (Koczkodaj, 1993). For example, a possible use of the pairwise comparison in this study, would be to compare each owner inefficiency to one another regarding its affect on project success. A matrix like visual would be used to put a value to each individual comparison, resulting in a final prioritized list of alternatives (Saaty, 2008).

Experimental

Experimental design is used to compare different groups, based on applying different measurements of a variable in each group. This type of research is greatly used in the medical industry. This method is designed with two groups, where one group is receiving the experimental variable, while the other group acts as the 'control', with no change in variables (Bausell & Li, 2002). The research involves determining the differences between the groups, and measuring the effect of the given variable. This type

of research is less applicable in the construction management industry. It is difficult to measure relationships and skills at a broad level using experimental tools.

Method Decision

This research study will utilize a mixed methods approach to determine research question outcomes. The Delphi technique will be the model method to determine the project owner inefficiencies. The technique will be altered slightly, however the concept of a series of data collection with the intent to determine a group consensus remains true. The most notable variation is that the participants will not be able to revise any original response, based off of the group's combined opinion.

In order to properly identify specific areas of improvement for project owners, more than one method will take place. This research will comprise of four phases, each with its own unique research question outcome. Phase 1 will answer the question 'According to designers and contractors, what inefficiencies do owners possess that obstruct or impede the path to achieving each of the four project goals: quick schedule, low cost, high quality, and present citizenship behavior?' Phase 2 corresponds with 'What are the most commonly identified inefficiencies for each of the four project related goals and how frequently do they occur?'

Phase 3 will explain 'How do these inefficiencies specifically affect a project's ability to achieve goals?' Phase 4 will conclude by responding to 'How can project owners identify their individual skills that are in need of improvement?' and 'What are examples of project owner inefficiencies shown in the current construction industry?'

Principal data collection throughout the various phases will stem from qualitative approaches. Follow up data collection will be quantitative, and will be used for more

specific and measurable results. The intent of the research is not to provide the designers and contractors with previously identified owner inefficiencies and to seek validation. Rather, the researcher's goal is to determine if there are common patterns shown in the designers and contractor's unique data. The data will then provide a generalized concept among similar project owners.

Qualitative survey research is the most appropriate method to use for Phase 1 to define project owner skill areas needing improvement. Specifically, an open survey will be used to collect raw data in relation to project owner areas of improvement. Since the intent is to collect new and relevant data in a broad range, the open survey will be most useful. However, there will be a portion of the survey that will be pre-structured. This will be discussed later on in the Data Collection section.

The researcher's goal is to discover which project owner inefficiencies are currently affecting construction projects in the industry. The researcher did not want to rely on previously identified research to narrow the possible responses. Also, the it is important to find this broad range across a large number of participants, rather than just verifying the results of an initial small participant sample. Keeping these goals in mind an open qualitative survey is the best method to use for Phase 1.

For Phase 2, the research question mentions 'top inefficiencies' from Phase 1, which implies a 'count' or the more commonly stated, and the question also mentions 'frequency'. These two words obviously imply using a quantitative method. This phase will combined the data from Phase 1 to execute an altered Delphi method. To begin Phase 2, Phase 1 data must be previously analyzed. Now, participants will have a change to perform another survey on the same topic. However, this time the results have been

narrowed and they will be asked to determine frequencies for each of the most commonly identified inefficiencies. Essentially, the group will be coming to a consensus on their new tapered data to determine which of the most common areas of improvement are also the most frequently occurring on a project site.

Phase 3 reverts the research back to a qualitative method procedure. This phase dives into a deeper understanding of the previously identified inefficiencies. In order to provide the 'lessons learned' concept from the inefficiencies and dive deeper into the cause of the inefficiencies, the researcher must understand the full story behind particular events. Interviewing participants to collect case study data will be a best fit for this phase. Participants will share their experiences and how owner inefficiencies specifically affected a project he or she was working on. Each participant will be considered a 'case' to show how various inefficiencies affect construction projects. Phase 4 focuses on research deliverables, rather than data collection. This phase will use the data collected from phases 1-3 to provide project owners with useful tools to study industry events and determine their own areas of improvement.

Data analysis will also be a performed via mixed methods. The definition of this type of analysis is 'altered exploratory sequential mixed method design'. Exploratory mixed method design consists of beginning with qualitative research, analyzing the data, and then using the data to conduct a quantitative study to determine if the result can apply to a larger population (Creswell, 2014). This method is altered for the first three phases of data collection. Instead of developing owner inefficiencies through a small focus group, the researcher aspires to gain many more original opinions, without the

boundaries of a focus group's assessment. Therefore, the larger open qualitative survey comes into play.

The end result will predominantly be qualitative, since the research aspires to explain the inefficiencies from the designer and contractor's opinion. However, to provide supplemental frequency data, quantitative analysis will be used to help justify the responses. The sequential format comes in during the quantification of the qualitative survey responses. As the data moves through the sequential process, it becomes greater endorsed to be able to apply universally. This grouping of methods is the most effective way to capture and understand the desired data.

Data Collection

This research will consist of two primary types of data collection: surveys and interviews. The surveys will be issued to the participants using Qualtrics, a software commonly used to issue online surveys. Qualtrics allows hosts to create their own questions and choose between a wide variety of open and closed question options. Any survey used on the project will go through a trial period to refine the questions and the formatting in order to create a reliable survey. This pilot study will help the researcher identify any potential issues or question misunderstandings early on in the process, as to not cause data problems with future participants. Ideally, at least 3-5 'trial participant' would complete the survey and provide constructive feedback to help refine the survey style, flow, and questions. Since this research aims to collect designer and contractor unique opinions, it is important for the survey questions to be worded in a way that allows for truly open reactions. In Phase 1, the researcher shall not write questions that sway or predict participant responses.

Nowadays business employees can be bombarded with online surveys. It is vital for this research survey to be simple and concise. The data can be significantly skewed, or produce false or incomplete results if the participants feel the survey takes too long to complete; so they fill it out quickly and give thoughtless responses. This research requires detailed answers; the participants will have as much space as needed to complete each question.

Interviews will also be used to collect data regarding project owners. Interviews will start with a few opening structured questions such as 'what is your job title?' The next category will be non-directional questions, which ask the interviewee about relationships with project owner, then move to semi-structured questions that ask participants to opening explain their experiences with project owners, and lastly revert back to structured questions, where the aim is to gather more details about their experiences (Flick, 2009). A non-directional question may be 'As a contractor, what are your impressions of project owners?' while a structured question would ask 'In your opinion, what skills do project owners need to improve in relation to project citizenship behavior?'

Interviews will be conducted in a one-on-one setting to allow the interviewee to be comfortable and provide honest answers. In order for the participants to feel prepared for the interview, the researcher will send all participants a document a few days prior to the interview outlining the topics to be covered, and generic sample questions that will be discussed. Since this is a qualitative section of the study, the interview topics may sway in certain directions depending on the stories and experiences provided by the interviewee. As to not miss important details and potential quotes for

the research findings, the interviews will be recorded, pending each participant's approval. The researcher will also be taking notes and asking follow up questions to gain further understandings and better explain research question outcomes.

Phase 1

Phase 1 will consist of implementing a survey, aimed at identifying current project owner inefficiencies. The survey will be constructed in five sections. The first section will ask the participants to describe themselves, as it relates to the research topic. For example, it is important to identify which role they identify as on a project team, and what type of previous experience they have in the industry. This first section will consist of all closed questions to categorize the participants.

Sections two through five of the survey will breakdown the responses as they relate to hindering project goals of having a quick schedule, low cost, high quality, and present citizenship behavior. Participants will be asked to identify project owner inefficiencies as they relate to obstructing project goals. The researcher would like to gain a reasonable number of responses per each respondent. The ideal number would be five to eight inefficiencies, per each project goal. This number will be re-evaluated after the pilot study is conducted to determine if the quantity is feasible for participants to supply. For all participants to be on the same page according to project goal definitions, the survey will provide full descriptions and explanations for each of the project goals.

Understanding that it may be challenging for participants to categorize and describe owner areas of improvement on the spot, a few currently known inefficiencies will be provided for reference. This component will be created using the content found in the literature review. These example inefficiencies will act as brainstorming initiators.

The examples will also show participants the style of response that is being requested by the survey. Participants can follow this style for their own responses, while adding their own content. Participants will have the option to choose these examples and add them to their responses, but do not need to select them if they do not agree with the inefficiency described.

The term 'inefficiencies' will relate to specific owner tasks, behaviors, roles and responsibilities for a construction project. It will be most useful if the respondents provide full sentence response answers in a precise fashion. For example, in the project schedule category, it is not beneficial for the participant to say "too much delay in shop drawing approval." Ideally, this concept would be portrayed as "each submittal has an expected approval response time associated with it, the owner does not typically follow these timelines, and instead needs multiple reminders to complete shop drawing approval. This causes a schedule delay in the construction phase." This example implies that the fault is correctly assumed by the owner and provides details as to the cause, otherwise delays could come from lack of deadlines specified by a contractor, or confusion of all team members on where the documents are in the submittal process. Another example response could be "owners do not have the design fully complete prior to the submittal phase. This problem causes too much back and forth communication via email between the owner and designer to pick out simple submittal items such as paint colors or floor finishes. This inefficiency causes a delay in the submittal process during the construction phase."

The participants will have approximately four weeks to respond to the Phase 1 survey. During that time, the researcher will be collecting the results and will begin data

analysis. If respondents are not filling out the survey in a timely manner, the researcher will send multiple reminder emails to follow up with the data collection.

Phase 2

After receiving all owner inefficiencies as they relate to the four project goals, the researcher will analyze the results and identify the top 5-10 recurring themes for each of the four project goal categories. The exact value of the 'top' responses will depend upon the results of the survey in Phase 1. For instance, if there are eight inefficiencies that respondents seem to agree upon relating to project schedule, but only five main inefficiencies that respondents agree upon relating to citizenship behavior, than those categories will have a different number of 'top' responses.

Phase 2 will begin by initiating another online survey to all participants. The survey will provide the top five to ten answers from each goal section from Phase 1, and request the participants to identify the frequency of each common area of improvement. The survey will include a Likert Scale with categories 'almost never', 'rarely', 'sometimes', 'often', and 'almost always'. The questions will ask participants to match the listed inefficiencies to what they believe the appropriate occurrence level is on their projects.

This survey should take less time for the participants to complete than Phase 1, as they are only choosing a frequency level, instead of developing their own descriptions of inefficiencies. Again, the survey will be broken into five sections. Section one is to classify the participants' characteristics and sections two through five are for each project goal to label their inefficiency frequency.

The Phase 2 survey will be sent out to all of the people who participated in Phase 1. Since the response to the Phase 2 survey will be conceptually easier to complete than

the Phase 1 survey, the respondents will have approximately two weeks to complete it. After this, the researcher can finish data analysis for the survey portion of the project.

Phase 3

Phase 3 will consist of interviewing select participants in order to gain deeper knowledge of specifically identified owner inefficiencies. Identification of these select participants is explained in the 'Sampling' section of this paper. Phase 3 will look at experiences as individual case studies, as designers and contractors share their personal stories. For example, the researcher will ask a designer to explain a particular inefficiency that he or she mentioned in the Phase 1 survey. This question may spark a connection to a distinct project, which shows a clear cause of a missed project goal due to the project owner. These stories will help the researcher better construct a description for each area of improvement in the research results.

The researcher will intend to propose and discuss all potential questions and topics during the interview, however the interview will be fairly open allowing the interviewee to branch off on content related to project owner skills. Near the end of the discussion, the researcher will ask if the interviewee has any other relative experiences or valuable data they would like to share. Leaving this question open ended is important, so the interviewee feels they can share information that may have been missed in earlier questions.

Interviews will be conducted in person and over the phone depending on participant schedules and geographic location.

Phase 4

Phase 4 will consist of creating tools for owners to use to improve their skills. Case studies will be written to show how specific owner inefficiencies affect the success of projects in the current construction industry. Also a team member satisfaction survey will be created for owners to use to identify their personal skill inefficiencies. This tool will be in the form of an online survey that owner companies can send out to their personal project team contacts to request individualized results. To create the case studies and survey, the researcher will use data collected and analyzed from Phases 1-3, therefore no new data will be collected in this phase.

Data Collection Tool: Qualtrics

Qualtrics is an online research tool that prides itself as being "the most sophisticated survey software tool [that] is also the easiest to use" (*Survey Software*). Iowa State University has a partnership with Qualtrics, allowing students to use this program for free. Various types of survey questions can be created, such as multiple choice, text entry, rank order, matrix tables, sliders, and side by sides. These options allow for both qualitative and quantitative surveys to take place. In the Phase 1 qualitative survey, text entry will be the primary type of survey question used. This allows for participants to type in their personal opinions as survey responses. The Phase 2 quantitative survey will consist of a mix between rank order and matrix questions.

Qualtrics also allows the survey creator to design his or her own visually pleasing background and survey aesthetics. The Phase 1 and 2 surveys will have a construction theme. The goal is to have the participants visually enjoy filling out the surveys,

compared to a plain or generic theme. Qualtrics has options to download the collected data for the researcher to use in the program of their choice.

Sampling

A significant advantage to qualitative research is the ability for the researcher to partake in purposeful sampling. This means, the researcher will seek and identify individuals that will best help in understanding and answering the research problem and questions (Creswell, 2014). Unlike random sampling, purposeful sampling can guarantee that the study's participants have backgrounds and experience working with project owners. The designers and contractors asked to participate will first need to inform the researcher if they have experience working on private projects and constructing building infrastructure.

Phase 1 and Phase 2 sampling goal will consist of surveying approximately 50 individuals. Ideally, half of the group would fall in the 'designer' category, while the other half would be a part of the 'contractor' category. The concept of saturation will be used to collect the data for Phase 3. This implies "that you stop collecting data when the categories (or themes) are saturated: when gathering fresh data no longer sparks new insights or reveals new properties" (Creswell, 2014, p. 189). The initial goal of Phase 3 is to find approximately 10 individuals to participate in an interview, or until the data is saturated. Prior to reaching out to individuals for participation, the Institutional Review Board (IRB) approval was met to ensure ethical research practices. The IRB approval letter is provided in Appendix I.

To locate these participant groups, the researcher will contact local Midwest contractor, design, and engineering firms who have affiliations with Iowa State

University. The Iowa State University Civil Engineering (CE) External Advisory Council, and the Iowa State University Construction Engineering (ConE) Advisory Council will be used as resources to locate participants. These two councils provide external service to the Department of Civil, Construction, and Environmental Engineering to aid with student services, and support university research (Civil Engineering External Advisory Council, 2018). The council members are known experts in the industry, who may accept the invitation to participate in the study, and who may help find other experts willing to participate. This construction project owner research was initially presented to the Construction Engineering Industry Advisory council at their Fall 2018 meeting. The council responded with extremely positive remarks regarding the influential outcome of the research results. In essence, the council was excited to learn about what designers and contractors identified as owner inefficiencies; and more importantly, the council acknowledged their willingness to provide participants in the study.

The researcher's committee members also suggest reaching out to major industry groups such as Design-Build Institute of America (DBIA) and the American Institute of Architects (AIA) for additional participants. Another final source for pinpointing participants is to access firms where the researcher already has an established relationship. These firms are already known to have experiences with private project owners. Since the researcher already has a favorable relationship with these companies, the belief is that they will provide other sources of designers and contractors for the researcher to request to participate in the study.

Sampling Outcomes

Between the CE and ConE External Advisory Councils, DBIA, AIA, and other regional offices, the researcher contacted 54 people to aid in the process for seeking research participants. The majority of these communications were made through email, however the researcher presented at the Fall 2018 ConE IAC Meeting and requested assistance in finding quality research participants. Appendix A provides the email correspondence for this step. The researcher knew that many of the members of the advisory councils and industry associations were high level executives in their employers. The researcher not only requested those executives to participate in the research, but to primarily provide contact information for whom they would suggest as good participant candidates, not only limited to their own company.

From these 54 "request for participant contacts", 98 potential research participants were identified. The researcher created another email correspondence, shown in Appendix B, requesting these 98 individuals to participate in this research project. As shown in Appendix B, the request provided an overview of researcher's background, request for participation in the research, time commitment, confidentiality, and a summary of the study. Seventy of the 98 individuals responded indicating that they would be interested in participating in the research study. Seven of the 98 responses specified that their personal career experience did not align with the project topic, or that they strictly worked in the public sector. A follow up email was sent out to those who did not respond promptly, yet 19 people did not respond at all to the request.

As Phase 1 began, the survey was sent to the 70 individuals who had agreed to participate in the study. Many survey responses filed in quickly within the first week. A

total of four follow up emails were sent to those who had not yet finished the survey by the designated deadline. In total, 54 participants completed the Phase 1 survey. Of those participants, 27 labeled themselves as 'contractors', 7 as 'subcontractors', 12 as 'engineers', and 8 as 'architects.' In summary, 34 participants would fall under the combined 'contractor' category, while 20 would fall in the combined 'designer' category. Although the ideal split would be 50/50, realizing where the majority of the participant contact info came from (ConE Advisory Council), the 63/37 percentage ratio is acceptable.

The research participants have an average of 22 years of experience working in the construction industry, with 19% of participants above 30 years of experience and 44% above 20 years of experience. A map is provided in Figure 6; the purple and green highlighted states show which project locations these 54 participants currently work on. Twenty-six of the states are highlighted, and they span across all regions in the country. This discovery verifies that the results of this study can be claimed as true nationwide.

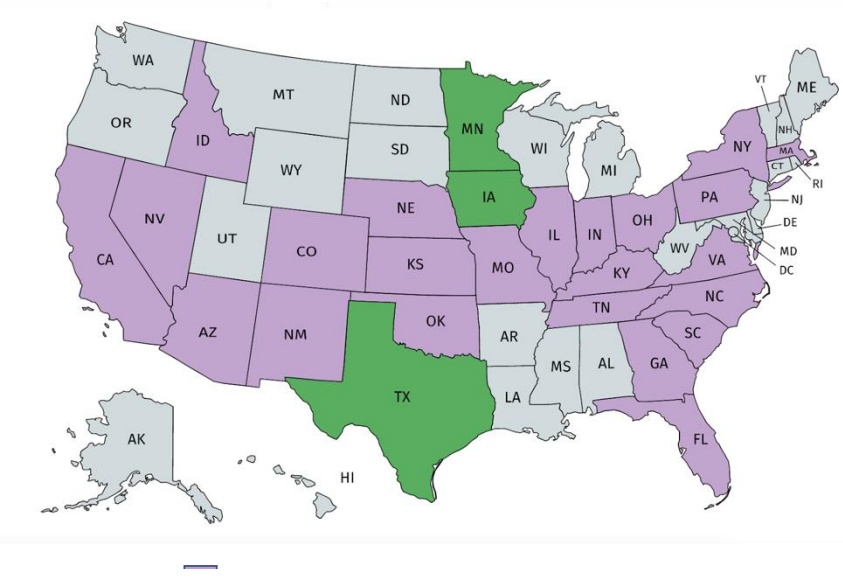

Figure 6: Research participant project locations

The Phase 2 survey was sent to all 54 participants from Phase 1. Phase 2 achieved 40 completed surveys. The researcher sent 3 follow up emails as a reminder to complete the survey online. Of those 40 participants, 26 were contractors and 14 were designers. The last question in the Phase 2 survey asked participants if they would be interested and willing to participate in an optional interview discussing the results from the first two surveys. Twenty-three participants had answered 'yes' to this question. If they answered 'yes', a follow up question was asked to determine if they would prefer an in person or phone/skype interview. Four individuals chose the in-person category, while 19 chose phone/skype. To determine which of the participants would be most valuable to collect interview data from, the researcher reviewed the job position and background of the participants. Eight final participants were chosen to participate in interviews. Of those eight, five were contractors and three were designers.

Data Analysis

Phase 1

As Phase 1 survey results begin to arrive, the researcher will begin to peel apart the results to categorize the responses. Survey results will need to be reviewed, combined and categorized to relate the data to the original research questions. Essentially, "qualitative content analysis involves interpreting, theorizing, or making sense of data by first breaking it down into segments that can be categorized and coded, and then establishing a pattern for the entire data set" (Jackson et al., 2007).

As an example, 'changes' might be a common theme recorded in survey responses. Possibly, the researcher will use changes as the umbrella topic in the schedule section.

The various survey results will need to be interpreted to determine what type of owner skills related to 'schedule changes' need to be improved. Possibly 'change' in regards to issuing change orders, or changing products after orders have been made. These would be separate inefficiencies that designers and contractors determine; not merely just 'delayed schedule' or 'too much change' issues that arise from owners' actions. From these details, the researcher will compose the inefficiencies to summarize the survey results in a straightforward manner.

Once those patterns are developed, interpretations and claims can be made about the data. These claims end up producing research results that will be used to explain what events are occurring in any given industry. In relation to this study, the researcher will code the data collected through various surveys and interviews. Ideally, when coding is completed, claims can be made about the current construction industry, specifically project owners.

There are various types of coding; this study will be focus on two in particular: inductive and deductive. In order to develop these types of codes, a certain process will be followed. The process includes initial coding, line-by-line coding, categorization and finally defining themes. As the coding process progresses, the fuller, or more complete, the research results will be portrayed.

Coding

Many scholars provide information about coding qualitative data. In Schatzman and Strauss (1973) the authors consider coding as a strategy for analysis. They indicated that researchers should find linkages between points of data. These linkages can be split into classes, which is what they believe to be various levels of codes.

In Miles and Huberman's (1994) book, they consider coding as a way to assign meaning to the information found in a study. They define three types of codes, descriptive, interpretive, and pattern codes. Descriptive codes do not require in depth interpretation. These codes connect the data to the research phenomenon, or topic. In this study, the data could be separated into descriptive codes consisting of responses given by architects, engineers, contractors, and subcontractors. They next discuss interpretive codes, which take a step deeper into analysis. These interpretive codes help tell a story about the research topic at hand. Finally, pattern codes link together specific themes. Miles and Huberman suggest that codes can be formed by analyzing acts, activities, meanings, participation, relationships, and the setting of the data.

Strauss (1987) also provides insight on common coding practices. Strauss believes that researcher will develop codes by looking at the conditions of the collected data, interactions among the actors, and strategies and tactics used to find the data. He breaks up the process of coding into three steps: open coding, axial coding, and selective coding. Strauss defines open coding as the first step after looking at the data. This is the initial view of the data as the researcher begins to break it down into meaningful categories. It is assumed that these codes will be a working process as they can be added, removed, or altered at any time. The next move to take a step deeper is axial coding. Researchers will focus on one open code at a time and focus only on that category. By narrowing down the topic, a greater understanding of the data can be achieved. Finally, selective coding is used to determine which of the codes are relevant to the final results. Not all codes may be useful, so it is important to selectively choose the more appropriate and beneficial codes for the research.

Out of these three academics, Strauss' coding process is the most appropriate coding method to use as an outline for this study. Although each of these qualitative researchers has their own strengths, none of them fully fit the needs of this study. An author by the name of Erika Yi (2018) wrote an article called "Themes Don't Just Emerge – Coding the Qualitative Data". She discusses the coding process she used to complete her thesis that focus on deductive and inductive coding.

Deductive coding

Deductive reasoning is the process of starting very broad and working down to a very specific result. Deductive coding follows a similar suit. Figure 7 shows a visual representation of the deductive reasoning process, which could also be viewed as deductive coding. This type of coding process will typically begin though a research literature review. The literature review helps identify what topics are already out there for people to review and learn about. It also helps shape a path for new researchers to fill in gaps about the industry. The literature review will define some known codes about project owners that may be shown in this study's data as well. To use a deductive coding process, the researcher would begin the coding process in advance of the data collection period. These codes would be known project owner inefficiencies. This is where the researcher can map out broad topics and predict what may show in the data results. Then, once the data is collected, the pre-developed map can be used to guide the efforts in defining specific and detailed codes.

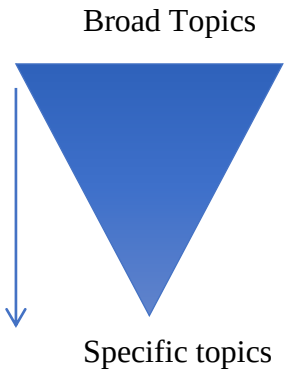

Figure 7: Deductive Reasoning

Inductive coding

Inductive reasoning is consequently the opposite of deductive reasoning. As shown in Figure 8, inductive reasoning begins with detailed topics, and ends the process with a broader understanding or theme. In this case, the study would not necessarily begin with a 'codebook' but rather the researcher would use raw data to find common themes to define them as specific project owner inefficiencies. Then, after analyzing the common themes, major claims about project owners can be made to show the greater meaning of those themes.

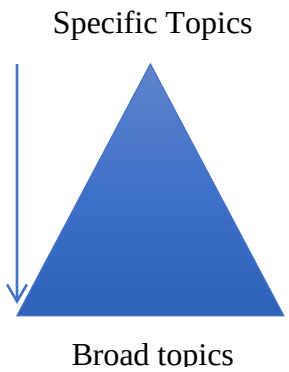

Figure 8: Inductive reasoning

Coding process

This study will use a combination of both deductive and inductive coding. The researcher created an initial codebook that was developed using the literature review. However, one could suspect that a lot of new information about project owners will emerge in the Phase 1 qualitative survey. This data provides specific details about codes that can help make broad claims about construction project owners that have yet to be defined in research papers. In order to create these codes, Erika Yi's (2018) four steps coding process is used.

Initial coding, as it suggests, is the first step in the coding process. The researcher will look at the data with a broad outlook. Data is placed into obvious and higher-level codes that can later be broken down into further segments. Initial coding is the researcher's fresh look upon the data; therefore, the data should be placed in obvious locations.

Line-by-line coding takes the initial coding a step further. Now that the data is in fairly broad coding categories, the researcher will walk through every line item of the data and separate it into more precise groupings. The researcher will become very familiar with the codes, as she will need to go through the data multiple times in order to code every response appropriately. This stage can be complex and messy, but the idea is to generate as many reasonable codes as possible.

Now that the research has an abundance of possible codes to work with, connections between the codes are made to show meaning among the individual ideas. Layers of codes will begin to appear, as codes are lumped into similar categories. The researcher might ask "what do the codes have in common? or "How do the codes

influence each other?" At the end of this section, all the codes should follow some type of flow, and you should be able to see the relationships between the codes through their categories.

The last step of the coding process in to define themes. Essentially, this is analyzing the topics that were concluded through the categorization step. These categories should explain outcomes of the research and should define the patterns that become the results of the research project. The themes are what a research uses to answer the research question, and these themes are found through the relationships between the participant responses.

Analysis Tool: Exploring Nvivo

In order to provide a thorough analysis section, the researcher must use technology resources to help aid in the data coding process. Nvivo is a qualitative research coding tool and is available for public, government or academic use. Nvivo specializes in storing and organizing, categorizing and analyzing, and visualizing a user's inputted data ("What is NVivo? | NVivo," n.d.). Nvivo's website defines coding research without a tool to being similar to "looking for a needle in a haystack."

Uploading data into Nvivo is very easy. Nvivo asks a few questions related to the context of the data. The software would like to know if the user would like the various categories (or columns) to be classifying or codable. For classifying data, Nvivo will automatically code various categories such as age, job title, years of experience, etc. Essentially, the data that has a quantitative aspect to it. For this study, classifying data would be participants' categorical questions. All other columns will be labeled as codable, where the researcher will walk through the data manually and determine codes.

For this project, the researcher will input all survey and interview data directly into the software. Nvivo has a partnership with Qualtrics, allowing for easy transfer of data from one software to the other. Nvivo will present the survey data by user preference; whether it be by participant, particular question, or the date the survey was submitted. The researcher will then go through all of the responses and begin the coding process.

Nvivo has unique coding tools to aid in this process. The software can search for specific terms and synonyms of terms and group responses together. For example, under the project goal category for quality, many survey responses may include some version of owners choosing inexpensive material choices, resulting in poor quality results. Not all respondents will write the exact same answer, but Nvivo can help to group the answers together that use the terms 'materials', 'products', etc. Also, the researcher can manually place critical survey and interview responses into various themes and attributes. By grouping responses by topic, the research will be able to determine what the top common responses are in each category. Once the researcher has determined the top subjects for owner inefficiencies, Nvivo can aid in the production of visual representations of the results for presentation ready figures.

Classes

Nvivo allows users to create classes among the data. Each class will act a hub for certain uploaded data and combine them to show connection between the classes. Most commonly, these classes will be labeled as participant names or ID's. Each participant will be labeled as a class, and then all their collected data will be connected. For example, this study will collect three points of data collection from each of participant: two online

surveys and one in person interview. Nvivo will connect the two surveys and the interview from each individual participant not only as a way to track responses, but also connect the responses from each step in the data collection process.

Nodes

Nvivo uses the term 'nodes' to symbolize codes. Users can create as many nodes as they want and edit their labels at any time. Also, the users can create nodes within other nodes. This is the deeper categorization of data within broader coding topics. While reading through the various data, the users simply need to highlight, drag, and drop the words into the created nodes. If the researcher determines that they believe the data belongs in a new code, they just need to make a new node and place the data inside it. This software is very user friendly.

Phase 2

Phase 2 data analysis will incorporate a mathematical approach. Since the participants are asked to define the frequency of each inefficiency, the analysis will consist of making sense of the new quantified inefficiency information.

First, it is essential to determine if the data is 'normal' or almost normal. If the distribution is 'normal', this refers to the graphical representation of the data shown as a bell-shaped curve that has a maximum peak at the mean of the variable (*Normal Distribution*, 2001). If the ranking results produce a normal, or almost normal, distribution then it is appropriate to that descriptive statistics may be used to represent the participant responses.

Figure 9 provides a standard normal plot distribution example. In a perfect research world, the results would align with the appearance of this plot. Of course, it is

reasonable to say that the data will not be 'perfect', but the hope is to achieve useful data which is shown in a plot that is somewhat representative of a normal plot. If the participant response plot relates to a normal plot, then it can be said that the participants have an agreed upon trend of opinions. Next, the data will be analyzed using Item Response Theory.

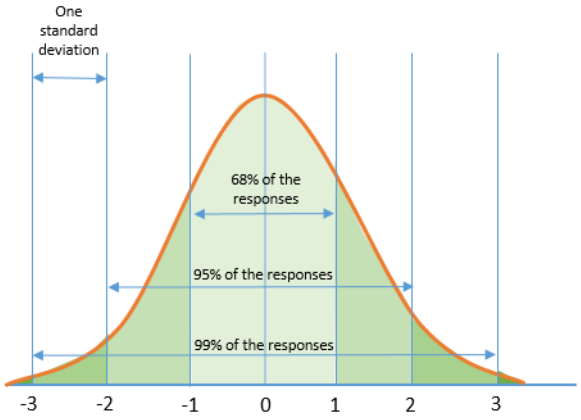

Figure 9: Standard Normal Distribution Plot (Adopted from "Normal Distributions")

Item Response Theory

As Christine DeMars (2010) describes, Item Response Theory demonstrates the relationship between a person's abilities, that are measured by an instrument, and an item response. Typically, the 'person' is the participant taking the survey, and the analysis would base their abilities measured against a known correct response. In this case, the 'person' in this study is considered to be the project owner since the participants will be reflecting upon the owner's abilities. This study's analysis will help discover what the known correct response will be. There will be no true indicator to show how frequent an inefficiency occurs in the industry 100% of the time, however the response will be shown as an industry average for each inefficiency.

The term 'item response' may be either dichotomous with simple yes/no responses, or polytomous with multiple categorical responses (DeMars, 2010). In the Phase 2 survey, there are five possible participant answers per each owner inefficiency: almost never, rarely, sometimes, often, and almost always. In order to simplify the data and discover inefficiencies that are considered to occur frequently vs. infrequently, the results will be converted to a binomial distribution. Binomial data transforms the results into yes/no, right/wrong, 1/0 responses. In this case, the positive, '1', response will be participant indicators that are considered frequent, which include 'often' and 'almost always', or values 4 and 5 on a 5-point scale. The negative, '0' response will be the grouping of the non-frequent indicators of 'almost never', 'rarely', and 'sometimes'. All the data will be converted to a binomial distribution. Then, the study can indicate simply whether each inefficiency is considered to occur frequently (1), or infrequently (0).

Lastly, 95% confidence intervals will be produced to represent the future outcomes of the owner inefficiencies. By producing a 95% confidence level, this implies that if the study is performed multiple times over again, 95% of the time the results from the frequency of occurrence of each inefficiency will fall within the calculated confidence intervals. In this sense, the frequencies calculated in this study will not indicate the exact representation of the current construction industry. However, by producing these confidence intervals the study can generally predict what the frequency rate most likely would be in the full scale construction industry.

The usage of item response theory implies that there would be a known 'correct' answer in which the data is being compared. In this case, the results of the Phase 2 data will be used to calculate that 'correct' answer. Although in this study the value is not

actually considered as correct (because there is no true correct or incorrect value), it will instead be considered as the industry standard of project owners.

Phase 3

Phase 3 data analysis will consist of evaluating qualitative narratives and details that the designers and contractors provide. The purpose of the Phase 3 data is to provide real construction industry connections to the data results from Phase 1 and Phase 2. Analysis will consist of reviewing dialogue from the interviews to find significant quotes and provide structure and background to the specific inefficiencies connected to project goals. These cases will provide stories behind the inefficiencies will aid in presenting the final results to project owner employers. It will help all team members understand how a teammate's actions may affect others and the project outcome.

Nvivo will be used to, again, to code the interview quotes and summarizations. A transcription of the interview can be uploaded into Nvivo, or the researcher can manually enter direct quotes, and then group them with similar topics. Interviews will be reviewed line-by-line, or comment-by-comment. The analysis will break down the overall conversation between the interviewee and the researcher to discover which inefficiencies are blatantly being described, while also uncovering inefficiencies that the interviewee may be explaining inadvertently.

Phase 4

Phase 4 includes producing tools for the construction industry to use to improve project owner skills. This phase will not include new data to analyze for this research. However, since Phase 4 produces a survey that can be used in the industry, the results of those surveys should be analyzed by the individual owner companies. These companies

would compare the results of their individual owner's performances to the industry standards that are discovered in this study. This is where the item response theory process is completed. If they are at or below the performance levels of the construction industry, then owner employers would know to focus training efforts in those areas of improvement topics.

CHAPTER 5. RESULTS AND DISCUSSION

This chapter lays out the results of the surveys and interviews conducted for this study. The results of the data collection components are used to create useful tools for the construction industry. Case studies are developed to show real examples of how project owners can negatively affect a construction project. The case studies will be used as learning instruments for future development of project owners. A "team satisfaction" survey is also created for current project owners to analyze their personal skills on a project.

Survey Results

Surveys were conducted in both Phase 1 and Phase 2 of the research. Phase 1 consisted of the qualitative survey, while Phase 2 involved a quantitative survey. Both results will be analyzed in this section.

Phase 1

A copy of the Phase 1 Survey is in Appendix C. As mentioned in the sampling section, 54 participants completed this survey. Participants had approximately three weeks to complete the survey. Before the survey results were finalized, the researcher established ideas for what would become some early codes.

Table 9-12 show this study's preliminary codebook. The highest-level codes indicate major categories, and in this case, these are the four construction project goals. Under each major code, three sub-codes were developed using literature from previous studies. A short description is provided for each sub-code.

These introductory codes were used to provide examples to the survey participants in Phase 1. These examples helped participants brainstorm new ideas to

contribute to their survey responses. It is understood that providing participants with potential responses may result in a higher agreement among the examples compared to the opinion-based responses. Therefore, the results of the introductory codes are shown separately than the remainder of the Phase 1 results. However, it was nonetheless significant to deliver data on these responses.

Table 9: 'Schedule' example inefficiencies

Project Schedule	**Percent of participants that agree the corresponding statement is a current project owner inefficiency**
Change Orders: If the change order request is related to an item on the critical path for construction, this can cause project delays. Oftentimes, owners do not understand the significance of their change order request related to the amount of preparation and completion time required.	72%
Site Delivery: When discussing the project schedule with the owner, the owner promised to turn over the project site for construction on a certain date. The owner falls through on delivering the site on time and the construction cannot begin.	44%
Submittals: When submittals (specifically product samples) are sent to the owner, there is a requested deadline for owner response of approval or rejection. Yet owners frequently miss those deadlines, requiring multiple follow up requests. This can delay the schedule and materials can be sold out or arrive late.	54%

Table 10: 'Cost' example inefficiencies

Project Cost	Percent of participants that agree the corresponding statement is a current project owner inefficiency
Contract Price: Project owners do not properly review the scope of the low bid contract. The contract is then awarded to a low bid contractor that has significant gaps in the scope causing all other project team members to pick up slack, meaning material and labor that was expected to be originally included.	65%
Value Engineering: The less design time the owner allots to a project, the less opportunity to take advantage of value engineering. As an example, an engineer with narrowed design time may result in more conservative designs, causing an increase in material price. If owners had more experience with the benefits of value engineering, they might pay for more design time, saving high material costs.	59%
Pre-Construction Documents: In an effort to begin construction as early as possible, the owner has not finalized on certain design decisions prior to the release of pre-construction documents. Contractors and subcontractors are then forced scramble in mid-construction trying to define all the incomplete decisions. Subcontractors may be booked and not taking on more work on the project, causing contractors to accept higher external invoices due to desperate times.	69%

Table 11: 'Quality' example inefficiencies

Project Quality	**Percent of participants that agree the corresponding statement is a current project owner inefficiency**
Material Choice: In an effort to save on cost, project owners ignore the quality standards of construction materials. Materials with short life spans or less durable materials cause rework, even after the project is complete causing disruption to occupants.	50%
Hiring Team Members: An owner who does not properly research project team member companies can hurt the remaining project team. All team members should be prepared and experienced to work on the given project. For example, if the architect hired has never designed a specialized project such as an ice arena, then the design may suffer causing all team members to suffer.	56%
Material Choice: An owner may not take the time to precisely review material options, causing dismay when the material or product is installed. Owners will then request rework with new products due to further review.	48%

Table 12: 'Citizenship behavior' example inefficiencies

Project Citizenship Behavior	**Percent of participants that agree the corresponding statement is a current project owner inefficiency**
Marketing: Owners do not allow for the exposure of the project team in terms of marketing. Team member companies are often left out of project marketing events, or left off of project informational documents.	26%
Timeliness: Project owners are asked questions in weekly meetings and are expected to have answers or progress on responses by the following week. However, tasks are forgotten about and the project team suffers from lack of information.	61%
Project Payments: Owners expect the project team to work continuously on the project even though the project payments are received late. This causes team members to must put their own company finances at risk.	54%

Tables 9-12 also provide the percent of overall agreement among participants for each of the three examples provided in every project goal category. By responding 'yes' to these examples, participants indicated that they agree the corresponding statement reflects a real problem in the current industry. These problems are associated with a project owner's role or responsibility on a project. From these preliminary results, project owners show the most room for improvement among the statements relating to change orders, contract price, and pre-construction documents. Specifically, issuing change orders that extend the project schedule; poor review of a team member's contract price leading to missing scope items; and non-completion of pre-construction documents prior to the start of construction, leading to cost issues when scope items are finalized late in the project.

This type of deductive coding was performed first since it was clear that the examples would produce results (whether it be agreement or disagreement) within the first survey. While coding, the example inefficiency results were kept separate than new opinion based responses even if they were directly related. By restating issues in the industry related to the examples, it would show a sense of importance that it needed to be reinforced with another new participant example.

The remaining data was analyzed via inductive coding. To begin, initial coding was used as the researcher took a first glance at the data. The initial codes were to break the data into one or more of the following categories: schedule, cost, quality, and citizenship behavior. The majority of participant responses focused on one project goal category at a time as shown here in a participant response: "clients tell their architects, engineers, and contractors that they are fortunate to be allowed to work on their projects, [yet] still

treat them poorly and request donations on top of it," for citizenship behavior. However, some responses fall into multiple categories such as schedule and cost. One participant indicated that owners "try to incorporate changes without a schedule extension. This will compress a schedule […] and will result in additional overtime, reduced productivity and more labor costs, [and] additional supervision/project management."

Next, line-by-line coding allowed for each response from a participant to be coded into a specifically labeled group under each of the four highest level codes. For example, project owners need to improve their project cost estimating skills due to current "engineer estimates prepared using outdated information [and] incorrect assumptions; thereby setting a cost expectation that may not be relevant or realistic." A line-by-line code would indicate this response belongs in the cost category under the code 'budgeting'. As the data was being divided up into codes, a fewer amount of new codes needed to be developed, as data began to fall into similar categories that has previous been created. The researcher walked through the data multiple times to adjust codes and find the appropriate fit for the participants' comments.

The categorization coding process was where the data began to show patterns and expressed how the participant responses were related to one another. The various codes, or linkages, of data were grouped together if they fell under similar umbrella topics. Appendix G provides the complete coding package for the 'schedule' category. This illustrates the research participants made up of architects, engineers, contractors and subcontractors believe project owners could improve their skills in relation to each of the topics mentioned in Appendix G. By falling under the 'schedule' category, this indicates that project owners have shown a negative influence on the project schedule

due to improper expression, or follow through, of these coding topics. A summary of the negative effects, or the areas in need of improvement, is provided from the participant responses for each of the codes is provided. Suggestions for eliminating the inefficiency, or improving the skill, are provided for each code as well. Finally, if applicable, a meaningful quote from the Phase 1 data was provided to express the direct opinions of the project team.

Also in Appendix G, codes are shown for areas where project owners affect project cost, quality, and citizenship behavior, respectively. There were a total of 80 first level codes that would be labeled as the inefficiencies identified in all four of the project goal categories. Of the 80 in total, it was determined that 49 of the codes were unique, meaning they were not shown in more than one project goal category. The other 31 codes were duplicates across project goal categories; for example, 'changes' to the project was mentioned as negatively affecting each of the four goals, but it would only be counted as one unique project owner area of improvement.

Phase 1 was performed to identify all possible skill areas in need of improvement. To focus the results on significant data discovered in the study, Tables 13-16 show the most commonly mentioned inefficiencies for each of the project goal areas. The tables also indicate the percentage of survey participants who had included that inefficiency in their Phase 1 responses. As mentioned the full inefficiencies with summaries of participant responses are provided in Appendix G. To determine which response topics would be considered most common, a base value of four similarly formulated responses was determined. By having four common responses per a certain topic, this showed a pattern, or that the topics would be labeled as 'common' responses.

Table 13: Most common inefficiencies that negatively affect a project's schedule

Schedule: Owner Inefficiencies	Percent of participants that indicated the topic as an issue on current industry projects
Owner responsibilities	61%
Changes	48%
Site delivery / project start	30%
Lack of construction knowledge	22%
Scope definition	20%
Submittals	19%
Financing/budget	17%
Owner to meet deadlines	11%
Owner representatives	9%
Owner expectations	7%

A brief summary of each ambiguous area of improvement will be provided for each project goal category. Again more complete definitions are provided in Appendix G. In the schedule category, or owner areas of improvement that negatively affect the project schedule, owner responsibilities was found to be the most common topic response. Owner responsibilities include items, or tasks, that owners should effectively complete themselves to help the project succeed. These tasks include creating concept and spacing plans for preconstruction, participating in the design to ensure approval of final installed products, expressing efficient decision making skills, effectively responding to RFI's, managing and coordinating logistics of owner provided suppliers and subcontractors, and coordinating move-in of furniture, fixtures, equipment (FF&E), and occupants.

Lack of construction knowledge refers to an owner's negative effect on a project due to inexperience relating to technical construction topics. These topics include the

ability to read and comprehend construction plan drawings and specification books, creating unrealistic cost estimates or schedules, and the misconception of proper construction patterns and work flow. Scope definition overwhelmingly refers to the lack of detail provided by the owner to define the project. Team members are forced to make too many of their own assumptions, which may not align with the owner desired outcomes. Similar to scope definition, owner expectations refer to the lack of detail provided by the owner to outline what goals, or expectations the owner expects for the outcomes, or priorities, for the project along with the expectations for contributions from team members.

Table 14:Most common inefficiencies that negatively affect a project's cost

Cost: Owner Inefficiencies	**Percent of participants that indicated the topic as an issue on projects**
Changes	44%
Delivery, procurement, contracts	24%
Scope definition	22%
Hiring team members	19%
Budget	15%
Lack of construction knowledge	13%
Risk	11%
Value engineering	9%
Contract scope of work	9%
Schedule	9%

In the cost category, hiring team members refers to the process and choices that the owner makes in relation to finding and securing various members for the project team. This includes bringing the contractor on earlier in a project to reduce constructability issues and allow them to aid in the design, and also includes not pre-

selecting team members which only wastes the time of other companies bidding for the project awards. Project team members feel that an owner does not include enough costs for potential risks when developing a project budget, which ends up costing more money for all team members later on. A possible reason is due to the unknown costs of these risks, but not included any funds to deal with potential issues that may pop up in the project can be cumbersome. In the cost category, the concept of schedule is worthy of its own inefficiency as it represents the owner requesting or providing the project team with a timeline that is setup for failure. These include providing unrealistic schedules for the necessary scope of work, or compressing schedules to meet owner deadlines without providing additional resources, and not considering how this would affect the project team.

Table 15:Most common inefficiencies that negatively affect a project's quality

Quality: Owner Inefficiencies	**Percent of participants that indicated the topic as an issue on projects**
Hiring team members	39%
Material choice	28%
Focusing on cost	22%
Changes	15%
Lack of construction knowledge	9%
Quality control	9%
Scope definition	9%
HVAC	7%

In the project goal quality category, material choice refers to the owner disliking a material after it has been installed, not researching enough material options to find the most appropriate choice, ignoring product data, and not requesting mockups of material

combinations prior to installation. When an owner focuses on cost only, they ignore quality standards and may end up choosing products that will produce poor project results. By only focusing on the initial upfront cost, owners disregard any benefits from lower lifecycle costs; this is also true in the HVAC inefficiency topic. Project team members believe owners do not put in enough time researching and looking into other mechanical system options, which can potentially be more efficient for projects.

Table 16: Most common inefficiencies that negatively affect a project's level of citizenship behavior

Citizenship Behavior: Owner Inefficiencies	**Percent of Participants that indicated the topic as an issue on projects**
Payments	24%
Timeliness	17%
Owner expectations	13%
Changes	11%
Communication	9%
Owner representative	9%
Trust	9%
Character traits	7%
Teamwork	7%

Project team members are frustrated with the owner's lack of proper timeliness, or follow up, on project related items. Delayed decisions and responses to emails, documents, or requests for information can unnecessarily drag a project on and cause bitterness among teammates. Although this research ideally would like to focus on aspects of the project owner that can be improved upon via educational trainings, owner character traits was a common inefficiency mentioned in the survey results. These traits include items such as lack of leadership and the inability to take responsibility for project

faults. Possibly project owner employers can look for future owners who show strong leadership skills and generally do not place blame on others for their own wrongdoings.

Making changes to the project is the only most common project owner inefficiency that occurs in all four project goal categories. Not only that, but it is also listed within the top four most common responses for each goal. 'Lack of construction knowledge' and 'scope definition' were both present among three out of the four project goal categories. By appearing as challenges to the project in multiple goal categories, this shows how these inefficiencies affect the project in various different ways. On the flip side, 'owner responsibilities' is the most common inefficiency defined in Phase 1 for the schedule category. It does not show up in any of the other three most common areas of improvement lists. This means that the project team believes that owner responsibilities, most prominently pertaining to owner suppliers and subcontractors, typically affect the project schedule more than the other components of a project.

The intent of this study was to determine which areas the 'project team' felt that project owners need improvement. There was not a central focus on whether the architects or subcontractors agreed or disagreed upon certain areas of improvement. Since, overall, the improvement need is shown nonetheless. However, a supplemental analysis was performed to show which areas of improvement each member of the team believed needed the most improvement. Table 17 provides the top, or most common, two areas of improvement, chosen by each team member for each of the four project goals. If there was a tie for number one or two, that tie was indicated in the figure. Architects only had one common area of improvement for the citizenship behavior category.

As indicated in Table 17, 'changes' is a reoccurring topic strongly mentioned by each team member in relation to areas that affect a project's schedule and cost. Contractors and architects both agree on 6 out of their 8 strongly believed owner areas of improvement. Engineers appear to be the very diverse, as their greatest commonly believed owner areas of improvement are most unique compared to the rest of the project team. Three out of four teammates believe 'changes' on a project is the topic areas with the most room for improvement in relation to negatively affecting project schedule. Likewise, three out of four teammates believe considerations for hiring team members on a project shows the most room for improvement in relation to a project's quality level; and three out of four team members believe project payments issues is an owner's top area of development to improve a project's sense of citizenship behavior.

It could have been assumed that contractors and subcontractors would have similar responses, and architects and engineers would have similar responses due to their relationships and resemblances in project tasks. However, since contractors and architects have very similar responses, a theory could be made that due to their frequent communication and direct relationship with the owner, they are facing similar challenging in projects in terms of owner inefficiencies.

Table 17: Most Common Inefficiency as Indicated by Project Team Member

	Contractor	Subcontractor	Architect	Engineer
Schedule	(1) Owner Responsibilities	(1) Site Delivery	(1) Owner Responsibilities	(1) Changes
	(2) Changes	(1) Changes	(2) Changes	(2)* Lack of Construction Knowledge
				(2)* Scope Definition
Cost	(1) Changes	(1) Scope Definition	(1) Changes	(1) Changes
	(2) Delivery, Procurement, Contract	(2) Changes	(2)* Delivery, Procurement, Contract	(2) Risk
			(2)* Lack of construction knowledge	
Quality	(1) Hiring Team Members	(1) Hiring Team Members	(1) Material Choice	(1) Hiring Team Members
	(2) Material Choice	(2)* Focus on Cost	(2) Focus on Cost	(2) Focus on cost
		(2)* Scope Definition		
Citizenship Behavior	(1) Payments	(1) Payments	(1)** Payments	(1) Communication
	(1) Timeliness	(2) Timeliness		(2)* Conflict Resolution
				(2)* Expectations

*Tied for second place
** Only one major agreed upon inefficiency

Other commonly identified owner areas of improvement correspond with the project teammate's job responsibilities. For instance, subcontractors indicated that the most commonly identified project owner inefficiency was a lack of delivering the project site on schedule. Subcontractors have the most to lose from a late site delivery. They have the most field staff on site, which requires great management of employee time commitment that can ultimately negatively affect other company projects.

Engineers indicated that risk was their second most commonly agreed upon owner area of improvement. None of the other three teammates had indicated risk as a most common inefficiency. Engineers typically determine what structural materials will be used to construct the building. Structural materials, while being a major project cost, can be highly influenced by world events and market prices. Engineers would like to see owners better account for project site and material risks. This may include tariffs on steel, lack of concrete laborers, or the variation in labor wages during a project. Likewise, engineers design a project for the known site conditions and cannot include unknowns that might be under the site soil. Owners and engineers seem to have difficulties dealing with the unknown conditions, as engineers believe owners could improve on their risk calculations.

Phase 2

In order to create the Phase 2 survey, Phase 1 results and analysis needed to be complete. Phase 2 involved analyzing the most reoccurring responses from the Phase 1 survey and using them to create more refined survey questions. Using these 'top' responses, the Phase 2 survey's primary goal was to determine which of the owner inefficiencies most frequently occurred on construction projects.

The online survey asked participants to answer two main questions for each of the project goal categories: schedule, cost, quality, and citizenship behavior. The first question asked participants to rank each of the top responses in order according to which of the inefficiencies they believed a project owner should improve upon first. The goal of this questions was to see if there was an agreed upon ranking that showed a priority order for future skill development. The second question asked participants to determine

the frequency of occurrence on a project for each of the inefficiencies. The possible responses included a range from 'almost never', 'rarely', 'sometimes', 'often', and 'almost always'. The goal of this question was to determine if there was an agreed upon frequency of occurrence of project owner inefficiencies, from the perspective of the project team.

Although the primary goal was to discover the results from the second question (frequency of occurrence), the supplementary ranking question created out of curiosity was to see if the inefficiency frequency aligned with the priority order of improvement. Unfortunately, the ranking data was inconclusive and will not be discussed in this study. It was determined inconclusive due to the data collected not representing a normal or almost normal plot.

Frequency

To determine the results from questions regarding frequency of occurrence, the survey data was downloaded from Qualtrics and uploaded into a Microsoft Excel file. To alter text responses to a statistical form, new values are assigned to participant responses; 1 representing 'almost never', 2 for 'rarely', 3 for 'sometimes', 4 for 'often', and 5 for 'almost always'. To prove validity within the final frequency determinations, the data was uploaded into the R Studio statistics software where normal tests were performed. From the calculated descriptive statistics, which include averages and standard deviations, these tests conclude whether the participants tend to show a pattern of agreement among their results. A normal curve for each inefficiency was calculated and placed over the data histogram. Figure 10 shows an example of the data and the normal plot for the inefficiency labeled 'Lack of construction knowledge' under the schedule category. The remaining plots are provided in Appendix H. Generally, the

data was considered to be normal or almost normal. Due to this, the researcher felt the data could be used to create claims, which represented the viewpoints of the project team at an industry level.

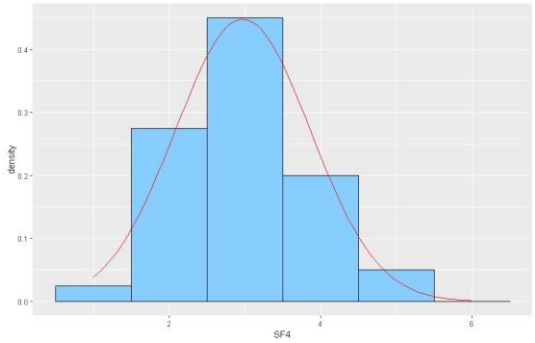

Figure 10: Normal Curve 'Schedule' Lack of Construction Knowledge

The results from the survey were translated into a plot using R Studio. Figure 11 provides an example of the results from the 'schedule' category. A similar plot was produced for all of the most common inefficiencies in the cost (Figure 12), quality (Figure 13), and citizenship behavior (Figure 14) categories.

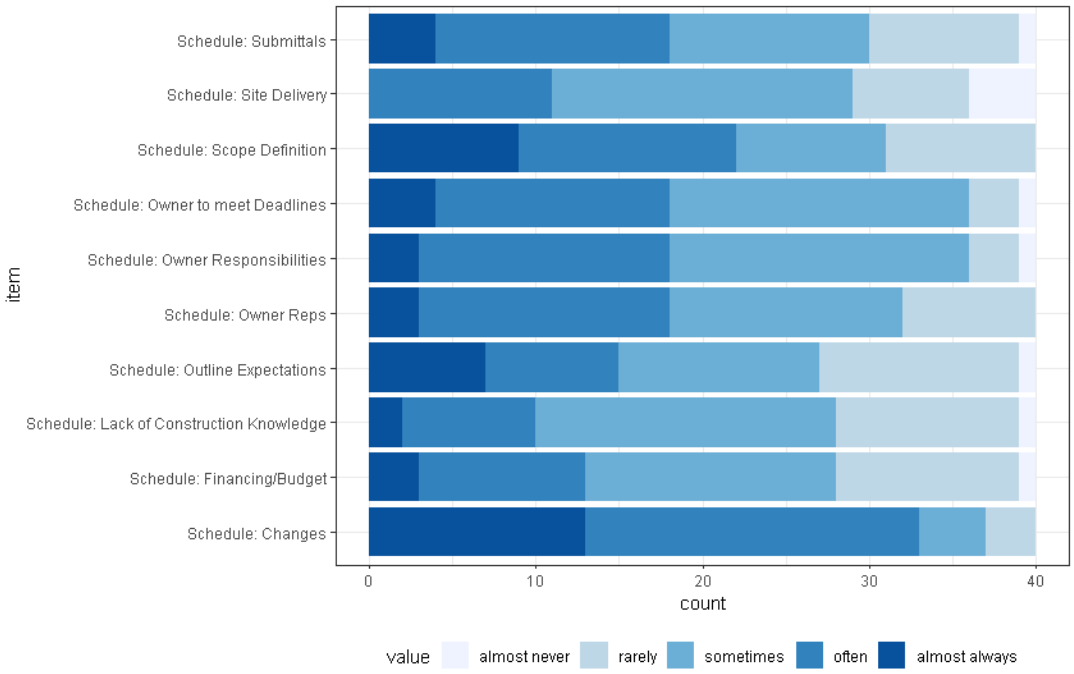

Figure 11: Frequency array of common 'schedule' inefficiencies

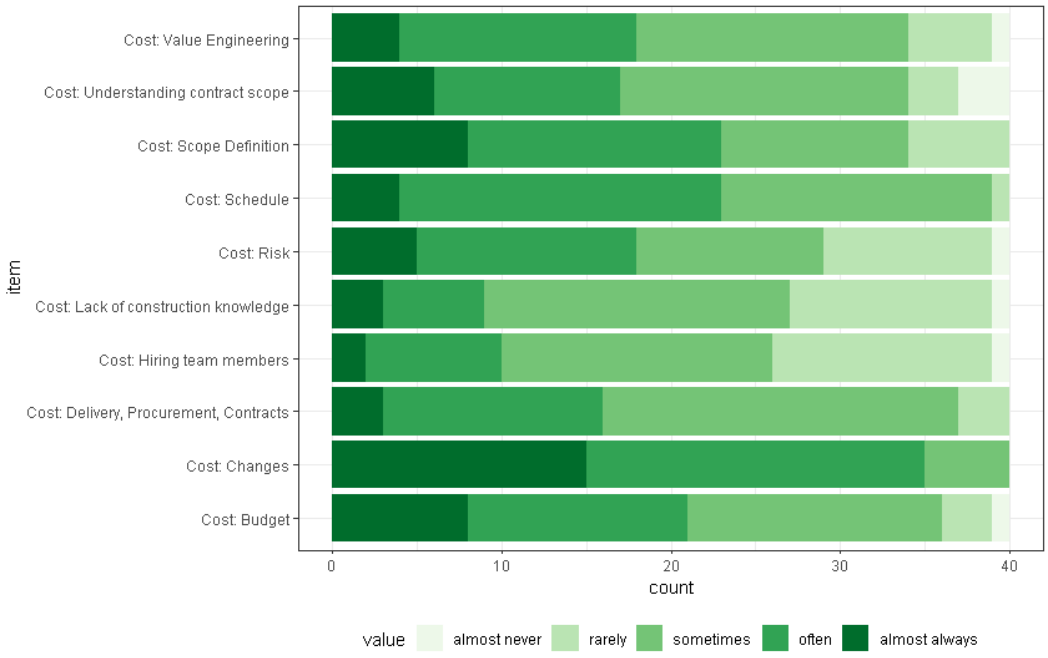

Figure 12: Frequency array of common 'cost' inefficiencies

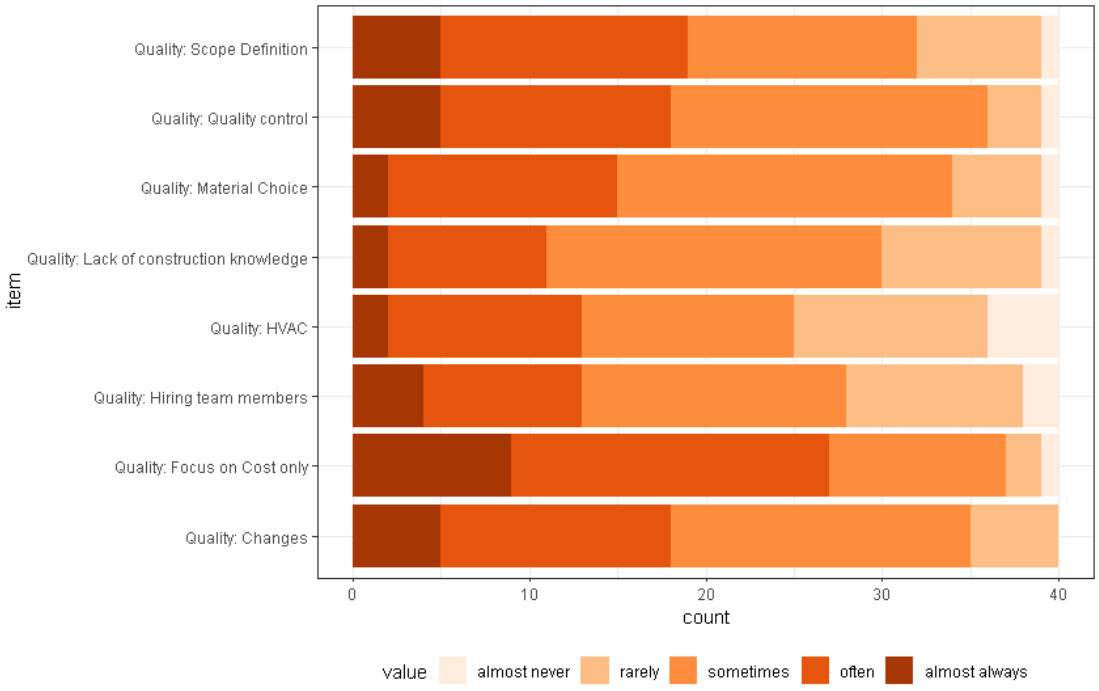

Figure 13: Frequency array of common 'quality' inefficiencies

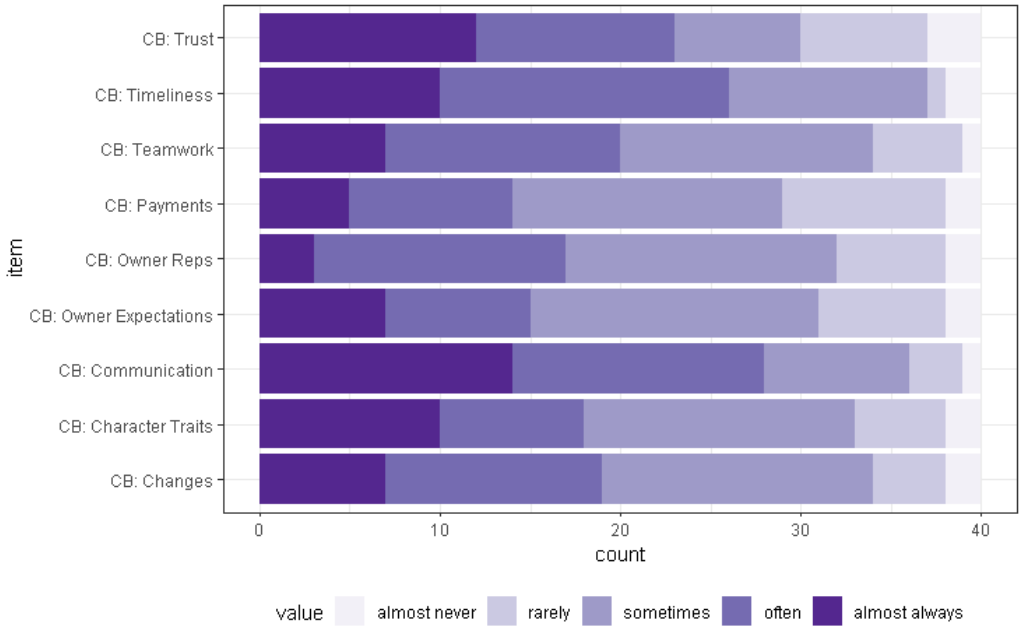

Figure 14: Frequency array of common 'Citizenship Behavior' inefficiencies

Next, the results of the survey were converted to binomial distributions, designated as '0' for all responses for 'almost never', 'rarely', and 'sometimes', and '1' for 'often' and 'almost always'. The new responses listed as '1' would be considered to occur frequently. This data would be used to determine which of the owner inefficiencies occur most often. A new plot was calculated describing the quantity of participants believing the inefficiency occurs in high frequency. Figure 15 – Figure 18 provide examples of these plots for each of the project goal categories. For example, in the inefficiencies affecting the project schedule goal, lack of 'scope definition' occurs in high frequency on construction projects according or 55% of the survey participants.

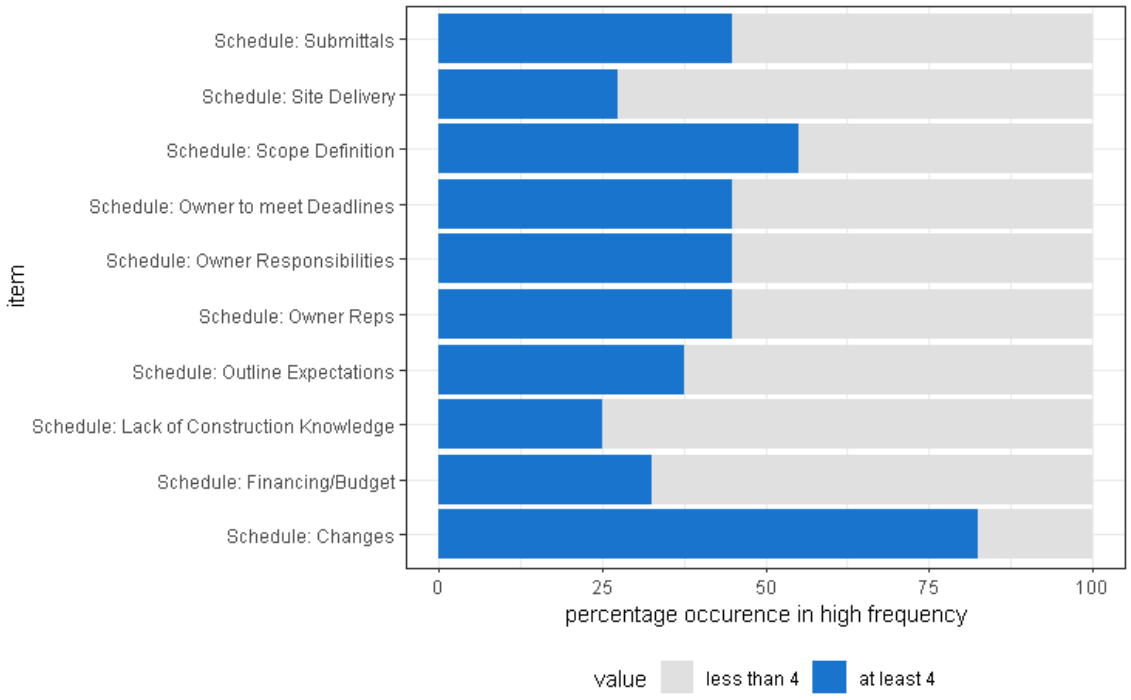

Figure 15: Binary data of frequency for common 'schedule' inefficiencies

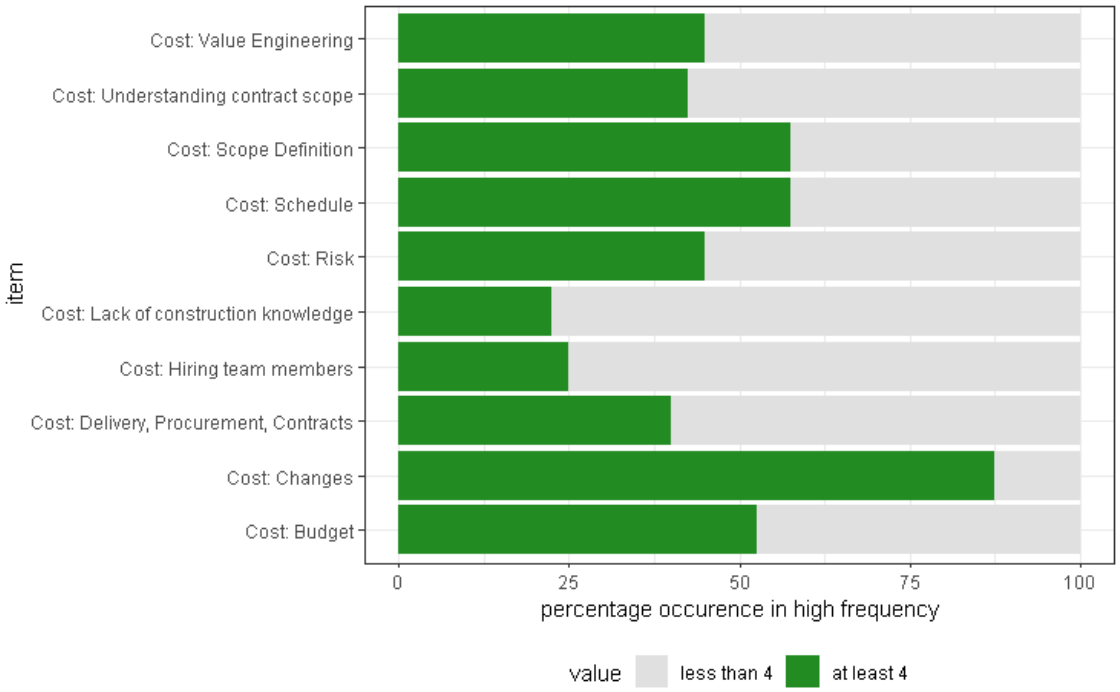

Figure 16: Binary data of frequency for common 'cost' inefficiencies

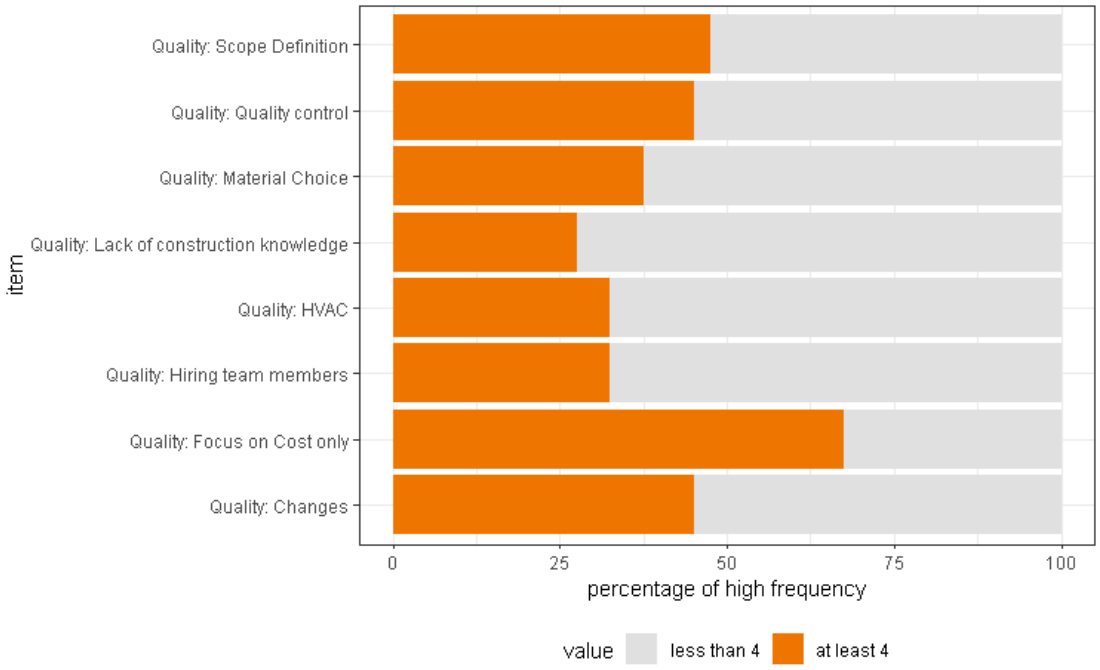

Figure 17:Binary data of frequency for common 'quality' inefficiencies

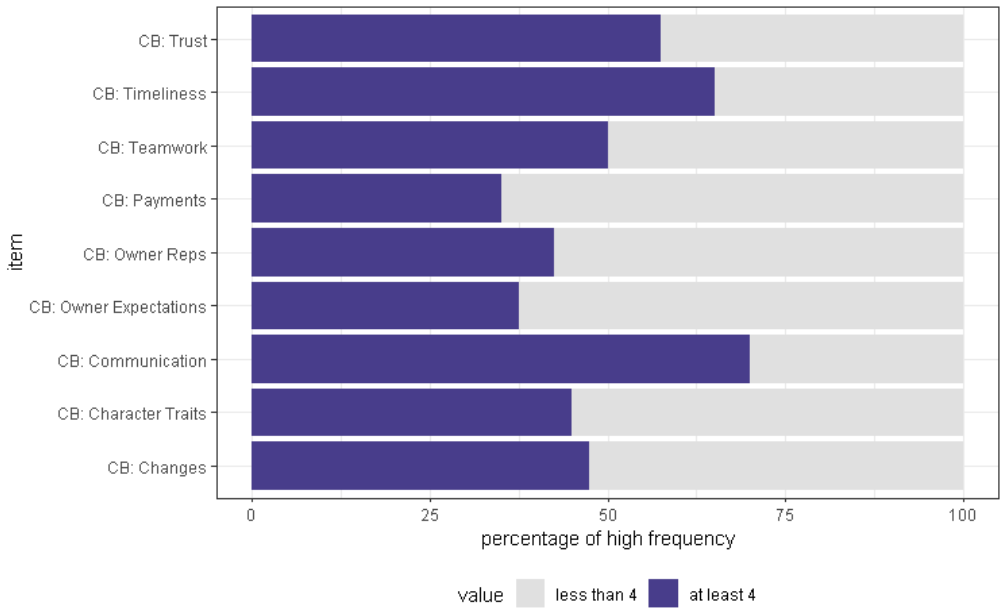

Figure 18: Binary data of frequency for common 'citizenship behavior' inefficiencies

Finally, confidence intervals (Figures 19-22) were produced in order to predict the agreement among industry members of these areas of improvement occurring in high frequency on construction projects. A 95% confidence level was chosen to produce these intervals. That means if the study was repeated many times, 95% of the time the results would fall within these intervals. These new plots describe the data to show what percentage the industry would agree in which these inefficiencies occur in high frequency. As we can see from the data results, the majority of project team members believe project owners most frequently cause challenges due to changes, scheduling, scope definition, budget, communication, timeliness, trust, and focusing on cost only in highly frequency on construction projects. These are the areas of improvement that construction project owners need to focus on to improve their skills in order to reduce

delays, eliminate added costs, produce higher quality projects, and work toward team goals.

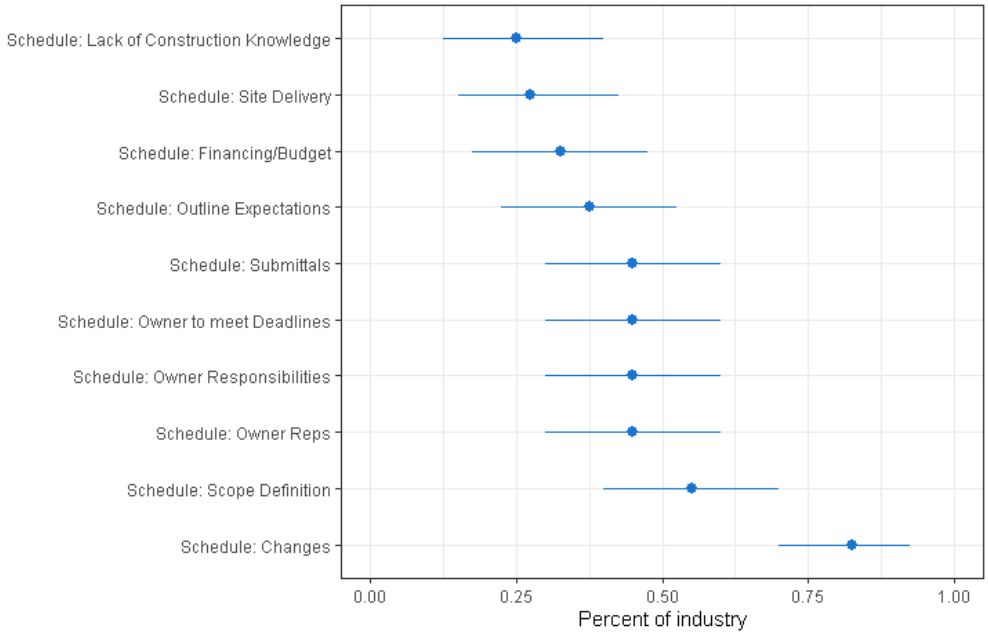

Figure 19: Confidence intervals for 'schedule' inefficiencies

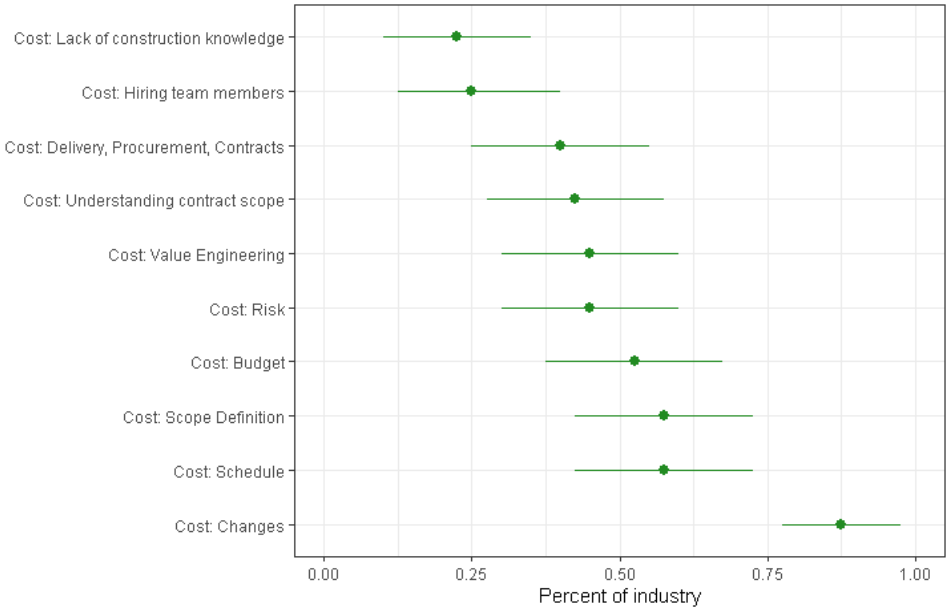

Figure 20: Confidence intervals for 'cost' inefficiencies

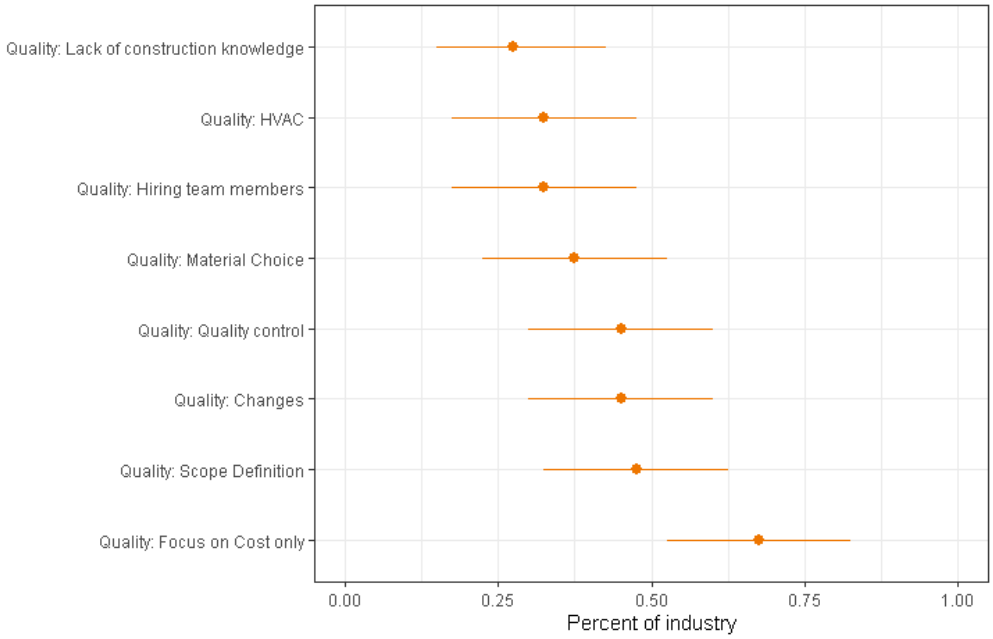

Figure 21: Confidence intervals for 'quality' inefficiencies

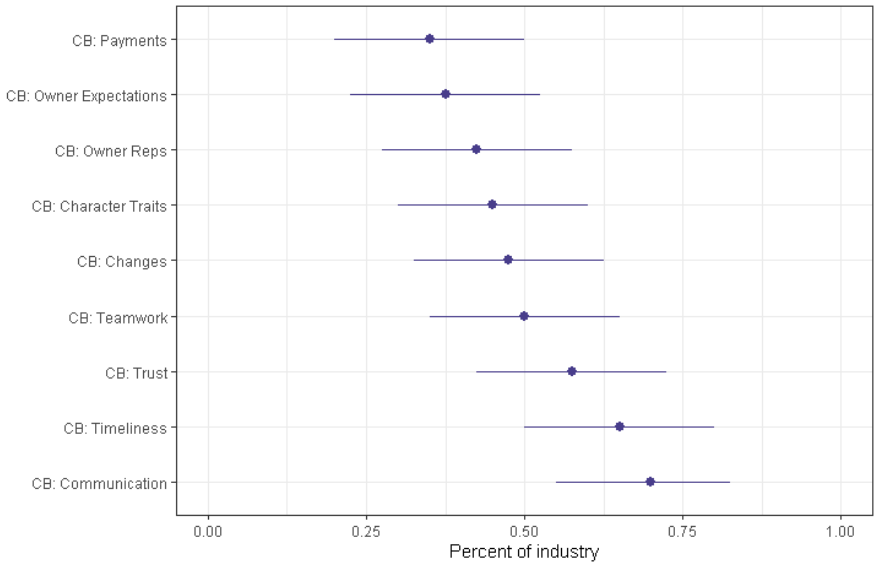

Figure 22: Confidence intervals for 'citizenship behavior' inefficiencies

The results from the Phase 1 survey contributed 48 total unique areas of improvement for construction project owners. Of those 48, eight improvement areas were found to occur most frequently according to the project team. These eight are making various changes to the original scope and design, creating unrealistic or compressed schedules, ill-defined project scopes, not creating a sufficient or complete budget, lack of proper communication with team members, missed deadlines or delaying responses, lack of trust among team members, and focusing only on the initial cost when choosing products and equipment for a project. These eight inefficiencies are considered to be the first-tier focus areas for project owners to improve upon. This would be the starting point for project owner employers or third-party trainers to focus their educational efforts.

Once these training topic areas have been mastered, trainers can expand their efforts to a second tier of inefficiencies. This second tier includes improvement areas that occur in high frequency according to at least 44% of the industry team members. This is compared to the first tier inefficiencies, which were labeled occurring highly frequent on construction projects by 50%, or the majority, of project team members. The second tier of improvement areas include teamwork, challenges during the submittal process, the owner to meet their own committed deadlines, owner responsibilities on a project, owner reps, value engineering, accounting for risk, quality control efforts, and difficult character traits.

Interview Results

Research participants were asked to contribute additional information via an optional interview. The goal of the interviews was to discover real industry examples as

to where the owner areas of improvement are demonstrated. These interviews helped to provide case study data, as well as provide a fuller understanding of the owner inefficiencies and some direction for improvement. This section will combine a discussion of the owner inefficiency descriptions from Phase 1 and the deeper understandings of those descriptions discovered from Phase 3.

Phase 3

A total of eight interviews were conducted, some through phone conferences and others via in-person meetings. The interview participant classification included three contractors, two engineer, two architects, and one subcontractor. Typical interview durations were between a half an hour up to two hours. The length grew as the participant was willing to share their experience in greater detail.

The interviews were setup to be very open and casual. The researcher asked opening questions to create a comfortable environment for the interviewee, but quickly dove into the greater meaning of the interview, which was to allow participants to share their experiences with project owners. Many interviewees provided narratives, or stories, about their projects to describe how a project owner negatively affected one or more of the project goals. Some participants required more follow up questions than others.

The most frequently occurring owner inefficiencies were described in detail, providing real industry examples. Considering the most frequently occurring owner inefficiencies, discussion will focus on the eight topics that were determined to occur over 50% of the time in 'high frequency' on construction projects. These include making various changes to the original scope and design, creating unrealistic or compressed

schedules, ill-defined project scopes, not creating a sufficient or complete budget, lack of proper communication with team members, missed deadlines or delaying responses, lack of trust among team members, and focusing only on the initial cost when choosing products and equipment for a project.

Changes

Generally, changes from the original scope of work or drawings are undesired by all project team members, yet they are an inevitable process teams must work through together. The topic of 'changes' in terms of construction project owner inefficiencies was a front-runner in all four project goal categories, most notably negatively affecting the schedule and cost of a project. The term 'changes' refers to a variation in project team member scope or design drawing that differs from the originally agreed upon plan. These would be due to the project owners action, or lack thereof, in causing the change.

From the project team's perspective, making changes (other than safety updates) to the project only helps the owner's goals succeed and not the team's goals. As changes begin to multiply, the project citizenship behavior is left behind. Project team members have a very challenging experience quantifying the time and costs associated with these changes. It is not clear cut to list what is new/added/altered compared to what was deducted. Many materials are priced in bulk quantities when determining an original estimate, which may not match newly added scope prices with smaller quantities. Also, sometimes deleting scope items can actually add cost. As an example, if an owner asks the team to remove an interior door to save money, this can cost the team more money if the area is already framed. Now the subcontractor must go back in and cut and insert drywall, mud, and tape. If the door was removed during the design period before

approving the final plans, the team could have made a continuous drywall section and not had to perform patchwork.

Most of the time, the changes to the project are occurring far too late in the timeline. Architects and engineers designate meetings early in pre-construction to discuss the design and request that the owner make any potential changes at the time of the meeting, instead of later down the road. Oftentimes a few adjustments are made, and the project continues to run its course. One architect described a project that she worked on for a private midwestern college. The President of the college would be considered the ultimate owner of the project. During a pre-construction meeting, the owner brought in five department heads to participate in the initial design review. They each had suggestions for minor improvements, and the architect made the changes and construction began.

After approximately 50% of construction was complete, the owner brought in 25-30 building occupants such as lab technicians, faculty members, and facility managers. Many of them had facility needs that were not being met by the current design. The architect was extremely frustrated at the amount of new feedback she was receiving. Due to their arguments, the architect agreed some of the changes could positively impact the function of the building, however her design fee was already used up and re-designing the project now would take her a great deal of time to complete. This architect felt it was important to incorporate the building tenants/space users into the initial design functionality meetings. She commented that the "decision making owner reps were brought on the project way too late." The owner would now have to decide if he was willing to give up the newly desired function of the space to meet the original budget and

schedule goals. If changes would occur this late in the game, many of the costs would be considered 'lost costs' as project team member's time and efforts have already passed, as well as construction materials ordered and installed.

On another project, an engineer was asked to make significant design changes in relation to project materials. The material changes would have in fact saved the project significant costs if the change was made early on, unfortunately the current materials were already on order, and some had already been delivered. Making these project changes past approving design will rarely actually save the project significant costs. What the owner did not consider was restocking fees, reshipment fees, and engineer and architect design fees. Unfortunately for the contractor and subcontractors, tracking their lost costs seems impossible, and they were unlikely capable of making those costs back.

The project team has indicated that at some points they need to refuse project owner changes. One participant expressed her concern on an industrial project that was incurring multiple changes. Eventually, her team told the owner they will ask themselves "Is it safe? Does it work? [If yes], then we aren't changing it if you want to meet your schedule goals."

There appears to be a trend among participant responses indicating that making changes on a project will be inevitable, but project owners do have the ability to control the quantity of them. The goal would be to reduce the amount of changes that occur on a project and if a change is needed, make it as soon as possible. Ideally, this would still occur in the design phase of the project. Another common suggestion for project owner improvement was for them to work on their level of satisfaction for the decisions they made early on in the project. Expertise comes with experience, the more experienced an

owner is, the less changes he or she will make during later phases of the project. No project is perfect, coming into mindset of accepting, or being content with, your decisions with help the project team achieve its goals.

Schedule

Although schedule is listed as one of the four main goals, various components of scheduling tasks are highly influential to the cost and quality of a project. These components include compressed project schedules, unrealistic schedule goals, and the owner's misunderstanding of how project scheduling works. An engineer indicated that her "hardest challenge is having a client who does not have a realistic budget or schedule in mind" from the start of a project. Beginning a project with an unrealistic schedule is highly detrimental to project success. This puts project teammates in a position to jeopardize their own beliefs on how to properly execute the project, or eliminates an owner's chance at working with intelligent and reasonable teammates and instead settling for someone who will agree to meet impossible deadlines. Many team members have experienced projects that have an owner who will hire the company willing to make big, and often false, promises on meeting schedules. Rather, they should look into the realistic components of that schedule, and compare it to other proposed project schedules to determine its feasibility.

An owner expecting unrealistic schedules is also true for the design phase, not just construction. Requesting designers, both architects and engineers, to complete their work in unrealistic time periods can actually add unwanted costs to the project. Proper design time includes determining which structural, functional, and aesthetically pleasing options will work best for the project. With a shorter time period, these options become

more conservative and may ignore more efficient methods. Owners should be asking the designers what project factors are driving their design timeline to get a better understanding of how the fee is created and what durations were budgeted.

Oftentimes a project's schedule is driven by the owner's ability to secure proper funding, but if the funding is delayed there may be no adjustment to the project completion date causing a compressed schedule. The inability to move the completion date is often due to building occupancy obligations that owner has previous agreed upon. An engineer with prior construction experience indicated that she is "usually not as efficient if [she is] putting more resources on the project, that's for both engineering and construction." She felt she found the most efficient process and crew size needed to successfully complete a project, and adding more resources to meet an unrealistic, or compressed, owner deadline would not actually help the project succeed.

The engineer did indicate that there was a difference between an unrealistic schedule and an accelerated schedule. Accelerated schedules are typically requested and not demanded and come with an incentive for teammates to meet. There could be added monetary bonuses for delivering a project at a new accelerated deadline that the project team has accepted as reasonable. In this case, added resources could be valuable in terms of overtime and added crew sizes. However, unrealistic schedules are typically forced upon the project team and will cause harm to the team goal success.

It is important for owners to understand what efforts have gone into the creation of the project schedule. When team members make their schedule estimates, they are trying to be competitive with the market while also allowing themselves enough time to properly perform their scope of work in a successful manor for the team, project, and

their own company. Owners need to understand schedule drivers, or scope items, that dictate the length of time needed to complete the work. Requesting an unrealistic schedule, or hiring a team member based on their frankly impossible projected schedule will always end up hurting the project and the team and will not help achieve all project goals. By forcing an unrealistic schedule, the chances of losing the ability to meet cost, quality, and citizenship behavior goals increase.

Scope Definition

Lack of well-defined project scope was a significant theme among the participant responses in Phase 1. It appeared to be a frustration that all team members shared during a project. Participants indicated that project bid documents are becoming increasingly less detailed, forcing them to make educated to fill the scope gaps. This can lead to discrepancies in design between what the project installed vs. what the project owner had in mind. One engineer said that owners "don't look at any of our design drawings," and that they instead assume certain items will be included, which were never made clear to the project team.

Another team member suggested, "Defining what [owners] will get in a project early on will give a better idea of the actual, or the true, cost in the end." This implies that the less detailed owners are in providing detail in their bid documents, the less accurate project estimates can be, which is what a project owner uses to secure proper funding. This concept remains true pertaining to project schedules as well. Schedule durations are highly based off specific activities in the project, and unknowns in the project scope can lead to unknowns in the project schedule.

Some participants shared specific mishaps when it comes to ill-defined projects scopes, specifically relating to the definition of particular materials or equipment required. One participant described how some owners feel they can get away with 'finishing' the design during the submittal phase, where a subcontractor would submit a suggested product or material and the owner would then approve, reject, or make additional comments. Subcontractors become frustrated if their suggestions are rejected or are asked to make significant changes, if there was no direction to begin with.

Some owners leave interior finish selections until the latter end of a project, believing that these decisions can be put off since these products will be installed close to the end. The problem is that many of the interior finishes require long lead times, especially the custom products. The lead times cannot be determined until the product is selected. In cases like this, unnecessary arguments between team members may occur because in order to meet schedule deadlines, simple ready to buy products must be chosen. This same idea applies to a project's cost and quality goals. Certain project goals may be missed if products become unavailable due to the significantly late decisions. Another example is shown when owners call for '15 offices on level 2 of the building' with no indication as to what basics each office needs. The designers will create the plan and make the layout and structural components work for the space. However it will most likely then be assumed that only floor, wall, and ceiling finishes will be estimated. Any cabinets, countertops, permanent wall fixtures, or specialty lighting and electrical needs will not be included unless they are written specifically into the scope of the project. Oftentimes, thinking about the individual functions of each space will allow owners to

project the future desires to help complete the scope definition so team members include that work in their schedules and budgets.

A possible suggestion to help better define the project scope early in the project is to invest in Virtual Design Construction (VDC) services. Project team members believe that "a lot of owners are not fluent in reading floor plans," which may be due to their lack of prior construction knowledge. However, VDC can help owners visualize the design, which will most easily display any gaps in scope or design selections that need to be made prior to the bidding phase.

Essentially, project owners need to understand that they can no longer send out bid documents with the attitude of 'we will finish the details later'. This only leads to issues on the project relating to schedule, cost, and quality. The project can run smoother and be more successful if the owners provide the designers with as much detail as possible, while also allowing the design to be complete prior to receiving bids.

Scope definition is highly related to changes on a project. Increasing scope definition can lead to fewer changes that will occur later in the project. It is understood that once a project has begun, the intent would be to complete it rather quickly in order to the save the owner costs possibly related to sitting on empty land. However, an effective and efficient project will save more costs than a rushed project. The project team has requested that owners spend more of their preconstruction efforts working directly with the designers to make decisions of their project scope needs. The greater scope definition, the greater chance the project has to succeed and meet its goals.

Budget

All too often projects are designed with a vision in mind that does not follow an achievable budget. Typically, architects are blamed for choosing high cost items, too much scope, or inefficient designs. However, without guidelines from the owner the designers may deviate from any cost goals. It can be difficult for the project team to help develop the building if they are unaware of an appropriate budget goal the owner has in mind. The design should be created to fit the budget, rather than forcing the design to be packed down later on when the budget is missed.

Missed budget goals will almost always lead to late value engineering, which can delay a project schedule. Value engineering certainly isn't always a bad process for a project team to work through, however typically as one architect put it "[owners] want the number cut but they don't want to lose anything." This puts the project team in a position where they feel they cannot do anything to help the project, the owner is directly impeding the projects ability to succeed. In some cases, "owners are taught that you want to bully your contractor to get the most out of them." Whereas the owner stands their ground in continuing with the desired project scope and demanding the costs meet the budget goals.

In other cases some contractors are "asked to bid against another contractor who will tell him whatever he [or she] wants to hear" in order to secure the contract award. This sets up the project to fail from the start. Contractors believe "it is really hard to compete against someone who will say the cost is much lower than it will end up being." A solution to this dilemma is for owners to do their research on why an estimate is much lower than other bids; possibly they have scope gaps, or are assuming the lowest grade

in materials and equipment. Other times an owner will base their budgets off of "someone who threw out a number to them, or they heard the competition was doing a project for this price, but they have no data to back it up," as indicated by a contractor. Owners then set their project budgets to match these unrealistic expectations of how much a project can cost. Typically, a project like this has a high quantity of change orders and teammates with their hands out asking for more compensation. One contractor thought that sometimes "owners need to get burned in order to learn their lesson." He believed that after an owner chooses to work with teammates that knowingly give unrealistic budgets, that owner will suffer lost project goals and choose to work with a more qualified team members on the next project.

Owners need to work with designers early on in the project to match the design with the budget. Work through the programming with an architect and setting various levels of needs to determine the mandatory items, or items that are required for the project, compared to desires, or items that would be great to have if the budget allows. This way, the designers can provide alternates for the owner to choose from if he or she has room to enhance the design.

Communication

While relating to communication with in a project team, two central topics were presented as themes for barriers to meet project goals. The first theme involved project owners making project decisions without informing all members of the project team. If for instance an owner had made a new decision with an architect relating to the design, the contractor would not become aware of this change until new drawings were released, in the meantime subcontractor's on site would continue to build per the now outdated

drawings. It is important to share project information with all team members as soon as possible. Keeping everyone in the loop is the best way to eliminate misunderstandings.

The second common theme was the length of time an owner takes to respond to team members. Unfortunately, great lengths of zero communication occurs all too often on a project. Project team members will follow up with the owner on issues and may receive no response. Writing or calling the team back, even to inform them on the status of the issue is crucial. Complete and extended silence is unacceptable project team behavior. During one project, an owner refused to call, write or meet with his contractor for an extended time period. The project had issues on site relating to an existing building's unknown exact locations of water piping, which lead to repair challenges. The contractor made a proposed fix, which the owner was unhappy with the price. The owner stopped all communication with the project team while he reached out to another contractor for a second opinion and quote to repair the piping. This lead the project team incredibly frustrated and confused, especially because they were unaware of the reason for the lack of communication. During the time of silence, the team members were unsure if they should more forward with the project, or work on other projects they were obligated to. The owner caused a heavy strain on the teams dynamics.

Other owner areas of improvement relating to communication include strengthening the relationship between the 'corporate' owner and the 'site' owner. Too many time the designers and contractors become a middleman between the various owner entities. The corporate owner's goal is to receive a return on investment for the project, while the site owner's goal is to make the most out of the function of the building. Oftentimes, these two goals do not always align and the project team because responsible

for leading the communication between the owner's team. The corporate owner will make cost effective decisions such as reducing the quantity of glazing on the first floor due to high costs. However the site owner understands that the high quantity of storefront glass is appealing to tenants and can raise incoming rent collection.

Lastly the communication paths for a project team should be made simple and reasonable. If a project team member needs to receive information from the owner, the path to receive the answer should not be unattainable and go through multiple different sources. This is where misinformation is formed and the question's response time is deeply lengthened. Limit the amount of levels, or hoops, a teammate needs to go through to reach the decision making authority member.

Timeliness / Meeting Deadlines

While the team is working hard to meet the project deadlines set by the owner, they expect the owner to also follow through with their own commitments and deadlines as well. An architect described how she needed to adjust her typical design process with some owners and walk them through every step of the design phase. Typically, she would like to work on her designs, then send them to the owners for their review; however, this follow up request is rarely achieved as she does not receive feedback by the requested date. The designer now sets aside an entire workday at the end of every deadline to meet with the owner and explain the drawings in a piece-by-piece format. An engineer had a similar issue as she described how "the biggest [issue] occurs during design. We send [owners] drawings for review and they never look at them." Both designers compared this process to 'hand holding', as some owners do not do any work to prep for the design review outside of the arranged meetings.

Many project teammates expressed how when an owner misses their own deadlines or delays the action of presenting the team with required information, the team is less inclined to meet their deadlines as well. The owner is the leader of the team and should set good examples if they would like their team to follow in the same fashion. Sometimes, events occur and an owner deliverable will be late. The best step is to inform the team of this delay immediately so they can plan accordingly. Withholding information with the slim hope of still meeting certain deadlines will not help the team succeed.

Lastly, all team members have requested the owner to be more decisive when it comes to project topics. Constructing a building is a major occurrence, and it is understandable that decisions need to have good backup and meaning as to why certain choices were made. However, it appears that some owners do not make project decisions a priority, and being more efficient with their rulings could save the project schedule time. The team would like owners to know that making project decisions in a timely manor is expected on all projects. Delaying decisions has a domino effect on other components of the project.

Trust

As mentioned in the communication discussion, an owner was dealing with a challenge due to an older building with faulty and unknown locations of the water piping and supply. The contractor had proposed a solution to reroute the water supply and indicated the cost of the fix in which the owner was displeased. After a while, the owner decided he did in fact need to reroute the water supply but he did not inform the project architect nor the project contractor. Instead, he went outside of the project team and hired a new contractor in which he believed had a more reasonable cost estimate. The

project architect and contractor felt that trust between team members was immediately broken. The contractor knew the amount of time and work it would take to complete the rerouting of pipes and felt he gave a reasonable price, he was shocked another company was now working on their project site. Unfortunately, this had also damaged the team's willingness to go above and beyond for their teammates. The project contractor had decided that they would no longer take on any additional work on the project outside of their original scope of work.

The project team had also learned that the new contractor discovered complications in their solution, which ended up leading to a very similar price from the original project contractor's estimate. Possibly, the owner could have walked through the original price with the project contractor to discover areas of conflict in terms of cost. Negotiating the price should have been the first step prior to moving on to a separate contractor. It is understandable to assume price requests after the initial bid awards may not be as competitive as they could have been prior to bids, so the owner questioning the price is not unreasonable. The owner wishes to pay a fair price, while the contractor wishes to be paid a fair wage. Respecting team members time and efforts should be an owner priority.

In a similar situation, an owner was working with an architect to develop the final budget for a building project. The architect brought in an experienced design-build MEP contractor who volunteered their time to create initial budgets, with the hopes of securing a contract for the project. The owner was unhappy with the estimate and without informing the architect found a new design-build MEP contractor to perform the work for less. The owner had reached out to the new firm informing them of the desired

project MEP costs, in which the contractor agreed to perform the work for that price. The original MEP contractor was never told a desired price and did not have the opportunity to negotiate and work on the estimate with the owner, even after volunteering their efforts to the project. This MEP contractor felt used, that their time was wasted, and that they did not receive a fair second chance. They became discouraged to bid on future projects by this project owner. On top of that, the owner requested that the architect firm reduce their fee based on the new estimate even after agreeing to the original higher fee. The architects were displeased because they felt they were now being paid less money to perform the same amount of work, and that their time estimating the project had also been wasted. They ended up agreeing to the new fee in fear of burning project relationships early in the project because "sometimes you need to let things go in order to achieve a successful project" (interview participant).

Other comments mentioned in the research surveys surrounded the topics of speaking dishonestly to team members, or talking bad about one another. As a project team, the greatest assets are the relationships between the team members. Not being honest when discussing project topics is harmful to team dynamics. Essentially, all project teammates want to be able to trust the owner and have the owner fully trust them. The construction industry is strongly built on relationships between companies and team members, the goal is not to deceit anyone but to instead build trust to help projects better succeed.

Focus on initial cost only

As the type of project owner varies, so do the owner's priorities. Developers looking to sell the building after completion may prioritize having a low cost project with

the hopes of achieving a high profit sell. Do they understand the level of quality they may be giving up while only focusing on the initial costs? The project team members have expressed the countless times project owners have frankly ignored material and equipment life cycle costs, the costs that occur after the project is installed. Maintenance, durability, and utility costs may drive high bills during project occupancy. The team also warned owners of the affects poor quality products have on their surrounding objects. The team suggested that it is always important to read the product description and data to discover the possible outcomes of using it on the project.

A common response associated with ignorance related to lifecycle costs was HVAC equipment. Mechanical, electrical, and plumbing contractors indicated that it was very frustrating to install poor quality equipment, knowing there were more efficient options for the project's function. The owner can greatly benefit from a high quality HVAC system in the long run if they plan to keep or continue to occupy the project space. In fact, it can even be a positive marketing aspect if the owner is looking to sell the project.

Craftsmanship is affected by the quality level of the products and materials being used on site. When an owner makes project decisions purely based off the sticker price, this can affect the on site workers abilities to perform their work. Typically, but not always, a lower price is associated with a lower quality product. Construction workers would like to showcase their efforts and craftsmanship through the end results presented in the final building. If the worker uses low cost and low quality products, the results may be less acceptable to the owner. The lowest priced materials may not withstand durability measures required for the project. The project team requests that owners look

into the product and equipment data to better understand what they are receiving, rather than purely focusing on the initial cost.

Industry Tools

Phase 4

The goal of Phase 4 is to provide the construction industry with new tools that came directly from the results of this research study. The first is a survey that can be used by a project owner employer to learn more about their owners' performance. The survey is called a 'Team Member Satisfaction Survey,' with the intent that it is completed by other members of the project team, such as designers and contractors. Their responses would be in regards to the abilities of that specific project owner. The other industry tools are newly developed case studies that can be used as learning instruments to reflect upon real industry events. Industry members can compare these events to their own experiences, or use them to avoid future project challenges.

Team Member Satisfaction Survey

Item Response Theory will again be useful in a company's analysis of their individual owner feedback from the team member satisfaction survey. Now that this study has investigated how frequently the owner inefficiencies occur, company's can analyze the relationship and compare between their team member's responses regarding their own project owner's abilities and the known industry standards.

A survey has been created to allow for owner employers to understand their employee's strengths and weaknesses. Knowing that more complete and thoughtful responses will be received if the survey is kept to a minimum, 20 primary quantitative questions are asked. The questions are formed using a Likert Scale ranging from 1-5, 1

being the lowest score and 5 being the highest score. For every two of the 20 primary questions there is a directly related follow up question that essentially asks responders to elaborate on their initial responses and give specific details of strengths or areas of improvement. The first four primary questions focus on each of the four central construction project goals. As an example, one question asks "What affect do we have on achieving the project cost/budget goals?" The responses range from "Often delay the project schedule" to "often help produce a quick project schedule." The follow up question for this topic states "Comments regarding our (in)ability to help produce a quick project schedule."

The next 16 primary questions each relate to the top eight most frequently occurring project owner inefficiencies. The first question for each of the most frequent inefficiencies asks about frequency of occurrence, while the second question asks about level of satisfaction. An example of the first question is "How frequently do we miss or alter deadlines that we have agreed to meet?" with the next question stating "How satisfied are you with our ability to meet our own designated deadlines?" Responses from the first question range from "Almost never" to "Almost Always" and the second question varies from "Very dissatisfied" to "Very satisfied." The follow up question in regards to this topic asks "How has our (in)ability to meet deadlines affected past projects." This is where the respondents could list specific examples that represent their response to the primary questions. The survey concludes by asking respondents "What do you believe are our greatest strengths?" and "Other suggestions for improvement?"

Although this research study focused on finding the areas of improvement of project owners at an industry level, this individualized survey can actually help show

strengths of the singular owner as well. The project owner employers will take on the responsibility of viewing and analyzing their own survey response data. Although the questions asked are not directly equivalent to the questions asked in this research study, the topics were created and from the results of the study and enhanced to provide owner employers with more useful data. Since the eight most frequently occurring owner inefficiencies were used in this survey, the goal for project owner employers would be to receive positive remarks on all of these questions, which would imply their owners are doing 'better' than the standard in implementing these project skills. If not, then training and educational topics should be focused around areas with poor remarks.

The surveys will be available to project owner employers via a public Google Forms document. They will be asked to create a copy of the original survey and then they are able to send it to any recipients that they wish. Neither the researcher, nor Iowa State will have access to their personalized data that is collected. A copy of the project team satisfaction survey is shown in Appendix J.

Industry Case Studies

After viewing the research survey data and speaking directly to research participants about their previous experience with project owners, two industry case studies were developed. The goal of these case studies is to give members of the project team a chance to view other industry experiences. Ideally, these are used as learning tools to either compare them to the project team's past experience, or now have the understanding to avoid situations like the ones presented, in the future.

Case 1 is provided in Appendix K and Case II is provided in Appendix L. The first case focuses on many of the most frequent project owner inefficiencies including

schedule, scope definition, budget, and timeliness. The second case study focuses on changes, scope definition, timeliness, and trust.

CHAPTER 6. CONCLUSION

Current construction management research does not place a focus on project owners. Specifically, research has not discovered what skills project owners are currently lacking, which lead to less opportunity for successful projects. Identifying project owner inefficiencies will aid in construction project success, supporting project costs, schedules, quality, and citizenship behavior. Project owner employers can focus their training and educational programs to match the topics that are shown to be actual problems in today's industry.

In order to collect the most current and beneficial data, a sequential mixed methods study was performed. The method consisted of a three phase data collection, with a follow up phase creating tools for the industry to use. Phase 1 consisted of a survey sent to designers and contractors collecting owner inefficiency definitions for each of the four project goals. Phase 2 asked participants to determine the frequency of occurrence for each of the most common inefficiency responses from Phase 1. These first-tier most frequent inefficiencies include making various changes to the original scope and design, creating unrealistic or compressed schedules, ill-defined project scopes, not creating a sufficient or complete budget, lack of proper communication with team members, missed deadlines or delaying responses, lack of trust among team members, and focusing only on the initial cost when choosing products and equipment for a project. Interviews were conducted in Phase 3, as select participants provided a narrative response to their experience regarding areas project owners could improve upon. This displays how these areas of improvement actually affect the success of the project.

Lastly industry tools were developed to provide project owner employers with some educational support to learn from other project team members experience, along with providing the ability for owners to identify their own personal areas of improvement as they relate to this study's results. The objective was to identify inefficiencies and provide them to project owner employers, allowing their management to implement continuing education options. Ideally, now that these inefficiencies are identified, owner companies will aim to eliminate those inefficiencies, and project teams will see an improvement in the ability to achieve project goals. These first-tier most frequent inefficiencies include making various changes to the original scope and design, creating unrealistic or compressed schedules, ill-defined project scopes, not creating a sufficient or complete budget, lack of proper communication with team members, missed deadlines or delaying responses, lack of trust among team members, and focusing only on the initial cost when choosing products and equipment for a project.

Reliability and Validity

In order to claim the results of this study represent the thoughts and opinions of the current construction industry it is important to prove reliability and validity. First of all, both of the Phase 1 and Phase 2 surveys went through a pilot study. At least three people outside of this research study's participants volunteered for the pilot study. They were all involved in the construction industry and took the surveys and provided constructive feedback. The surveys were updated to better clarify the questions in order to receive consistently formatted results. The data was reviewed and it was discovered that the pilot study results matched the desired outcomes of the full phase surveys. The surveys did not limit the outcomes to a specific timeline or location. Neither survey asked

behavioral or physiological questions, so it seemed less appropriate to use internal consistencies to compare participant answers.

Although qualitative surveys are not commonly used in the research field, this is not the first study to use one. Harrie Jansen (2010) walks through the complete logic for using a qualitative survey and its most common appearance in the social research field. In terms of external validity, this is a proven method which was deemed as most appropriate to use in order to receive new descriptive opinions from project team members, rather than purely verifying what other researchers have previously discovered. Also, for Phase 2, the majority of the survey used a Likert Scale, which is a very well-known proven method for collecting quantitative data.

The results from this study were shown as comparable to external literature, showing consistency in the construction research field. Many construction topic categories that were discovered in this study's results were also identified in the preliminary codebook, which was developed using literature. For instance, Assaf & Al-Hejji (2006) identified many causes of delay by a construction owner, some of which were also shown in this study's results including delaying site delivery, submittals, change orders, payments and general information requests. Likewise, in the cost category, Rosenfeld (2014) showed similarities to this study's results in terms of scope definition, changes, and an unrealistic project budget. The inefficiencies identified in this study align with common tasks in the construction industry. They are not dramatically different from where one might expect owners to show improvement.

Construct validity aims to reduce the researcher's biases shown as a result in the conclusions of the study. Phase 1 is challenging to prove as valid since it uses a qualitative

analysis and requires the researcher to read through and examine the data multiple time in order to create the resulting inefficiency topics. If perhaps a new researcher were to perform this study, he or she may code the data slightly differently. However, Phase 2 verifies the results of the Phase 1 analysis. Research participants are asked to again fill out a survey regarding the same project owners that they used for Phase 1. This time, they were asked to identify the frequency of occurrence for each of the given inefficiencies. If the researcher's interpretations of the Phase 1 data did not properly represent the viewpoints of the industry, then the results would have shown consistent 'Almost Never' results on each of the inefficiencies. The researcher also may have received emails from participants indicating that the Phase 2 data was inconsistent with their industry experience. This would have prompted the researcher to revisit her analysis of the Phase 1 data. Fortunately, many of the most commonly identified inefficiencies from Phase 1 also happened to be discovered as most frequently occurring in Phase 2, which is an assumption that could have been made from the start of the study. A hypothesis could have been made essentially indicating that if many industry members identify the same areas of improvement, there is reason to believe that is because they are also the most frequently occurring topics that cause problems on their projects. Team members would most likely not identify inefficiencies that they rarely come across in the industry.

Lastly, not all research participants who volunteered to participate in the interview were chosen to participate in Phase 3. For those who did not interview, they were asked if they would be willing to volunteer their time to take and provide constructive feedback for the Phase 4 Project Team Satisfaction Survey. This way,

experienced industry members were able to provide their opinions on the survey deliverable of this study.

Limitations

It is important to note that all members of the construction project team show room for improvement, not only the owners. Construction projects continuously vary on the size, complexity, and location, so perfecting the process can be extremely challenging. Owners, designers, and contractors can continue to grow and expand their skill sets to better serve the project team. This research only focused on one of the project team members, which showcased the project owner from the perspective of designers and contractors. The owner's viewpoints were not considered in this data collection process. As a result, the supporting evidence as to why these inefficiencies occur may have been missing.

It was imperative to the researcher that the study be outlined in a way to gather new potential areas of improvement, rather than verify the currently known owner inefficiencies. Due to this, a qualitative survey in Phase 1 was used. Qualitative surveys require an extensive review process to interpret and code the meaning of the participants' responses. Increasing the number of participants could have aided with the secondary quantitative analysis, but would not have been feasible from a qualitative standpoint, which was the primary method for this study.

This study's participants included architects, engineers, contractors, and subcontractors. The majority of these participants would be considered contractors, primarily due to the researcher's direct contacts and Iowa State University's direct

affiliates. Possibly, the results would be altered if the participant characteristics and backgrounds were more balanced.

The results from this survey will be presented to owners, designers, and contractors at the Construction Owners Association of America conference after the study is complete. Feedback of the results and the industry tools will not be discussed nor reflected on to update any research results.

Future Research Opportunities

There are three apparent paths to continue future research surrounding this research topic. The first is to follow a similar study but to instead focus on other members of the project team such as the architect, engineer, contractor, or subcontractor. The project owner is not the only position that shows a need for improvement; finding real and current challenges in the industry caused by other positions would help guide the improvement for other project team members.

The second clear option for future research would be to provide the means for improvement of the now identified project owner inefficiencies. Although ideally organizations such as COAA can use their resources to deliver the training courses, and other educational processes can be developed. These could be shared with individual companies for them to use and train their employees on their own, or consultants can be hired to perform more one-on-one exercises.

The last distinct option is narrow the research down and determine the significance of these owner inefficiencies. Individual projects would need to be studied to determine the monetary value or time periods that project owners negatively affected. The measurement of these areas of improvement could be determined to understand and

place a value on each of these topics. For instance, if a project owner does not provide a full detailed scope prior to the construction phase, the researcher could determine the financial consequences. Possibly a result could be presented as projects between $1,000,000-$5,000,000 in value with only 75% scope completion prior to construction, the project will result in 20% of added or avoidable costs compared to projects with 100% scope definition prior to construction. This of course is just a fabricated example, but the researcher could study a few projects in detail to discover these measurable effects.

Other options include further developing case studies to be used as learning tools. Many educational institutions utilize case studies to promote critical thinking and problem solving skills, as they must discuss real industry events, which can help prevent similar events from occurring in future projects. Developing case studies that surround the project owner's role can be used in undergraduate and graduate level engineering, construction, management, business, and real estate courses.

There could also be an opportunity to turn the results from this research into a business. Companies may be willing to hire consultants to come into their business and determine their inefficiencies, while providing specific ways to improve them. If more cases studies are developed, they could be sold to various companies for them to read and perform internal discussions with their employees. This topic is very niche, providing room to build a unique and sought after business opportunity.

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APPENDIX A. EMAIL REQUEST FOR CONTACTS

Below is an example of an email sent to an Iowa State ConE Industry Advisory Council member. The intent of the email is to gather contact information for potential research participants.

Hello Mr. X,

My name is Angela Christensen, I am a PhD student at Iowa State University focusing in Construction Management. I attended the ISU Construction Industry Advisory Council meeting in October and gave a brief introduction to my research topic.

To provide a quick summary of my research, I've developed a plan to survey and interview contractors, subcontractors, architects and engineers regarding construction project owner inefficiencies. The goal is to identify owner inefficiencies as they relate to project cost, schedule, quality, and citizenship behavior. The outcome will allow project owner employers to identify their personal efficiencies and inefficiencies to provide specific topics for future educational trainings or development. My ultimate outcome will focus on private sector owners who continuously work on design and construction projects.

I am seeking participants for my research study. I would highly appreciate your help if you could provide me with 1-5 potential participants (or yourself) that are contractors, subcontractors, architects and/or engineers who you feel would be beneficial (knowledgeable and responsive) participants for my research. Please make sure to include full names, email address, phone number, company, and position. If you could send me those by Friday, January 18th that would be great.

I have attached an abstract of my research to this email for your reference.

Thank you for your time.

Sincerely,
Angela Christensen

APPENDIX B. EMAIL REQUEST FOR PARTICIPATION

Below is an example of an email sent to a potential research study participant. The intent of this email request was to ask whether or not this individual would be interested in participating in this project owner study.

Hi Mr. X,

I received your contact information from John Doe. He suggested you would be an excellent contact for me to reach out to in regards to my research study.

My name is Angela Christensen, I am a PhD student at Iowa State University focusing in construction management. I am requesting your participation in my study. The commitment would only include two online surveys, and an optional interview. The surveys would be approximately 20 minutes long and be sent out around the March/April period. The surveys will be opinion based, asking for your responses based off of your experience. None of your personal information (name, company, etc) will be published or be for public viewing.

I have attached an abstract of my research, but I will also provide a short summary. I will be surveying and interviewing contractors, subcontractors, architects and engineers regarding construction project owner inefficiencies. The goal is to identify owner inefficiencies as they relate to project cost, schedule, quality and citizenship behavior. The outcome will allow project owner employers to identify their personal efficiencies and inefficiencies to provide specific topics for future educational trainings. My research will focus on the private sector, and owners who continuously work on construction projects.

I will send more details regarding the specific survey content as the date approaches.

Please let me know if you would be willing to participate. If you feel your experience does not relate to working on projects with private construction project owners, then I understand your participation would not be beneficial.

I would truly appreciate your help. Also, if you could specify your classification (is your position closest to a contractor, subcontractor, architect, or engineer) that would be great.

Thank you for your time.

Sincerely,
Angela Christensen

APPENDIX C. PHASE 1 SURVEY

Introduction
The purpose of this survey is to identify possible areas of improvement for private construction project owners. It is understood and assumed that private and public project owners can have differing roles, responsibilities, and characteristics. This study, however, will focus solely on private construction project owners.

In order to simplify the amount of positions/titles of team members, the study has summarized the team into five central components: owner, architect, engineer, contractor, and subcontractor. If your position does not align exactly with any of the five roles mentioned above, please select the one that fits most closely with your responsibilities.

Four goals have been identified that are assumed to be the goals of all private construction projects. These include having a quick schedule, low cost, high quality, and present citizenship behavior. Survey participants will be identifying project owner areas of development in relation to each of the four construction project goals.

A Note to Participants
Please be aware that this survey asks for some personal information such as your full name. None of your personal information will be made public, or will be identifiable within the research results. The information will be used for recording purposes only to keep track of participant progress. This survey is completely voluntary and if you feel uncomfortable answering any questions, please feel to skip them. There will be no reference to specific participant names. Also, while completing this survey, please do not include specific owner names or companies. These areas of improvement should be represented consistently among project owners.

Questions
If you would like clarifications on questions please contact Angela Christensen, akatoski@iastate.edu, for help.

Areas of Improvement
The survey focuses on improvement, or development, areas for project owners. The ‘areas’ for improvement relate to the job performance on private construction projects. These include roles and responsibilities, and the way these roles and responsibilities are performed.

The purpose of identifying the areas is to provide guidance for more focused training and development programs for project owners. <u>These areas of improvement should be items that can be realistically improved upon within the current sample of project owners.</u>

What is your name?
_____

What is your gender?
Male
Female

Please choose the category that most closely aligns with your company's position:
Architect
Engineer
Contractor
Subcontractor

Please choose the category that most closely aligns with your personal job position:
(What position do you represent in the construction project team)
Architect
Engineer
Contractor
Subcontractor
Other (if significantly different than any other option)
_____

How many years of experience do you have in the construction industry?
0 5 10 15 20 25 30 35 40 45 50

Years 

On average, how often do you interact with the owner of a project that you would be working on?
Potential answers might include 'daily', 'twice a week', 'twice a month', etc
_____

In which state are the private construction projects you work on primarily located?
_____

Survey Response Outline
Next, you will see four pages for survey responses. One for each of the construction project goals: schedule, cost, quality, and citizenship behavior.
On each page you will see the following:

1. A description of the project goal.

2. Three example owner areas of improvement related to the project goal.
Check each (or none) of the example areas of improvement that you believe are current problems in the private industry.
These are meant to help you brainstorm and initiate thought provoking ideas for part three.
Please do not rely on these to be your only input into the survey.

3. Open ended response areas for you to fill in your own opinion regarding owner areas of improvement, related to the project goal.

There are five possible areas of improvements for each of the project goals. You do not have to fill out all five open ended questions if you cannot think of five responses. However, you are the expert and know project owners well. I would appreciate you filling in as many answers as you find reasonable.

Ranking the significance of the areas of improvement is not necessary for this survey.

Schedule Inefficiencies

Schedule Definition: A construction schedule is characterized as a "plan of attack or strategy" in relation to sequencing, methods, and resource levels for the project. The purpose of a construction schedule is to allow all affiliates of a project team to properly plan ahead for current and future business practices. Examples of this include project owner's planning for future tenant move in dates and rent collection, or subcontractors determining what amount of time needs to be committed to the current project and deciding which crew will be available.

Previously Identified Examples

Please select the following, if any, that you believe are current areas that project owners need to improve. If you wish, you may use the same categories with different explanations in your own responses below.

Submittal Approval

Explanation: When submittals (specifically product samples) are sent to the owner, there is a requested deadline for owner response of approval or rejection. Yet owners frequently miss those deadlines, requiring multiple follow up requests. This can delay the schedule and materials can be sold out or arrive late.

Site Delivery

Explanation: When discussing the project schedule with the owner, the owner promised to turn over the project site for construction on a certain date. The owner falls through on delivering the site on time and the construction cannot begin.

Change Orders

Explanation: If the change order request is related to an item on the critical path for construction, this can cause project delays. Oftentimes, owners do not understand the significance of their change order request related to the amount of preparation and completion time required.

Please follow a similar process to the above examples, when filling in your believed owner areas of improvement required below. Create a category and provide a brief explanation. You may use the same category for separate areas of improvement if need be.

Owner 'Schedule' Area of Improvement 1
Category _____
Explanation _____
Owner 'Schedule' Area of Improvement 2
Category _____
Explanation _____
Owner 'Schedule' Area of Improvement 3
Category _____
Explanation _____
Owner 'Schedule' Area of Improvement 4
Category _____
Explanation _____
Owner 'Schedule' Area of Improvement 5
Category _____
Explanation _____

Cost Inefficiencies

Cost Definition: Failure to meet the cost or budget goal of a construction project can be represented in several ways. This survey is asking you to identify the possible owner areas of development in relation to higher total project costs (potentially at the cost of the owner) or costs where your company has had to spend more money than anticipated on a project, directly as a result from a project owner. This does not include compensated change orders.

Previously Identified Examples

Please select the following, if any, that you believe are current areas that project owners need to improve. If you wish, you may use the same categories with different explanations in your own responses below.

Contract Price

Explanation: Project owners do not properly review the scope of the low bid contract. The contract is then awarded to a low bid contractor that has significant gaps in the scope causing all other project team members to pick up slack, meaning material and labor that was expected to be originally included.

Value Engineering

Explanation: The less design time the owner allots to a project, the less opportunity to take advantage of value engineering. As an example, an engineer with narrowed design time may result in more conservative designs, causing an increase in material price. If owner's had more experience with the benefits of value engineering, they might pay for more design time, saving high material costs.

Pre-Construction Documents

Explanation: In an effort to begin construction as early as possible, the owner has not finalized on certain design decisions prior to the release of pre-construction documents. Contractors and subcontractors are then forced scramble in mid-construction trying to define all the incomplete decisions. Subcontractors may be booked and not taking on more work on the project, causing contractors to accept higher external invoices due to desperate times.

Please follow a similar process to the above examples, when filling in your believed owner areas of improvement required below. Create a category and provide a brief explanation. You may use the same category for separate areas of improvement if need be.

Owner 'Cost' Area of Improvement 1
Category _____
Explanation _____
Owner 'Cost' Area of Improvement 2
Category _____
Explanation _____
Owner 'Cost' Area of Improvement 3
Category _____
Explanation _____
Owner 'Cost' Area of Improvement 4
Category _____
Explanation _____
Owner 'Cost' Area of Improvement 5
Category _____
Explanation _____

Quality Inefficiencies

Quality Definition Eight attributes are used to define quality: performance, features, reliability, conformance, durability, serviceability, aesthetics, and perceived quality. Quality can refer both to any person working on or for the project, while also relating to the labor, materials, or site.

Previously Identified Examples

Please select the following, if any, that you believe are current areas that project owners need to improve. If you wish, you may use the same categories with different explanations in your own responses below.

Material Choice

Explanation: In an effort to save on cost, project owners ignore the quality standards of construction materials. Materials with short life spans or less durable materials cause rework, even after the project is complete causing disruption to occupants.

Hiring Team Members

Explanation: An owner who does not properly research project team member companies can hurt the remaining project team. All team members should be prepared and experienced to work on the given project. For example, if the architect hired has never designed a specialized project such as an ice arena, then the design may suffer causing all team members to suffer.

Material Choice

Explanation: An owner may not take the time to precisely review material options, causing dismay when the material or product is installed. Owners will then request rework with new products due to further review.

Please follow a similar process to the above examples, when filling in your believed owner areas of improvement required below. Create a category and provide a brief explanation. You may use the same category for separate areas of improvement if need be.

Owner 'Quality' Area of Improvement 1
Category _____
Explanation _____
Owner 'Quality' Area of Improvement 2
Category _____
Explanation _____
Owner 'Quality' Area of Improvement 3
Category _____
Explanation _____
Owner 'Quality' Area of Improvement 4
Category _____
Explanation _____
Owner 'Quality' Area of Improvement 5
Category _____
Explanation _____

Citizenship Behavior Inefficiencies

Citizenship Behavior Definition: Citizenship behavior closely aligns with contextual performance. In essence, it is the action and behavior each team member portrays to further aid his or her teammates, or the project as a whole. Showing citizenship behavior would mean that each team member must devote themselves to the project team, not only their individual company. Lack of citizenship behavior can hurt team moral.

Previously Identified Examples

Please select the following, if any, that you believe are current areas that project owners need to improve. If you wish, you may use the same categories with different explanations in your own responses below.

Marketing

Explanation: Owners do not allow for the exposure of the project team in terms of marketing. Team member companies are often left out of project marketing events, or left off of project informational documents.

Timeliness

Explanation: Project owners are asked questions in weekly meetings and are expected to have answers or progress on responses by the following week. However, tasks are forgotten about and the project team suffers from lack of information.

Project Payments

Explanation: Owners expect the project team to work continuously on the project even though the project payments are received late. This causes team members to must put their own company finances at risk.

Please follow a similar process to the above examples, when filling in your believed owner areas of improvement required below. Create a category and provide a brief explanation. You may use the same category for separate areas of improvement if need be.

Owner 'Citizenship Behavior' Area of Improvement 1
Category _____
Explanation _____
Owner 'Citizenship Behavior' Area of Improvement 2
Category _____
Explanation _____
Owner 'Citizenship Behavior' Area of Improvement 3
Category _____
Explanation _____
Owner 'Citizenship Behavior' Area of Improvement 4
Category _____
Explanation _____
Owner 'Citizenship Behavior' Area of Improvement 5
Category _____
Explanation _____

APPENDIX D. PHASE 2 SURVEY

Introduction
This is a follow up survey building off of the first survey you filled out relating to private construction project owners. In the first survey you were asked to provide responses as to where you believe project owners show room for skill improvement.
This second survey includes a summary of the most common responses from the first survey. This survey asks you to rank the most common responses in a priority order for which you believe project owners should improve upon first. Also, this survey asks you to determine how frequently you believe each project owner area of improvement occurs.

A Note to Participants
Please be aware that this survey asks for some personal information such as your full name. None of your personal information will be made public, or will be identifiable within the research results. The information will be used for recording purposes only to keep track of participant progress. This survey is completely voluntary and if you feel uncomfortable answering any questions, please feel to skip them. There will be no reference to specific participant names.

Questions
If you would like clarifications on questions please contact Angela Christensen, akatoski@iastate.edu for help.

Areas of Improvement
The survey focuses on improvement, or development, areas for project owners. The 'areas' for improvement relate to the job performance on private construction projects. These include skills, roles and responsibilities, and the way they are performed.

What is your name?

How often do project owner skills that need improvement affect the following project problems?

	Almost Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Almost Always (5)
Schedule Delay (1)	○	○	○	○	○
Cost Overrun (2)	○	○	○	○	○
Poor Quality (3)	○	○	○	○	○
Lack of Citizenship Behavior (4)	○	○	○	○	○

Schedule Definition
A construction schedule is characterized as a "plan of attack or strategy" in relation to sequencing, methods, and resource levels for the project. The purpose of a construction schedule is to allow all affiliates of a project team to properly plan ahead for current and future business practices. Examples of this include project owner's planning for future tenant move in dates and rent collection, or subcontractors determining what amount of time needs to be committed to the current project and deciding which crew will be available.

These are the most common responses for project owner skills needing improvement that negatively affect the **SCHEDULE** of a construction project. Each area of improvement indicates common themes found in participant responses. Please rank them in an improvement priority order. Which area do you believe should be improved first? Second? etc.

Owner Responsibilities Logistics of owner provided suppliers and subcontractors, participation in design, creation of concept and space plans, move in logistics, RFI responses, ability and timeliness of decision making
Changes Change orders, design changes, scope changes, late value engineering
Site Delivery Delayed start time, length of time between contract award and start date
Lack of Construction Knowledge Construction flow, plan reading and visualization, project costs, requests unrealistic schedules
Scope Definition Incomplete plans or incomplete goals/concepts prior to project bid or start date
Submittals Lack of owner participation, late responses, continuously makes comments/adjustments
Financing/Budget Funding delays, missed funding goal, budget transparency/goals, improper contingency

Owner to Meet Deadlines Meet deadlines for owner deliverables and owner provided information
Owner Representatives No decision making authority, responsibilities are unclear, added unnecessary communication challenges
Outlining Expectations Defining project goals and priorities

How often do the following project owner skill improvement areas negatively affect a project SCHEDULE?

	Almost Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Almost Always (5)
Owner Responsibilities Logistics of owner provided suppliers and subcontractors, participation in design, creation of concept and space plans, move in logistics, RFI responses, ability and timeliness of decision making	○	○	○	○	○
Changes Change orders, design changes, scope changes, late value engineering	○	○	○	○	○
Site Delivery Delayed start time, length of time between contract award and start date	○	○	○	○	○
Lack of Construction Knowledge Construction flow, plan reading and visualization, project costs, requests unrealistic schedules	○	○	○	○	○
Scope Definition Incomplete plans prior to project bid or start date	○	○	○	○	○
Submittals Lack of owner participation, late responses, continuously makes comments/adjustments	○	○	○	○	○

Financing/Budget Funding delays, missed funding goal, budget transparency/goals, improper contingency	○	○	○	○	○
Owner to Meet Deadlines Meet deadlines for owner deliverables and owner provided information	○	○	○	○	○
Owner Representatives No decision making authority, responsibilities are unclear, added unnecessary communication challenges	○	○	○	○	○
Outlining Expectations Defining project goals and priorities	○	○	○	○	○

Cost Definition
Failure to meet the cost or budget goal of a construction project can be represented in several ways. This survey defines a missed cost goal as higher total project costs (potentially at the cost of the owner) or costs where your company has had to spend more money than anticipated on a project, directly as a result from a project owner. This does not include compensated change orders.

These are the most common responses for project owner skills needing improvement that negatively affect the COST of a construction project. Each area of improvement indicates common themes found in participant responses. Please rank them in a skill improvement priority order. Which area do you believe should be improved first? Second? etc.

Changes Change orders, design changes, scope changes
Delivery, Procurement, Contracts Focused on cost only, misunderstanding of method advantages/disadvantages, insufficient contingency, improper method used
Hiring Team Members Bring teammates on project earlier, review for quality team members, pre-qualify team members, discourage premade team selections
Lack of Construction Knowledge Construction flow, plan reading and visualization, estimating, weather effects, operation costs

Scope Definition Incomplete plans or incomplete goals/concepts prior to project bid or start date
Budget Outlining expectations for the budget, insufficient budget
Risk Sharing risk, industry conditions, site conditions, not accounting for any risk
Value Engineering Spend time to review options, unwilling to give up scope items
Understanding of Contract Scope Review team member contract scopes, understand allowance inclusions/exclusions
Schedule Unrealistic schedule, compressed schedule, work flow

How often do the following project owner skill improvement areas negatively affect the project's COST?

	Almost Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Almost Always (5)
Changes Change orders, design changes, scope changes	○	○	○	○	○
Delivery, Procurement, Contracts Focused on cost only, misunderstanding of method advantages/disadvantages, insufficient contingency, improper method used	○	○	○	○	○
Hiring Team Members Bring teammates on project earlier, review for quality team members, pre-qualify team members, discourage premade team selections	○	○	○	○	○
Lack of Construction Knowledge Construction flow, plan reading and visualization, estimating, weather effects, operation costs	○	○	○	○	○
Scope Definition Incomplete plans prior to project bid or start date	○	○	○	○	○
Budget Outlining expectations for the budget, insufficient budget	○	○	○	○	○
Risk Sharing risk, industry conditions, site conditions, not accounting for any risk	○	○	○	○	○
Value Engineering Spend time to review options, unwilling to give up scope items	○	○	○	○	○

Understanding of Contract Scope Review team member contract scopes, understand allowance inclusions/exclusions	○	○	○	○	○
Schedule Unrealistic schedule, compressed schedule, work flow	○	○	○	○	○

Quality Definition
Eight attributes are used to define quality: performance, features, reliability, conformance, durability, serviceability, aesthetics, and perceived quality. Quality can refer to any person working on or for the project, while also relating to the labor, materials, or site.

These are the most common project owner skills needing improvement that negatively affect the QUALITY of a construction project. Each area of improvement indicates common themes found in participant responses. Please rank them in a skill improvement priority order. Which area do you believe should be improved first? Second? etc.

Changes Change orders, design changes, scope changes, no extra time given for added scope
Quality Control Quality standards, procedures, third party inspectors, continuous inspections
Hiring Team Members Bring teammates on project earlier, review for quality team members, focuses on cost only pre-qualify team members, company culture, personalities, owner representatives
Lack of Construction Knowledge Plan reading and visualization, industry norms, codes and standards
Scope Definition Incomplete plans or incomplete goals/concepts prior to project bid or start date
Material Choice Dislike of aesthetics after install, not enough research of material options, review product data and durability, mockup review, inflexibility
Focus on Cost Only Going with the cheapest option, payback and lifecycle cost analysis
HVAC Understanding HVAC systems, efficiency cost benefits

How often do the following project owner skill improvement areas negatively affect project QUALITY?

	Almost Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Almost Always (5)
Changes Change orders, design changes, scope changes, no extra time given for added scope	○	○	○	○	○
Quality Control Quality standards, procedures, third party inspectors, continuous inspections	○	○	○	○	○
Hiring Team Members Bring teammates on project earlier, review for quality team members, focuses on cost only, pre-qualify team members, company culture, personalities, owner representatives	○	○	○	○	○

Lack of Construction Knowledge Plan reading and visualization, industry norms, codes and standards	○	○	○	○	○
Scope Definition Incomplete plans prior to project bid or start date	○	○	○	○	○
Material Choice Dislike of aethetics after install, not enough research of material options, review product data and durability, mockup review, inflexibility	○	○	○	○	○
Focus on Cost Only Going with the cheapest option, payback and lifecycle cost analysis	○	○	○	○	○
HVAC Understanding HVAC systems, efficiency cost benefits	○	○	○	○	○

Citizenship Behavior Definition

Citizenship behavior closely aligns with contextual performance. In essence, it is the action and behavior each team member portrays to further aid his or her teammates, or the project as a whole. Showing citizenship behavior would mean that each team member must devote themselves to the project team, not only their individual company. Lack of citizenship behavior can hurt team moral.

These are the most common responses for project owner skills needing improvement that negatively affect the CITIZENSHIP BEHAVIOR within a construction project. Each area of improvement indicates common themes found in participant responses. Please rank them in an improvement priority order. Which area do you believe should be improved first? Second? etc.

Changes Change orders, design changes, change management
Payments Not following contract payment terms, rejecting change orders
Timeliness Decision making, follow up, information exchange
Owner Expectations Setting project goals, project priorities, work ethics
Communication Not keeping all team members in the loop, extended periods of no contact
Owner Representative Defining responsibilities, no decision-making authority, no owner rep when the project could benefit from one
Trust Lack of trust, lack of honesty, blatant distrust
Character Traits Not accepting responsibility, accountability, egotistic, leadership
Teamwork Aligning team goals, wanting all team members to succeed, collaboration

How often do the following project owner skill improvement areas negatively affect a project team's CITIZENSHIP BEHAVIOR?

	Almost Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Almost Always (5)
Changes Change orders, design changes, change management	○	○	○	○	○
Payments Not following contract payment terms, rejecting change orders	○	○	○	○	○
Timeliness Decision making, follow up, information exchange	○	○	○	○	○
Owner Expectations Setting project goals, project priorities, work ethics	○	○	○	○	○
Communication Not keeping all team members in the loop, extended periods of no contact	○	○	○	○	○

Owner Representative Defining responsibilities, no decision making authority, no owner rep when the project could benefit from one	○	○	○	○	○
Trust Lack of trust, lack of honesty, blatent distrust	○	○	○	○	○
Character Traits Not accepting responsibility, accountability, egotistic, leadership	○	○	○	○	○
Teamwork Aligning team goals, wanting all team members to succeed, collaboration	○	○	○	○	○

Would you be willing to participate in an interview discussing private construction project owner areas of improvement? Expected interview time is approximately 1/2 hour - 1 hour.

Yes
No

Would you prefer an in person or phone interview? Interviewer may be able to travel depending on the location.

In person
Phone/Skype

APPENDIX E. PHASE 3 INTERVIEW BREIFING

This briefing was sent to interview participants a few days prior to the scheduled interview. This way, participants could brainstorm their responses and prepare for the interview questions.

Interview Goal
Discover real industry examples that demonstrate the project team's experience with a project owner. Specifically focusing on the experiences that express a need for a project owner to improve their skills.

Interview Style
Informal, open discussion

Central Interview Question
Describe (in detail) a time where you had to deal with a problem on a construction project due to the project owner's action, or lack of action. Please choose an example that relates to one or more of the topic options listed below.

Project Schedule
Changes
Change orders, design changes, scope changes
Owner Responsibilities
Poor logistics of owner provided suppliers or subcontractors, participation (or lack of) in design, creation of concept and space plans, move-in logistics, RFI responses
Owner to meet deadlines
Missing deadlines for owner deliverables and owner provided information

Project Cost
Schedule
Unrealistic schedule, compressed schedule, improper work flow
Scope Definition
Incomplete plans or incomplete goals/concepts prior to project bid or start date
Budget
Not outlining expectations for the budget, insufficient budget

Project Quality
Focus on Cost Only
Going with the cheapest option, ignoring payback and lifecycle cost analysis
Quality Control
No quality standards, procedures, third party inspectors, continuous inspections
Changes
Change orders, design changes, scope changes

Project Citizenship Behavior

Communication

Not keeping all team members in the loop, extended periods of no contact

Timeliness

Poor (or lack of) decision making, follow up, information exchange

Teamwork

Not aligning team goals, disregard for team members success, no team collaboration

The example(s) should not be restricted to each of the categories of project schedule, cost, quality, and citizenship behavior. The project problem, or struggle, can affect any or all of these categories if need be. For example, if you have a great example of a quality control issue you had on a project, you may discuss how this issue affected not only the project quality but also the schedule, budget, etc.

I would ask you to describe the problem, why you think it happened, and how you or your team dealt with it, or solved the problem. If the problem was not solved, how did it affect your work? What should the owner have done differently? Did it affect your willingness to work with that owner again?

Interview Data Goal

As a result of the interview, I would like to create/write case studies that can be used as learning tools in the industry. We can certainly extend our interview time if need be, or schedule follow up times to gain more detail. You can use real names/company names while describing your experience, but I will change all names for my research and the case studies.

APPENDIX F. PHASE 3 INTERVIEW QUESTIONS

Opening questions:

a) May I record our conversation?
b) What is your role/title and your specific responsibilities on a project?
c) How would you describe the role of a project owner on a construction project team?
d) What does your typical interaction with an owner look like?
    i) Communication type (email, phone call, in person, etc.)
    ii) Interaction topic (meeting, asking questions, reminders, etc.)
    iii) Positive vs negative

Case study questions:

In relation to a project's schedule (cost, quality, citizenship behavior), or timeline, I've provided you with a list of the top three skill areas that owners need to improve upon. Describe a situation where you have experienced challenges on a project due to a project owner not conveying one, or more, of these skills.

Follow up questions:

What struggles or difficult internal decisions did you need to debate or deal with?

How did your team actually deal with the problem?

Did you solve the problem? If so, how?

Which skills does the owner need to improve?

What should the owner have done differently?

How could owners improving their skills help your company perform on a construction project?

Is there anything else you would like to add?

Many of the interview questions will be developed as the participant is describing his or her experience with the project owner. The researcher will ask clarification questions, or as participants to expand on certain topics.

APPENDIX G. PROJECT OWNER INEFFICIENCY TABLES

Colored (blue, green, orange, purple) rows indicated first level inefficiencies
Light grey rows indicated second level inefficiencies (related to the first level above them)
Dark grey rows indicated third level inefficiencies (related to the second level above them)

Project Goal "Schedule" Owner Inefficiencies

Table G18: Project Owner Inefficiencies that Negatively Affect the Project's Schedule

Schedule Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Bring in team early on the project	▪ Full team is often not brought onto the project early enough ▪ Bring in contractors as early as possible	▪ All members of a team can contribute to more accurate designs and early budgets	
Changes	▪ Projects often do not follow original plan sets	▪ Reduce the quantity of changes on a project, especially changes that are not absolutely necessary	"Typically, where the misalignment occurs is the cumulative impact of multiple smaller changes later in the project schedule that individually may not directly show on the critical path schedule, but overall cause large disruption to a predictable outcome."

Table G18. (continued)

Schedule Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Change orders	▪ Time extensions are not granted for added work ▪ Many small adjustments can add up quickly even if they appear individually insignificant ▪ Small changes typically have large effects on other scope items ▪ Changes that affect the critical path need to be made immediately ▪ Subcontractors may stop work if payment for change order is not made in a timely manner	▪ Employ proper staffing numbers designated for quick reviews of change documents ▪ Research the consequential effects for each change ▪ Understand and adjust for changes that have schedule impacts ▪ Add time extensions into current change order monetary negotiations ▪ Do not ask a contractor to perform a change order prior to a fully signed pricing agreement	"It is increasingly difficult to get time extensions on projects as change orders are approved for money and not time."
*Example: change orders	"If the change order request is related to an item on the critical path for construction, this can cause project delays. Oftentimes, owners do not understand the significance of their change order request related to the amount of preparation and completion time required."	Avoid changes related to critical path items - If necessary, grant reasonable time extensions	
Design changes	Too many changes made in the design aspects of the project	▪ Be aware of scope creep near design completion ▪ Become disciplined to fully stand behind original design decisions, do this by fully thinking through all decisions	

Table G18. (continued)

Schedule Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Late decision changes	▪ Changes made in the construction phase impact the schedule more than they would if made in the pre-construction phase ▪ Late changes have a ripple effect Several changes create a lack of urgency among teammates ▪ There is a false expectation that drawing updates can be done in the same time frame in construction as compared to pre-construction	▪ Thoroughly review and come to an acceptance of drawings prior to bidding process ▪ If changes need to be made, do so as soon as possible ▪ Appreciate and respect teammate's time as this is added work, not originally budgeted ▪ Owner's team should make one large effort in change order review comments instead of multiple revisions and comments from multiple sources	"Something that may require 5 minutes to do during the [pre-construction] document phase may cost $20,000 and take two weeks in the field when it's requested later." "There are times the changes are so frequent it creates lack of urgency to respond to changes. As a subcontractor I tend to focus my efforts on those projects that are organized and where the contractor and owner have it together."
Late value engineering	▪ May positively impact the cost, but if performed too late will almost always negatively impact the schedule ▪ It is more challenging to scale back, rather than add extras	▪ Involve key trades early to contribute to design alternatives ▪ Start with base options for products and equipment and add enhancements if the budget allows	"In my experience value engineering is successful in getting costs within budget, but often at the expense of schedule."
Material choice	▪ Changing product and material types after initial approval takes a lot of time to reorder and rework	▪ Do not choose an initial product as a place holder, knowing you will review it in more detail later on ▪ Make complete material decisions early	
Scope changes	▪ 'Scope creep' occurs after design is complete Added scope with no extra time granted	▪ Fully design all scope items early in a project Do not add scope to project team members after original timelines have been agreed upon	"If extra time is not granted, trying to fit it in will incur more costs (overtime) or potentially reduced quality if work has to be done too fast."

Table G18. (continued)

Schedule Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Communication	▪ Teammates are unaware of schedule created between the owner and owner suppliers and subcontractors ▪ Meaningful information is not shared with the team quick enough ▪ Making changes with one teammate without informing the other teammates ▪ Too many steps (or people) for communication between project team and the owner's authorized decision maker	▪ Frequently update the entire project team on owner provided subs/supplier schedules and needs ▪ Eliminate a complex path of communicate between owner decision maker and project team	"Often times, responses from the Owner need to go through several user groups - enhancing the possibility of a communication failure and delaying getting a timely response to the contractor."
Financing and budget issues	▪ Funding and monetary delays push back the overall project schedule	▪ Before committing to the project and the project team, secure proper funding to support the project and team members	
Budget transparency	▪ Unclear expectations on expected deliverables for the project budget ▪ Missed budget line items for items such as move-in costs, furniture, equipment, and contingencies ▪ Unrealistic desire to cut the budget without cutting scope ▪ Unclear budget goals lead to over design, which then leads to re-design and delays the schedule	▪ Start lean, add more scope if the budget allows ▪ Understand the difference between design costs, construction costs, and project costs	"Owners often start off asking for a lot of 'wants' or 'desires' for a project. Architects deliver plans to meet those expectations, but when budgeting exercises come into play, owners want to cut cost without cutting much from their wish list. It's a very difficult and time consuming process that doesn't serve any members of the team very well. Start lean; add more when possible."

Table G18. (continued)

Schedule Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Funding delay	▪ Project should not start without secured funding ▪ Securing funding often takes more time than initially anticipated, plan for longer funding securement periods	▪ Secure proper funding for a project before having team members spend, or potentially waste, their resources	"An Owner should never start a project until the contract amount including an amount for contingencies is fully financed."
Payment delivery	▪ Contract payment terms always need to be honored Design drawings may not be released to an owner if payment terms are not met	▪ Always honor contract payment terms Avoid putting teammates in tough positions to work 'in good faith'	
Lack of construction knowledge	Owners lack of experience or knowledge related to specific construction topics can delay the projects schedule	Perform research outside of projects to further expand construction knowledge	
Construction flow	▪ Trades have been asked to perform work out of proper construction order for unknown reasons other than by owner request	▪ Become familiar with typical work flow patterns	
Inability to read plan drawings	▪ Owners are often unaware of how the project will look in person until it is constructed	▪ Spend extensive time reading and reviewing plan sets and specification books ▪ Walk through each area in detail with project teammates, ask clarifying questions ▪ Request/pay for added 3D/VDC drawings to help visualize the project outcome	"If the Owner does not do a thorough review of the design (before starting construction) and does not understand the design concept, they will walk through the building as it is being constructed and see details or layouts they do not like causing cost increases for re-work and also delays to the schedule."

Table G18. (continued)

Schedule Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Project costs	▪ Owners do not have a general sense of how much project components cost	▪ Perform research on typical equipment and materials to understand which products are possible options	
Unrealistic schedule	▪ Unrealistic time allotted to design a project to meet specifications ▪ Projects with unrealistic schedules are setup to fail ▪ Pre-construction items such as permitting, design, and funding often take more time than expected	▪ Research comparable projects for schedule expectations ▪ Review past projects to estimate project activity durations ▪ Become familiar with the specific project permitting steps prior to beginning the process ▪ Meet with project architects and engineers to discuss extended/proper design time costs versus the costs of a more conservative design ▪ Extended design schedule can lead to less conservative designs which can lead to high construction cost savings	"Owner's develop design and construction schedules arbitrarily to fit their business goals without honest and informed input from design and construction professionals. Once these professionals are brought on board they feel that they cannot correct the owner's arbitrary schedule for fear of being replaced by another firm that is willing to commit to anything to get the job. This leads to a spiral of unattainable dates, conflict and the sacrifice of quality and safety for the sake of schedule."
Owner expectations	▪ Project goals and priorities are not outlined ▪ Too often the project team has to guess what the owner's expectations are for equipment and design ▪ Unclear expectations lead to re-design	▪ The owner's team should prepare a written documents of project goals, priorities, and expectations ▪ Do not ask or expect team members to work on projects without compensation	"The selection of a project team, can be cumbersome and often hard to navigate. Some project owners are requiring architects and contractors to provide design work, construction estimates, schedules without compensation. This is incredibly hard on the construction industry and limits the selection pool of teams to those that have the resources to chase a project, often resulting in direct costs to the team in excess of hundreds of thousands of dollars."

Table G18. (continued)

Schedule Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Owner rep	▪ Owner reps without decision making authority cause road blocks in schedule Owner and owner rep communication is not performed in a timely manner	▪ Provide the project team's owner point of contact with the ability to make official project decisions Limit the number of reviewers needed for final decision making	"Owners often have a complex project approval process which often delays key activities which impact projects. Project schedules need to allow for the unexpected and all the float cannot be taken away during the project approval process."
Owner responsibilities	▪ If not performed correctly items, or tasks, that project owners are typically responsible can delay a project	▪ Place proper management resources on tasks that would be considered to be owner responsibilities	
Concept and space plans	▪ Complete and detailed pre-planning, organized programming, and project needs are not provided to designers indecisiveness on programming and site selection delay valuable project schedule timelines	▪ Prepare detailed programming before beginning a project ▪ Programming should include types of spaces, size of spaces, adjacency requirements, and any plans for future growth	"When more detail is provided, the architect team can more quickly & efficiently prepare plans to meet the owners needs with fewer revisions."
Decision making	▪ Decision making is drawn out and put off too long	▪ Decisions should be fully thought through but made in an efficient manner ▪ Avoid changing prior decisions	

Table G18. (continued)

Schedule Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Move-in	▪ Contractors are not always included in the coordination of furniture, fixtures, and equipment (FF&E) Project team is not aware of 'smaller' activities occurring on site prior to the official move in date	▪ Perform dry runs of the move-in process to ensure a smooth official move ▪ Performing dry runs for technology is especially important ▪ Include the contractor in all FF&E conversations and coordination Move-in milestone dates need to be made clear and early	"Examples include the need to have the server or network room 2 weeks prior to substantial completion, the need to begin racking or stocking with product in advance of move-in. Clarity on exactly what is required and when is extremely beneficial on projects with aggressive schedules."
Participation in design	▪ Some owners are unaware of the actual project design until after it is built ▪ Owners see the products in person and then request changes that could have been avoided if they participated in the design	▪ Active owner participation eliminates the need for changes later on ▪ Designs should be reviewed promptly and thoroughly	

Table G18. (continued)

Schedule Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Suppliers and subcontractors	▪ The Owner and contractor need better coordination on each other's suppliers and subs timeline and scopes ▪ Expectations and needs from owner suppliers and subs need to be made clear to other teammates ▪ Owner provided suppliers and subs are brought on the project too late ▪ Underperformance of owner provided suppliers and subs create more work for the project team ▪ Owner suppliers and subs often hold major importance in successfully achieving a certificate of occupancy	▪ Aid in the communication between the project team and owner suppliers/subs ▪ Perform proper due diligence when hiring suppliers/subs	"When the Owner purchases major equipment (such as gas turbines, steam turbines, etc.) and assigns to the construction contractor, the equipment delivery to the site may be set at a date that is comfortable to the supplier but does not support the overall project construction schedule."
Request for Information (RFI)	▪ Delayed response to project RFI's cause schedule delays	▪ Respond to RFI's promptly	"During the project, there are RFI's or design decisions to be made regarding certain aspects of the building which the Architect will defer to the Owner. Not making quick decisions can delay a project or cause the project to be built out of sequence."

Table G18. (continued)

Schedule Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Owner deadlines/timeliness	▪ Missed project owner deliverable dates can cause major schedule delays ▪ Often these missed owner deadlines do not reflect in added time for the project team ▪ Owner's noncommittal of hard and fast deadlines may delay the schedule for other team members ▪ Missed deadlines by the owner cause less incentive for team members to meet their own deadlines	▪ Meet all contract defined deliverable dates ▪ If dates cannot be met, inform the project team immediately	"I'll have my material on site on time per the schedule, but the building will not be ready for me to install my products."
Scope definition	▪ Project bid documents are increasingly becoming less detailed ▪ More accurate schedules can be produced by having greater scope detail ▪ 'Finishing' the design in the submittal review process is unacceptable ▪ Too often do owners believe it is ok to select building finishes late in the project schedule	▪ Clearly define which project team member is in charge of securing project permits ▪ Meet with the project team to all discuss and identify scope gaps ▪ Provide designers with as much detail as possible ▪ Finalize bid package details prior to the bidding process	"Sometimes project owners are vague or unclear about what their expectations are for the systems we are designing, leaving us to guess at elements of our design. This can result in project delays due to needless redesign of hvac systems"
Site delivery	▪ A change to the project start date results in significant effects on a project schedule	▪ When determining a site delivery date, make sure that day is feasible and perform all measures to deliver the site on time	

Table G18. (continued)

Schedule Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
*Example: site delivery	▪ "When discussing the project schedule with the owner, the owner promised to turn over the project site for construction on a certain date. The owner falls through on delivering the site on time and the construction cannot begin."	▪ Prepare documents to secure the project site early ▪ Provide extra focus on items that may hinder the ability to turnover the site to construction	
Time between contract award and state date	▪ The contract is awarded too close to the project start date, not allowing teammates to properly plan for their work ▪ Construction cannot begin on the requested start date if the project is awarded too late	▪ Discuss proper timelines with team members to understand how much time is needed to begin construction after awarding contracts	"The owner does not realize the time required to complete the design, permit process through the city, and the fabrication lead times in order to mobilize to the site."
Moving the original state date	▪ Subcontractor staffing becomes a problem with a continuously changing start date ▪ Weather may play an effect on the schedule length due to an adjusted start date ▪ The expectation is to start construction on time, yet design is still incomplete ▪ The start date is delayed without any extra time given to the completion date	▪ If the start date is delayed, adjustment to the budget or project end date needs to be made ▪ Design-Build delivery methods allow for designers and contractors to hold each other accountable for construction start dates	"Delays by the Owner due to unrealistic timelines in securing project financing, construction permits, government approvals, obtaining right of ways, etc. can cause project delays or require schedule compression if the project completion deadline is set."
Stakeholders	Stakeholders or end users of a space are often not brought onto the project until late in the project	Involve building occupant/managers in early design to avoid re-design later on	

Table G18. (continued)

Schedule Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Submittals	▪ Delay in reviewing submittals, or lack of review may cause schedule delays	▪ Place the submittal process as a priority, as the results can significantly affect project scheduling goals	
*Example: submittal approval	▪ "When submittals (specifically product samples) are sent to the owner, there is a requested deadline for owner response of approval or rejection. Yet owners frequently miss those deadlines, requiring multiple follow up requests. This can delay the schedule and materials can be sold out or arrive late."	▪ Complete submittal review quickly and by the agreed upon deadlines to avoid schedule delay	
Owner review	▪ Never ending feedback (back and forth communication) pushes back the installation schedule ▪ Owners often miss deadlines for submittal review, or the review process is ignored ▪ Owner has architects and engineers review submittals that they should also be reviewing	▪ Limit submittal review to one round of comments/requests ▪ Limit the number of owner reviewers - Many people may review, but only one comment/approval document should be sent to the project team ▪ Work with designers to determine a list of submittals each team member should review ▪ Provide proper staffing to allow for complete review of project submittals Use 'approved as noted' instead of 'revise and resubmit' whenever possible	

Table G18. (continued)

Schedule Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Teamwork	▪ Poor team dynamics can cause avoidable delays	▪ Select a high functioning team ▪ Higher levels of teamwork and trust produce quicker project results	“Adversarial relationships can delay projects and drive up costs”
Unknown site conditions	▪ 'Small' site fixes are not performed early, in an effort to save initial costs. This almost always leads to huge delays and costs later on.	▪ Perform proper proactive tests on a site prior to the start of construction	"Subsurface access can refer to not relocating utilities or getting rid of obstructions "we will see how bad it is when you get there" can lead $10's of thousands in delays and lost time where some proactive work can go for 10% of those delay costs"
Work breakdown structure	▪ Not all projects use a work breakdown structure	▪ Involve all team member when creating a work breakdown structure	

Project Goal "Cost" Owner Inefficiencies

Table G19: Project Owner Inefficiencies that Negatively Affect the Project's Cost

Cost Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable Participant Quotes
Architect's fee	▪ Architect's design time is not unlimited ▪ Owners often ask designers to reduce their fee without reducing the desired scope	▪ Review fee contract language to understand time commitments and scope inclusions	"Architects are faced with the choice of losing any profit on the project or crating conflict with the owner/client"
Bid packages	▪ Contractors should be used to help review and create project bid packages ▪ Typical bid packages can vary on geographical location, some owners use the same ones for all projects	▪ Review bid packages in detail to eliminate any redundancies or gaps prior to receiving bids	
Budget	▪ Project budgets are almost always missed after design is complete	▪ Design with the project budget in mind, do not wait to see if the design fits the budget after it is complete	
Expectation of budget	▪ Unclear budget goals will cause designers to create projects out of the desired cost range ▪ Ill-defined budgets cause major value engineering requirements later in the project	▪ Provide budget goals to designers before design begins	"Design proceeds based on owner's direction on program requirements and it is later determined that the cost is outside the owner's budget expectations."

Table G19. (continued)

Cost Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable Participant Quotes
Insufficient budget / Contingency	▪ Higher design contingencies need to be budgeted early in the project Some owners are not aware the project itself will cost more than just the construction costs ▪ Projects are continuing with less contingency, while also proceeding with less finalized design details ▪ Contingencies are cut to save funding costs but are often too small to support the project	▪ Include a proper design contingency based on the level of design completeness	"They want the perfect project, but don't want to spend the money on it" "It seems that clients are increasingly proceeding with less and less contingency while designers provide less and less detail increasing the need for contingency funds to fill in the gaps as the design develops or when work in the field must be added to fill gaps in the design."
Changes	▪ Too many changes occur on the project that then affect a project's and project team's costs	▪ Reduce the quantity of changes on a project for teammates to have a better change to stick to cost goals	
Change orders	▪ Change order pricing is reviewed after the change is made in the field causing cash flow issues for teammates ▪ Changes negatively affect general conditions which rarely get compensated in change orders	▪ Prior to requesting a change order, discuss the effects of the change with the project team	"Change orders are bad for everyone and they usually increase every team member's cost. "
Added design time	▪ Making changes in the field without paying architects to update the drawings cause construction problems and cost more money to fix ▪ If the architects do make drawing changes, they rarely get paid for this added work	▪ Determine if any time designating to altering the design is included in the architect's fee ▪ Properly compensate teammates for their added time and efforts	"The project changed brick facade to stone in some areas. The Owner did not agree to pay the Architect to update the drawings. During submittal review there were comments to align window mullions with adjacent stone, but no-where to reference in the drawing where this stone was."

Table G19. (continued)

Cost Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable Participant Quotes
Design changes	▪ Changing products to save initial costs can actually cost more to re-detail or re-engineer the work ▪ Re-stocking fees are often overlooked ▪ Team members most likely will not be able to make up costs for lost production or work stoppage	▪ Prior to changing products or material, ask project teammates if there are any restocking fees	
Late design decisions	▪ Changes cost more in construction than they do in the pre-construction phase ▪ 'Scope creep' after initial design results in a missed project budget	▪ Fully think through and review all aspects of a design before teammates begin to order materials and begin work If a change needs to be made, do it as early as possible	"Many owners will come up with ideas for changes during/throughout the construction process. Often times they expect it is a simple change, however it can be difficult and expensive once the design is complete and construction is in place."
Scope changes	▪ Adding more tasks than original specified will increase the project costs ▪ Added scope with no extra time granted will result in higher costs (overtime)	▪ Review contract language in depth to understand the scope requirements/obligations for each team member	"A recent client requested a rendering of every space in the 40,000SF facility. He did not understand why we were requesting additional services. Our contract clearly stated that 3 renderings would be produced and they were requesting 15."

Table G19. (continued)

Cost Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable Participant Quotes
City approvals	▪ Re-work occurs when a city does not approve the design but construction has already begun	▪ City approvals need to be secured prior to construction as to not cause rework or fines	"the owners inability to commit to a hard deadline causes contractors to move ahead "at-risk" meaning if the city reviewing the documents doesn't like something, and it needs to be changed, but the contractor has already began construction, they are responsible for taking the hit."
Communication	▪ Costs may go up in order to fix the breakdown in communication	▪ All teammates need to be aware of project decisions, keep everyone in the loop	
Cutting corners	▪ Skipping vital steps to save initial costs, cause greater costs later in the project	▪ Invest in proactive steps to avoid major costs later in the project	"For example, if an owner wants a designed one without a full site survey to save initial costs, and then starts construction only to realize there are issues that cost more to fix than they survey would have cost. Same issue happens with hydraulic studies"
Decision making	▪ Time = money, delayed decisions create higher costs	▪ Make project decisions efficiently to save time and money	
Delivery, procurement, contracts	▪ Management and operation methods can influence the project cost	▪ Identify project priorities and goals when considering project method decisions	

Table G19. (continued)

Cost Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable Participant Quotes
Best value	▪ Best value bidding is not used enough on construction projects	▪ When hiring contractors, consider balancing business quality with bid price	
Delivery method	▪ Delivery methods have an affect on how the project budget is managed ▪ Design-Build should be considered more often and can be used as a value engineering option	▪ Perform research on best delivery methods for different types of project	"Design-build [...] creates opportunities in the design stage to improve performance, economy, and constructability"
*Example: contract price	▪ "Project owners do not properly review the scope of the low bid contract. The contract is then awarded to a low bid contractor that has significant gaps in the scope causing all other project team members to pick up slack, meaning material and labor that was expected to be originally included else ware. "	▪ If low bid is the chosen procurement method, it is important to review the lowest bid for scope items and identify any gaps	
Low bid, low fee	▪ Low bid does not imply the most qualified teammates will bid on the project ▪ Oftentimes engineering management or project controls are dismissed to save costs ▪ Engineering management and project control costs are typically insignificant and can save the project's overall cost down the line ▪ Low fee bids result in a more conservative design where the budget is not used efficiently	▪ Consider other procurement methods if possible ▪ If low bid is the goal, understand the low level of compensation teammates will achieve, implying less focus and time granted to the project	"More times than not, owners select a GC based on fee, when the RFP says quality craftsmanship, schedule, and budget are important"

Table G19. (continued)

Cost Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable Participant Quotes
Financing	▪ There is government assistance money available for developers, not all owners are aware of this money	▪ Research federal and state provided funds that may be available, this time and effort spent could bring benefits to the project funding goals	"There is a lot of government money out there for private development through grants and programs like TIFS. [Owners] could end up spending more money than needed."
Payments	▪ Teammates may increase their bid if they know an owner is typically late on their payments	▪ Adhere to contractor bid payments to eliminate unnecessary added costs	
Project team awards	▪ Team members are brought on the project too late	▪ Pre-plan the process for onboarding project team members	
Bring in team early	▪ Constructability issues occur when a contractor is not involved in the design ▪ Construction pieces that are fabricated on site are very costly, many of these could be pre-fabricated with contractor assistance	▪ Award contracts to the contractor team as soon as possible so they can aid in the design process ▪ Involve contractors to provide more complete designs prior to bidding	"The more planning that can take place upfront before the on-site construction, the smoother and more cost effective it will be for the overall project [team]."
Pre-selected team	▪ Pre-selected team members are made but the owner still has competitors put effort towards the project, wasting their time	▪ If pre-selected team members are made, do not waste the industry's time and money having others chase the project	
Lack of construction knowledge	▪ Owners have a strong business background with very little experience in construction work	▪ Continue education in construction related topics to better understand and contribute to the design and creation of the building	

Table G19. (continued)

Cost Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable Participant Quotes
Approved suppliers	▪ Limiting suppliers can drive up costs	▪ Only limit approved suppliers if absolutely needed	"Owners requirements for approved manufacturers with limited or single suppliers for certain equipment can create a non-competitive environment and drive up project costs"
Inability to read plan drawings	▪ Owners may be unaware of the final product they will receive if they cannot properly read construction plans	▪ Spend immense time walking through plans and specifications to understand all components of a project ▪ Ask project team members for guidance to read plan sets ▪ Designate time outside of the project to improve plan reading abilities	
Estimating	▪ Costs outside of construction are left out of project estimates, these costs can be major ▪ Engineering estimates are made with outdated information not current to the industry	▪ While performing engineer's estimates, work with the project team to create a list of agreed upon assumptions	"oftentimes, the owner does not have a handle on the "soft costs' required to complete a project - such as land cost, design fees, testing fees, and furniture."
Operating costs	▪ Payback and lifecycle costs should be researched prior to choosing equipment ▪ The occupant or manager of the building is not involved in design, so operation/maintenance needs are not considered early enough	▪ Prior to making project decisions, research payback and lifecycle costs for project equipment and materials Involve the occupant of the space when determining needs and equipment for each space	"Recently had an owner change equipment of a room after completion of project. The room did not have a drain it its original use as it was not warranted. New equipment and maintenance for the area needs drain for cleaning. Now adding that after the fact is more expensive."
Weather effects	▪ Weather can delay a project causing added costs Rarely will weather not affect a project, proper budgeting for impacts should be made early	▪ When planning a project, consider the time of year that construction will take place, and how the weather may play a factor	

Table G19. (continued)

Cost Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable Participant Quotes
Contract scope of work	▪ Owners expect all allowances include the 'full package', when some only designate material or install values ▪ Often contract scopes are not properly reviewed and owners become shocked later in the project ▪ Gaps in scope occur too frequently ▪ What is expected vs. reality is often missed due to a non-reviewed of contract scope	▪ Review allowance definitions too determine if they include material, delivery, install, overhead or only some of these components ▪ Take the time to properly read and review all contract scope language prior to signing	"It is critical that an owner fully understands what was bid in each scope of work."
Owner reps	▪ Owner reps are not in agreement on project decisions ▪ Owner reps create unnecessary project requirements (not made by the owner) driving up project costs	▪ The owner's team should have one representative to make project decisions, this person should be heavily involved in the project ▪ Employ representatives that will positively impact a project, not add a barrier between the team and the owner	"Owner's engineers, third party law firms, outside counsels, etc. can specify additional requirements and obligations with minimal value to the project and drive up the project costs if not evaluated closely by the Owner."
Owner responsibilities	▪ If not performed correctly items, or tasks, that project owners are typically responsible can delay a project	▪ Place proper management resources on tasks that would be considered to be owner responsibilities	
Suppliers and subs	▪ Proper funding for furniture, fixtures, and equipment (FF&E) is left out or forgotten about in initial project budgets ▪ Coordination is missing between owner and contractor suppliers and subcontractors	▪ Inform all team members of logistics and coordination efforts with owner suppliers and subs ▪ Create separate budgets for owner suppliers and subs (land, utilities, move-in, FF&E, etc.)	

Table G19. (continued)

Cost Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable Participant Quotes
Risk	▪ Transfer of the risk to the contractor is poor contract management ▪ Delaying the schedule outside the contract indicated timeline may result in increased market prices ▪ Owners make budgets for only known site conditions and fail to account for the risk of unknown conditions under the site	▪ Be aware that pushing risk onto team members will increase bid and contingency costs ▪ Union labor rates should be a risk sharing item among project team members ▪ Exclude tariff adjustments from a contractors scope ▪ Designate project team meetings to discuss and mitigate future risks	"Owners can inadvertently increase their cost exposure risk by not aligning overall project risks (geotech, hazardous materials, unforeseen site conditions, damages, errors & omissions, etc.) with how they are contracting out their projects causing potentially unnecessary, inflated contingencies and risk monies to be held by engineers, construction contractors, equipment providers, or EPC (Design-Build) firms."
Schedule	▪ Delays to a schedule will increase costs to all team members ▪ Improper timelines put unnecessary pressure on team members to produce quality results for owners	▪ Work with the project team to create reasonable deadlines and schedules	
Compressed schedule	▪ Accelerated schedules will increase costs	▪ If a compressed schedule is needed to meet deadlines, consider the option to pay overtime work Stacking trades to work in the same area does not save time or money, it just create more challenges	"A general contractor may be able to cover these costs from the approved GMP, though that still reduces the potential savings to the owner."
Scheduling work	▪ Multiple mobilizations are wasted costs to the owner and project team members	▪ Discuss mobilization costs with trade workers Minimize mobilizations and increase scope per mobilization	

Table G19. (continued)

Cost Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable Participant Quotes
Unrealistic schedule	▪ Designers are given too short of time frames to properly design a project	▪ Discuss the added benefits and costs of extended design times with architects and engineers	
Scope definition	▪ Design documents are being released for bidding and construction with improper and missing details ▪ The less detail that is provided in drawings, the less accurate the budget will be ▪ More pre-planning results in lower contingencies ▪ Certain products may cost more for speedy delivery if the scope was not originally defined ▪ Closed specifications do not allow for competitive bids	▪ Take the time to complete the designs before sending them out for bids ▪ Reduce the amount of assumptions contractors need to make, this eliminates cost variances ▪ Design-Build delivery method can provide assistance to the owner to minimize missing scope items	"The best pricing that an owner will receive is at bid time, after that the contractor knows that there is no competition on changes and is not motivated to provide competitive pricing."
Example: pre-construction documents	▪ "In an effort to begin construction as early as possible, the owner has not finalized on certain design decisions prior to the release of pre-construction documents. Contractors and subcontractors are then forced scramble in mid-construction trying to define all the incomplete decisions. Subcontractors may be booked and not taking on more work for the project, causing contractors to accept higher external invoices due to desperate measures. "	▪ Finalize designs before releasing them for bidding	

Table G19. (continued)

Cost Inefficiency	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable Participant Quotes
Participation in design	▪ Clear expectation of budgets are not made early so a designer must make their own assumptions	▪ Participate in the design to guide designers to stay on budget	
Urban renewal	▪ Some industrial plant projects have urban renewal requirements, these are presented as added work for the project team	▪ Urban renewal scopes should be considered separate contract projects and not added to current project scopes	
Value Engineering	▪ Late value engineering can actually cost more money than it tries to save ▪ A lot of time and money is spent performing value engineering exercises but then owner only accept a few minor options	▪ Do not ask a project team to create major value engineering options if the owner is unwilling to designate time and money into this process ▪ Be specific on which items are options to remove or reduce from the project scope	"Invest in ingenuity, you will be surprised at the results."
Example: value engineering	▪ "The less design time the owner allots to a project, the less opportunity to take advantage of value engineering. As an example, an engineer with narrowed design time may result in more conservative designs, causing an increase in material price. If owners had more experience with the benefits of value engineering, they might pay for more design time, saving high material costs."	▪ Engage in discussions with designers and contractors to weigh the costs and benefits of value engineering options Do not only base decisions off of the original 'sticker' price savings or cost	

Project Goal "Quality" Owner Inefficiencies

Table G20: Project Owner Inefficiencies that Negatively Affect the Project's Quality

Quality	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Changes	▪ Too many changes occur that affect a team's ability to achieve the projects quality goals	▪ Reduce the quantity of changes that occur on a project	
Change orders	▪ If a change occurs after initial design, the time is lost for effective planning and coordinating between trades ▪ Redoing work grants poor craftsmanship ▪ Change orders are bad for all team members, not only the owner	▪ Eliminate all unnecessary changes Allow a proper timeline for re-work for quality results	
Design changes	▪ Determining a product or material is of poor quality after originally granting approval	▪ Take time to review the products/material in full detail ("do your homework") ▪ Allow yourself to be content with the design decisions initially made	
Scope changes	▪ Typically a change in scope does not result in added time, work has to be rushed to meet deadlines	▪ Grant time extensions for added or changed scope of work	
Codes and standards	▪ Technical specifications can be unnecessarily complicated	▪ Keep them simple and standard Make references to outside codes and standards	

Table G20. (continued)

Quality	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Communication	▪ Owner design intensions are not communicated to the team in a clear manner ▪ Commonly, less professional services provide less frequent communication ▪ Poor quality team members have in the past stopped communication once they receive a contract	▪ Spend project money on high quality service members	
Cutting corners	▪ Some owners may risk project quality to save on project cost or schedule ▪ Cutting corners seems to always result in major costly fixes later in the project	▪ Follow all specification requirements to ensure project quality	"For example, if an owner allows the contractor backfills the trench in larger lifts than required by specifications, the quality of the subgrade will be impacted and may ruin the parking lot for the development."
Engineering work	▪ Oftentimes engineers are blamed for producing poor engineering work, when instead the design was of high quality but the installation was of low quality	▪ Understand the difference between high quality engineering work and low quality installation ▪ Assess engineering work separately to measure team member strength	
Focusing on costs	▪ Owners prioritize the cost of the material/product/service over the quality of it	▪ If cost is a priority, consider 'best value' over a low bid to include quality level criteria in decision making	
Choosing the "cheap" option	▪ Disregard for life cycle, maintenance, utility, and durability costs. ▪ Installing 'cheap' materials can have negative impacts on surrounding quality materials ▪ 'Cheap' products do not perform the same as quality products	▪ Research the benefits and costs of your products and materials Read reviews by past customers to determine if products work or perform as they say they will	"quality products make for quality craftsmanship"

Table G20. (continued)

Quality	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Payback and lifecycle	▪ Lifecycle costs seem to be a hard concept for owners to grasp	▪ Lower lifecycle costs is a good selling point for potential project buyers ▪ Include consideration for lifecycle costs improves future satisfaction with the project	"Cost is a major driver but the value added side of a selection that is sometimes more expensive gets ignored with unsophisticated owners. The quality and longevity of a more expensive system should be considered as an investment against the cheaper system and its potentially lessor life span"
Funding	▪ Sections of the project are halted due to lack of funding ▪ Quality is decreased due to piecing a project together as funding is secured	▪ Do not start a project until you have secured proper funding	"For example, not performing hydraulic analysis can often lead to quality issues with a site development and future flooding."
Hiring team members	▪ The professional level of team members and the phase in which they are added to a project has an effect on the quality of the project	▪ Hire high quality team members ▪ Hire project team members in the early phases of a project	
Bring team in early	▪ Designers and contractors are brought onto the project team too late ▪ Value is lost when team members are not brought in during project pre-planning ▪ Project occupants are often never included in the project team, or are brought in at the end of the project ▪ Project occupants point out major flaws in design that need to be changed for the project to function properly	▪ Constructability and design issues can be worked out early before construction is set to begin ▪ Gain feedback while making design decisions, instead of after the decisions are made ▪ Team members can give owners advice on product outcomes from past experiences	"Owners should leverage their team members for information to fully understand the limits of performance for specific materials, and the appropriate level of aesthetics that can be expected for each. This specifically relates to manufacturing techniques and limitations for man-made materials, and naturally occurring deviations in natural materials such as stone, wood, etc."

Table G20. (continued)

Quality	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Culture / Personalities	▪ Misaligned teammate cultures can allude to vastly different definitions of quality work	▪ In the pre-qualification process, consider the culture of potential team members ▪ Specifically ask potential team members their definitions for project quality and safety ▪ Insure specific team member personalities will work well together ▪ Be considerate of team members training new employees	
*Example: hiring team members	▪ "An owner who does not properly research project team member companies can hurt the remaining project team. All team members should be prepared and experienced to work on the given project. For example, if the architect hired has never designed a specialized project such as an ice arena, then the design may suffer causing all team members to suffer."	▪ Perform research on potential team member abilities, strengths, and weaknesses	
Low bid	▪ The team is only as good as their weakest member ▪ Low bids are often missing scope items ▪ Low bidders may not prioritize their company reputation or lasting relationships as much as quality bidders ▪ Owners are often unhappy with their project results on low bid projects compared to quality bid projects	▪ "You get what you pay for" - If you want a quality project, pay for quality team members Include a pre-qualification process to avoid low/inadequate bids Review the scope inclusions and exclusions for all bids	"When the project is being built using a low-bid method of construction, general contractors are forced to use the lowest bid subcontractors to be awarded the project. The low bid subcontractors often have quality or manpower concerns. If the low-bid method is used, the Owner should understand they are not necessarily getting the best performing subcontractors."

Table G20. (continued)

Quality	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Owner rep	▪ The further separated (more owner reps) the owner is from the project team, the less blame the owner takes for poor quality decisions ▪ Some owners reps add more barriers to the project than they aid in solving problems	▪ The owners reps working daily on the project with the project team need to have decision making authority ▪ If an owner rep is needed, hire a fully qualified and specialized rep	"There is often a disconnect with the Owner's officer (the person approving/paying for the work) vs. the Owner's Operator (the person who will run project) once it's completed. The Operator will have higher expectations than the Officer or the Contractor"
Pre-qualifications	▪ Not all bidding contractors may have the resources to properly complete the project	▪ Select team members based on qualifications, experience, and track record of similar projects	
HVAC	▪ Mechanical system lifecycle costs are not considered a priority	▪ Always perform research on mechanical system lifecycle costs ▪ Ask HVAC team members for support on researching mechanical systems	"While an extra cost now, it will save money in the long run"
Lack of construction knowledge	▪ Owners come into projects without proper knowledge of construction practices	▪ Owners should receive training (outside of their projects) on construction topics	
Industry norms	▪ Project team members have to teach owners about standard construction topics on the project ▪ Owners do not have a proper understanding of what makes a project have a quality construction phase ▪ Owner equipment specifications are outdated	▪ Owners should take time out of their typical hours to research construction practices and new technologies ▪ Clean up old specifications to make them up to date and relevant to current projects	"When we go to procure the equipment, we get quotes with the manufacturers base-line standard product that has more advanced/superior technological features; however they do not meet Owner contract requirements. The vendors are not able to even provide a product that meets the Owner requirements (e.g. manufacturer a car w/ manual windows). "

Table G20. (continued)

Quality	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Quality standards	▪ Owners expect perfection but only specify low quality equipment/products	▪ Understand what type of equipment or products are needed to meet your specific standards of quality measurement	
Inability to read plan drawings	▪ Owners expect certain levels of quality but are unable to determine if the plan sets represent their expectations ▪ Owners cannot read or understand plan sets ▪ It is very frustrating for team members to show items in plan sets and have an owner not even attempt to understand the plans on their own	▪ Take the time to truly learn your projects plan set to be able to verify the design and scope of work that will be provided	"That causes changes that can compromise quality due to coordination issues or inability to afford the original scope."
Material choice	▪ The type of materials chosen for the project have a large impact of the level of quality that project will produce	▪ Perform research on materials to ensure proper quality	
Dislike aesthetics	▪ Project quality is compromised through re-work ▪ Field workers are less likely to produce high quality results if they have to re-do something they have already installed ▪ "Equal or better" does not include aesthetics (personal preference), it only includes technical data	▪ Pay for additional renderings if you are unsure about the product by only viewing samples ▪ Spend time with the designers in the planning phase to completely understand the materials that will be installed on site ▪ If you approve a product in the submittal phase, do your best to be content with it later in the project	"We provided numerous examples, renderings, and small scale mock-ups for the client for a slat system we were purposing. It was approved unanimously by their board. When the material was installed in half of the facility, the owner decided they did not like the aesthetics of it. "

Table G20. (continued)

Quality	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
*Example: Dislike of material	▪ "An owner may not take the time to precisely review material options, causing dismay when the material or product is installed. Owners will then request rework with new products due to further review."	▪ Spend time with the designers in preconstruction to jointly approve material selections	
*Example: Ignoring quality of material	▪ "In an effort to save on cost, project owners ignore the quality standards of construction materials. Materials with short life spans or less durable materials cause rework, even after the project is complete causing disruption to occupants."	▪ Research the quality level of the product/material, not only the appearance of it	
Mockups	▪ Mockups are not provided for enough construction components ▪ Mockups are missing on many projects	▪ Go on site to review the first installation of major construction components to verify quality and performance ▪ Include mockups in major trades' scope of work ▪ Review mockups with the designers and contractors	
Research options	▪ Owners specify subcontractors to use certain products that are not the best fit for the intended purpose ▪ Owners use outdated products/equipment ▪ Materials are changed late in the project when an owner sees a different building with new products	▪ Walk though design inspiring buildings prior to the current projects design phase ▪ Explore new material/equipment options instead of always using the same products ▪ Research materials early in the project, researching them late does not help the team ▪ Bring in your project team early so they can teach you about new products to use	"A great example is a spec for egg shell paint on a Level 4 sheetrock finish on a wall or ceiling that has indirect lighting. If the Owner or Architect wants to see no shadows he should spec a level 5 finish"

Table G20. (continued)

Quality	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Review product data	▪ Materials are chosen based off good sales pitches for poor quality materials	▪ Read the product data for each material/equipment prior to approval	
Contract scope of work	▪ Owners vaguely review bids and contracts	▪ Read each individual line item in contracts and bids ▪ Make comments and ask clarifying questions ▪ Ask contractors what exactly is included in allowance costs	
Owner expectations	▪ Misalignment of expectations between the owner and the designers ▪ Varying levels of quality expectations between team members ▪ Not indicating quality and performance expectations early can cause contractors to bid the lowest price/quality	▪ Clearly, and in detail, describe quality expectations at the beginning of projects	"Failure to explicitly identify quality expectations of certain critical elements."
Owner Involvement	▪ Owners are not involved enough in the design decision making early in the project ▪ Owners are too surprised by the materials/products chosen during the construction phase, when they should have made these decisions earlier ▪ Owners do not attend contractor's pre-installation meetings with subcontractors	▪ Attend pre-installation meetings ▪ Involve yourself in design decisions ▪ If you choose not to be involved in design, do not change materials later on ▪ If you do not have time to be involved in the project directly, designate someone to give it their full attention	

Table G20. (continued)

Quality	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Quality control	▪ Some owners do not conduct any quality control checks ▪ Some owners purely rely on teammates for quality control ▪ The project team does not have any quality standards in place	▪ Hold all teammates to the same level of quality standards ▪ Hire third party quality control experts ▪ Create quality control plans with the project team at the beginning of the project	"They need to clearly define areas that need to be inspected for quality purpose as well as documentation."
Schedule	▪ Quality is impacted by both cost and schedule constraints	▪ Allow proper time and funds to complete the level of quality desired for the project	
Unrealistic schedule	▪ Time extensions are not granted for added scope or changes caused by the owner ▪ Deadlines are moved up without cutting any scope ▪ Teammates will compromise quality in order to meet compressed owner schedules	▪ Eliminate the 'just get it done' attitude	
Scope definition	▪ Early definitions of project requirements is often missing Incomplete plans occur far too often ▪ Owner has high expectations but only makes vague and incomplete definitions for scope requirements	▪ Designate good quality time to finish design documents to completion ▪ Define project requirements in the pre-planning stage	"The more time that can be given up front to complete the design build plans and material in an accurate way, the better the quality will be of the installation and the overall project."

Table G20. (continued)

Quality	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Specifications	▪ Specifications are reused from old projects and are outdated ▪ Manufacturers no longer make equipment that is specified by the owner	▪ Highlight areas that are above industry norms in regards to testing and acceptance criteria ▪ Update outdated specifications for each project	
Unproven technology	▪ Teammates are burned by the costs or added time it takes from the learning process of producing quality results from using new or unproven technology ▪ Expectations are for high quality results even when teammates are using unproven technology requested by the owner	▪ Allow teammates to account for risk for using new technology	
Value engineering	▪ Cutting components of the project to meet a budget goal without thought as to how those items may affect a project's quality ▪ Cutting costs of materials but still expecting high quality products ▪ Value engineering almost always delays the document release to project team members	▪ Determine a priority list before removing scope items or costs What should remain the same? Where is there area to cut back?	"[Value engineering] results in a [reduced] quality that may not be to the standard the design team was planning on."
Work coordination	▪ Some owners don't manage their owner subs/suppliers well so there is poor coordination with contractors' subs/suppliers ▪ Non-professional services hired by the owner may not know how to coordinate work on a job site	▪ Work with the contractor on how to manage all contractor and owner subs/suppliers ▪ Hire teammates based on their experiences and reputation from working well with other companies	

Project Goal "Citizenship Behavior" Owner Inefficiencies

Table G21: Project Owner Inefficiencies that Negatively Affect the Project's Citizenship Behavior

Citizenship Behavior	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Bidding process	▪ If an owner does not like the results from a group of bids they might just move on to a non-bidding contractor and tell them what price to bid to win the contract ▪ Relationships are damaged if teammates feel they are being used or their time is being wasted	▪ Allow for fair second chances or give teammates the chance to update their bid if they wish	
Bring team in early	▪ Team members that are not brought onto the job early do not get to contribute to determining project and team goals	▪ Bring the entire project team onto the project as early as possible to help define project goals and work on the design together	
Changes	▪ Unwanted changes by the project team hurts team morale ▪ Changes only seem to help the owner's goals and not the team's goals ▪ No one wants to redo work they have already done	▪ Only make changes if they are absolutely necessary ▪ Positively recognize teammates time and commitment to make your change possible	"Excessive changes/rework can reduce jobsite morale, but recognition of a job well done can raise it."
Design changes	▪ The final design never seems to match the originally bid design	▪ If changes are necessary, make them as soon as possible ▪ Try your best to be content with the original design	

Table G21. (continued)

Citizenship Behavior	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Late changes	▪ Owners take a 'backseat' approach in Design-Build that leads to major changes late in the project	▪ Participate in the design phase to contribute in approval of materials	"Owners all too often impact the Citizenship Behavior of the project by not approving changes timely which has a negative impact on the project as a whole"
Late value engineering	▪ Late value engineering will lead to late document release and less prep time for other team members	▪ Involve the whole project team early to contribute value engineering ideas	
Change Order Management	▪ Refusing to negotiate change orders or rejecting fair change order requests will hurt the project team members ▪ Owners push change order negotiations to the end of the project causing team members to take on the cost risks	▪ Be fair when working through change orders ▪ Work through change orders as they occur, not at the end of the project	"Owners can cause disruption to projects by being heavy handed through any change management process."
Character traits	▪ Some owners are not accountable for their own actions ▪ Not enough leadership shown from the owner on projects	▪ Follow through with your obligations ▪ Be the type of teammate you would want to work with ▪ Be a strong leader for the entire project team	"I know clients who tell their [designers] and contractors that they are fortunate to be allowed to work on their projects, still treat them poorly and request donations on top of it."
Communication	▪ Project team will hear nothing (silence) from the owner for extended periods of time ▪ Only certain team members are included in decision making ▪ Not all team members are informed regarding decisions that have recently been made	▪ When project decisions are made, inform all project team members right away ▪ Establish project team communication paths early in the project	"it is common for owners to have side discussions with contractors regarding project components or circumstances. The contractor proceeds per owner direction, but the architect is not updated. "

Table G21. (continued)

Citizenship Behavior	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Community connection	▪ Some projects have negative reactions from the local community or local governments	▪ Involve the community in positive ways to support the project ▪ Community support can reduce stress on teammates during struggles between the local government and the project team's goals	
Conflict resolution	▪ Teammates are blamed for not identifying complications under the project site ▪ Some owners pit teammates against each other in order to reduce blame on themselves	▪ Do not place blame on project team members for unknown site condition issues ▪ Request that the team works together to find solutions to project problems ▪ Lead the team not to get defensive over conflicts and instead work towards solving project goals ▪ Aid with solving problems that may seem to only affect certain team members	"Usually, if the issue is addressed immediately, the costs are negligible." "you helped me on this issue, I will help you on the next"
Expectations	▪ Owner expectations are not outlined, or not clear, to the project team ▪ Team members prioritize other projects that have clear expectations and agreed upon team goals	▪ Outline project team expectations for communication responsiveness ▪ If certain expectations are highly important tie them to rewards and incentives ▪ Hold meetings at the beginning of the project to determine all team member expectations	"These [expectation] sessions let all members state their concerns, most important items, as well as starting to build trust and relationships. A dysfunctional team will make a project almost impossible to complete successfully."

Table G21. (continued)

Citizenship Behavior	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Incentives	▪ Contractors are asked to find cost savings without any share in the savings	▪ Provide incentives for team members to save the project time and money	"On a recent project of mine, the Owner had us (the Contractor), and two separate entities that provided the equipment for a plant. The 3 entities had no contractual tie to each other. The owner provided an incentive that a bonus would be given to all 3 if the plant was running x days before the contract schedule. It was an all or nothing bonus so all 3 of us had to work together to make it work. We collaborated together even though we had no contractual obligation to do so."
Inflexibility	▪ Repeat clients use the exact same process and procedure for all of their projects, even if there are better options	▪ Explore the possibility of different delivery, procurement, and contract methods	
Lack of involvement	▪ Some owners are not involved in design decisions and are surprised by the results later in the project ▪ Citizenship behavior suffers when there is no leader on the team	▪ Be a leader on the project team ▪ Work with the design team members early to make project decisions together	"[Owners] don't know what is going on from an engineering standpoint so may promise something completely infeasible without communicating with the engineering team first."
Lack of construction knowledge	▪ Project team members constantly have to re-explain project components to owners who cannot read plan sets	▪ Dedicate time outside of the project to improve plan reading skills ▪ Hire owner reps to be the authority figure on items where the owner lacks experience/knowledge	

Table G21. (continued)

Citizenship Behavior	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Marketing	▪ Project team members are not allowed to install temporary signs on project sites ▪ Project team member names seem to be purposefully left off project marketing documents	▪ Allow team members to market their business while working on job sites	
*Example: marketing	▪ "Owners do not allow for the exposure of the project team in terms of marketing. Team member companies are often left out of project marketing events, or left off of project informational documents. "	▪ Be considerate of project team members' business marketing opportunities	
Owner rep	▪ Owner reps without authority cause barriers for the project team ▪ Not all owner reps can act as the 'leader' of the team ▪ Owner reps and the owner central office may not always been on the same page in terms of project decisions	▪ Hire highly capable owner reps to aid in areas that you are less experienced ▪ Remove unnecessary owner reps that do not support the project team	
Owner suppliers and subs	▪ Owners do not inform the project team about activities between the owner and their own subs/suppliers ▪ Information is presented to the project team too late, not leaving enough time for proper coordination	▪ Provide contractors with the details and information about owner supplied subcontractors early in the project ▪ Be stern with owner subs/suppliers to provide submittals on time	
Payments	▪ It is very harmful on teammates when the owners do not abide by the contract payment terms	▪ Always pay all team members according to the contract agreements	

Table G21. (continued)

Citizenship Behavior	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
*Example: project payments	▪ "Owners expect the project team to work continuously on the project even though the project payments are received late. This causes team members to must put their own company finances at risk."	▪ Always pay all team members according to the contract agreements	"The company's accounts receivable can be an incredible drain on the financial ability to perform as well as effectively bid and finance work."
Payment terms	▪ Owners are often late with their payments to team members ▪ Contractors take on great cost risk which is very frustrating ▪ Project team members may need to threaten or stop work on a project if payment terms are not followed ▪ Project team members need to pay for employee payroll whether or not they have been paid for previously completed work	▪ Always pay all team members according to the contract agreements	"Payment delay causes hidden costs to subcontractor. Late fees, penalty and interest charges" "The best way the Owner can show his appreciation for a team's performance is to pay per the terms of the contract"
Project planning	▪ Owners come to the project team with no plan of how they wish to operate the project	▪ Proper pre-planning can help produce a smoother and more successful project	
Teammate discomfort	▪ Owners have asked designers to save costs by failing to meet certain codes and standards ▪ Owners have asked team members to begin work without first signing contracts	▪ Always act in an ethical manor to reduce putting your teammates in uncomfortable situations	
Safety	▪ Some owners feel they do not have to contribute to safety on the job site ▪ Project teams with a poor sense of safety culture can lead to injuries or fatalities	▪ Do not request project teammates to do anything that could be considered unsafe ▪ Be an active member in producing a safe work environment	

Table G21. (continued)

Citizenship Behavior	Need for improvement / Effects of inefficiencies	Improvement Suggestion	Notable participant quotes
Team appreciation	▪ Some owners feel that paying team members is the only way to show appreciation	▪ Remember to appreciate and thank your team for their efforts ▪ Understand the complex problem solving they went through to provide your project ▪ Consider sponsoring team events or lunches to boost team appreciation	"Simple gestures (sponsoring a jobsite lunch, shirts, etc.) can go a long way with building morale on a jobsite. "
Teamwork	▪ Oftentimes project teams are only working towards their individual company goals	▪ Encourage all team members to work towards group team goals	"The entire team should be focused on what is best for the project, not advancing their own individual agendas."
Timeliness	▪ Missed deadlines or lack of response can hurt the project team's moral	▪ Meet all agreed upon deadlines Respond to team members in a proper timeline	
Decision making	▪ Indecisive owners can drag a project on and negatively affect project productivity	▪ Prioritize decision making when items come up within the team ▪ Ask your teammates for their input if you cannot make a decision quickly due to experience	
*Example: timeliness	▪ "Project owners are asked questions in weekly meetings and are expected to have answers or progress on responses by the following week. However, tasks are forgotten about and the project team suffers from lack of information."	▪ If you say you will follow up with the team on a topic in a meeting, be prepared to present that result at the next meeting or sooner ▪ Assign and document follow up dates and responsible parties to all open project items	
Trust	▪ Sometimes the project team is not honest with one another ▪ Trust is immediately lost when team members talk bad about one another	▪ Conduct goal alignment sessions at the beginning of projects to build trust and strong relationships ▪ Eliminate negative comments about team members	

APPENDIX H. NORMAL DISTRIBUTION PLOTS

Below are the plots of the survey responses from Phase 2 regarding inefficiency frequencies. The appropriate normal distribution is also shown on each graph.

Schedule Normal Distributions

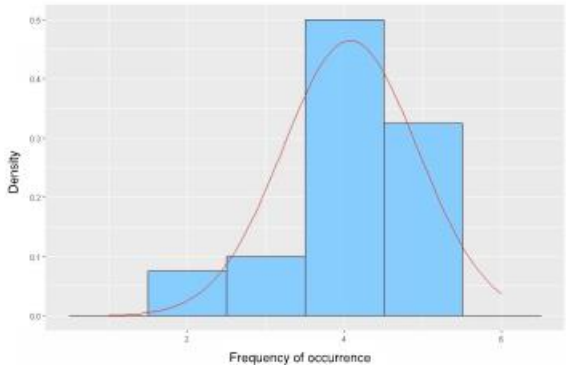

Figure H23: Normal Curve 'Schedule' Changes

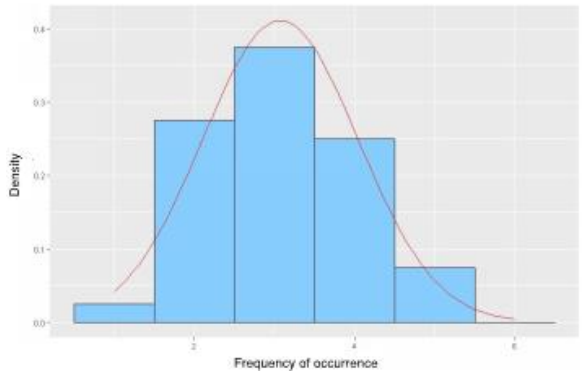

Figure H24: Normal Curve 'Schedule' Finance and Budget

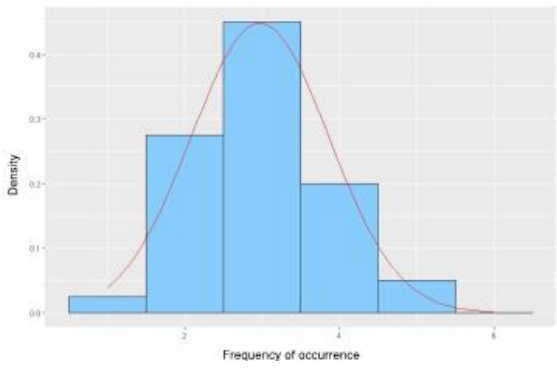

Figure H25: Normal Curve 'Schedule' Lack of Construction Knowledge

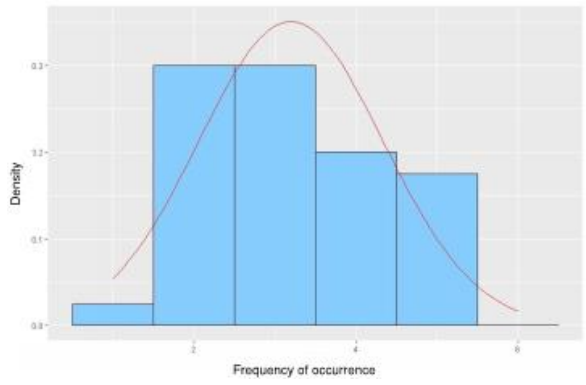

Figure H26: Normal Curve 'Schedule' Expectations

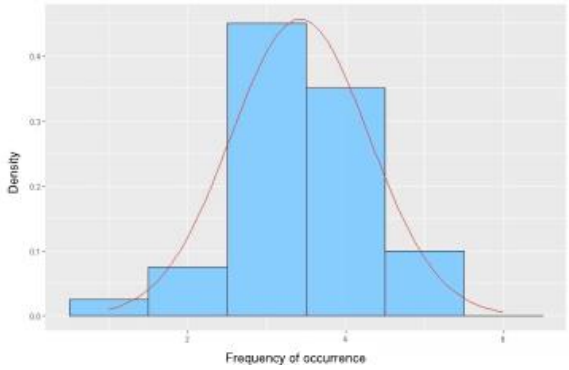

Figure H27: Normal Curve 'Schedule' Owner Deadlines

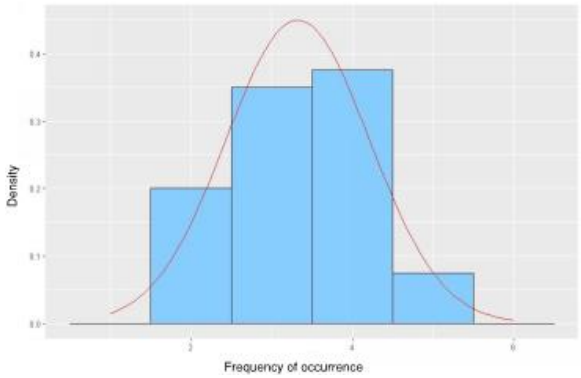

Figure H28: Normal Curve ‘Schedule’ Owner Reps

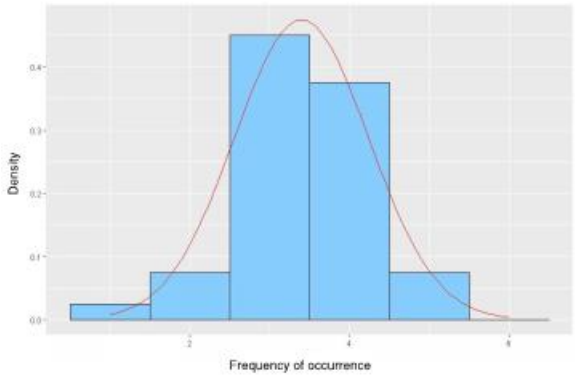

Figure H29: Normal Curve 'Schedule' Owner Responsibilities

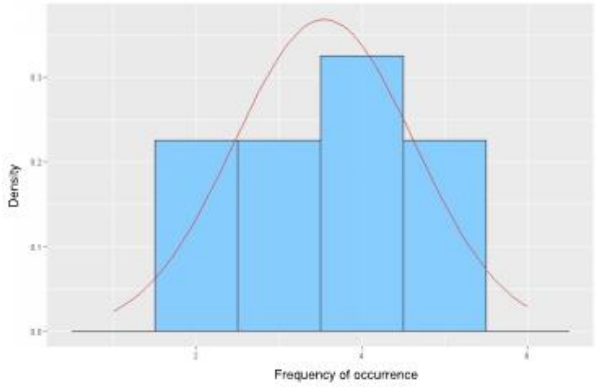

Figure H30: Normal Curve 'Schedule' Scope Definition

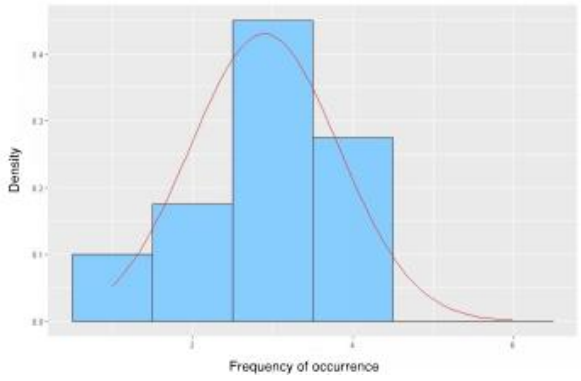

Figure H31: Normal Curve 'Schedule' Site Delivery

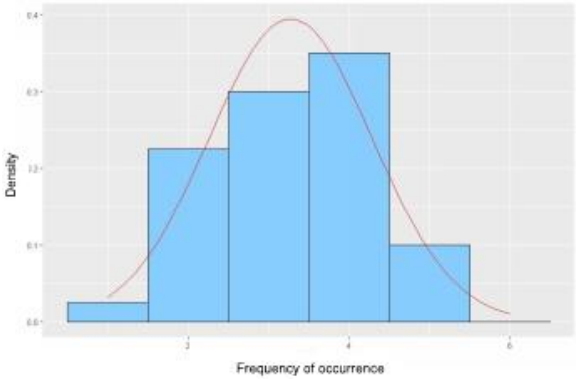

Figure H32: Normal Curve 'Schedule' Submittals

Cost Normal Distributions

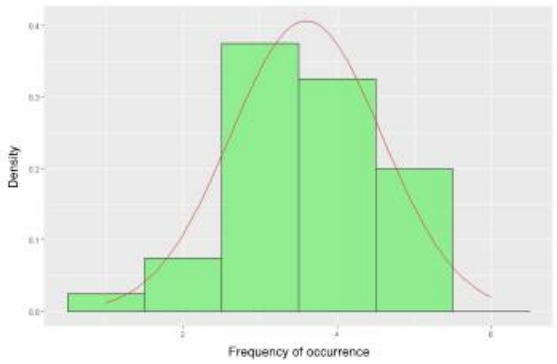

Figure H33: Normal Curve 'Cost' Budget

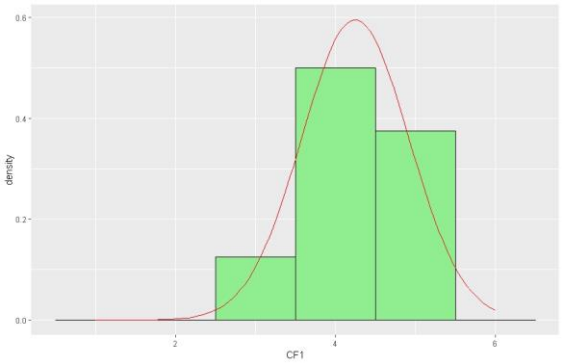

Figure H34: Normal Curve 'Cost' Changes

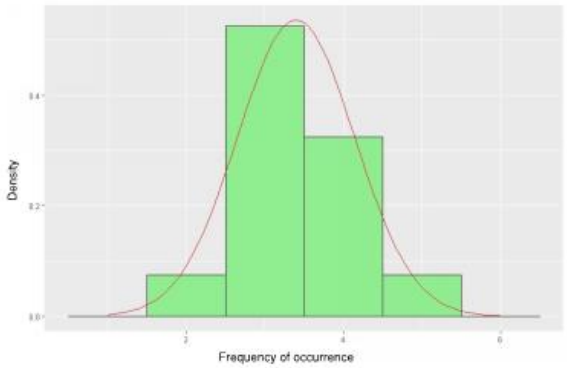

Figure H35: Normal Curve 'Cost' Delivery, Procurement, Contracts

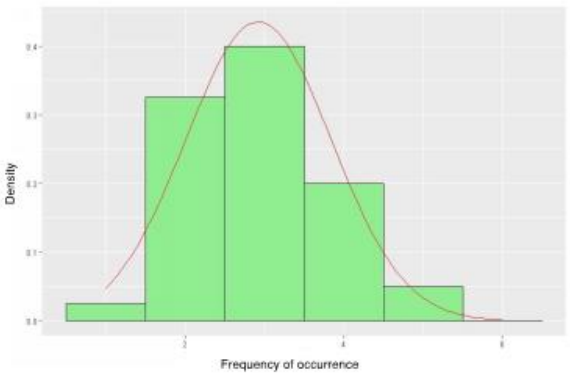

Figure H36: Normal Curve 'Cost' Hiring Team Members

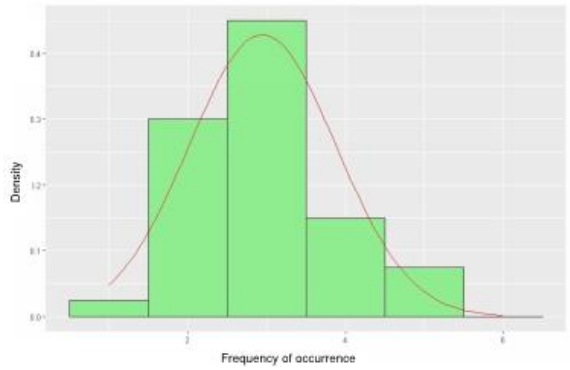

Figure H37: Normal Curve 'Cost' Lack of Construction Knowledge

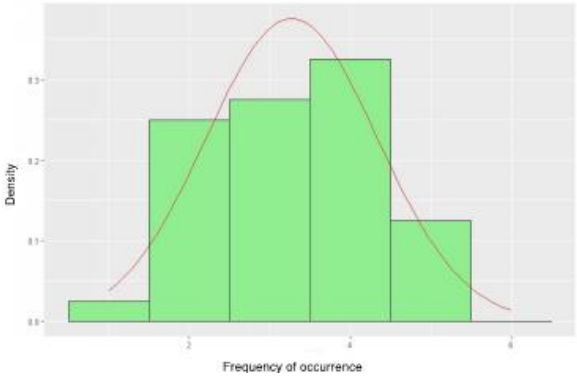

Figure H38: Normal Curve 'Cost' Risk

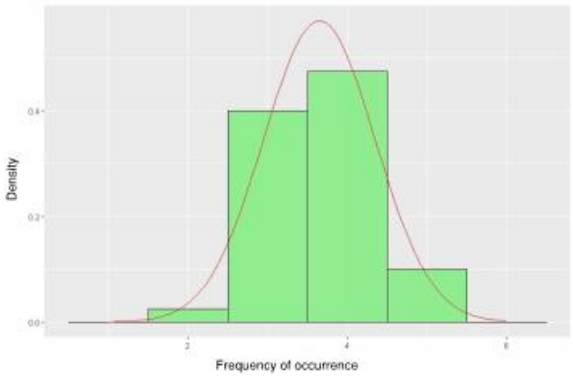

Figure H39: Normal Curve 'Cost' Schedule

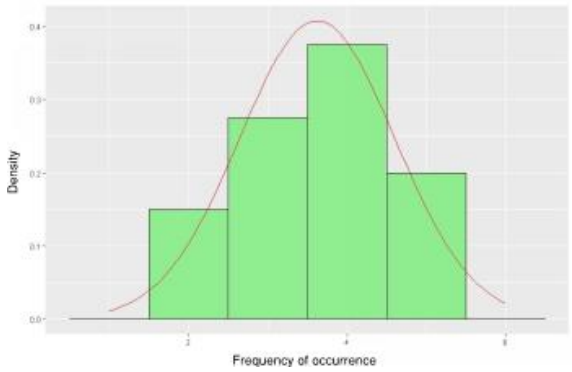

Figure H40: Normal Curve 'Cost' Scope Definition

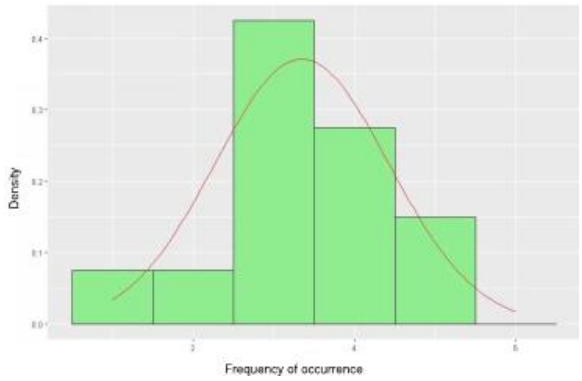

Figure H41: Normal Curve 'Cost' Contract Scope

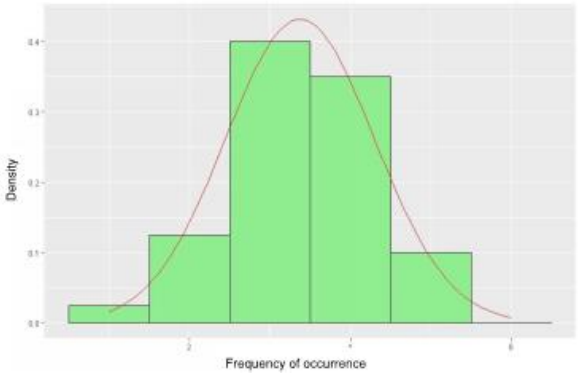

Figure H42: Normal Curve 'Cost' Value Engineering

Quality Normal Distributions

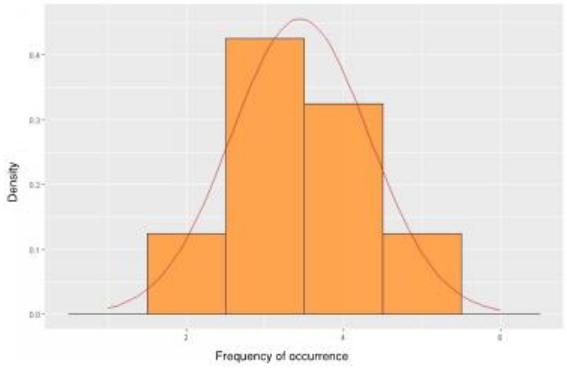

Figure H43: Normal Curve ‘Quality’ Changes

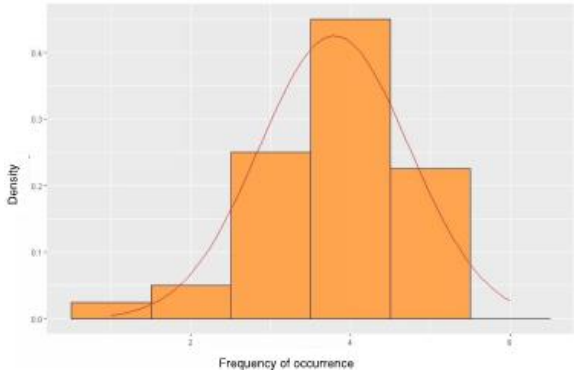

Figure H44: Normal Curve 'Quality' Focus on Cost Only

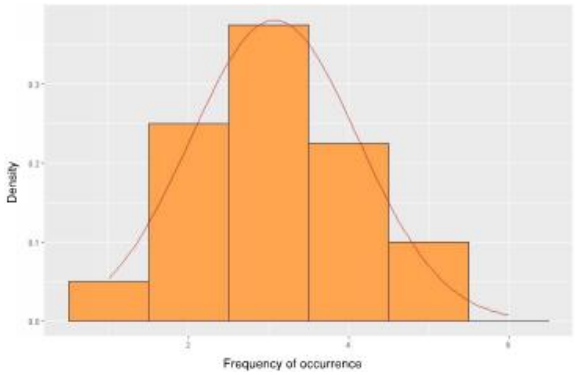

Figure H45: Normal Curve 'Quality' Hiring Team Members

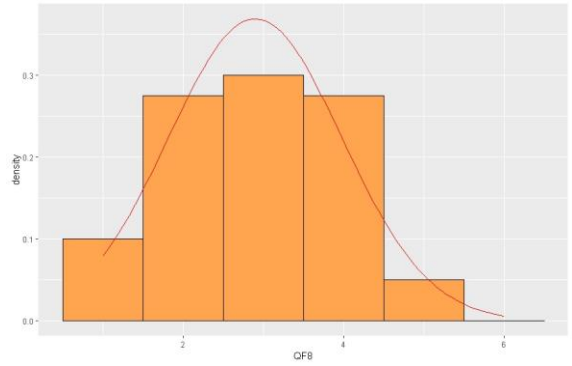

Figure H46: Normal Curve 'Quality' HVAC

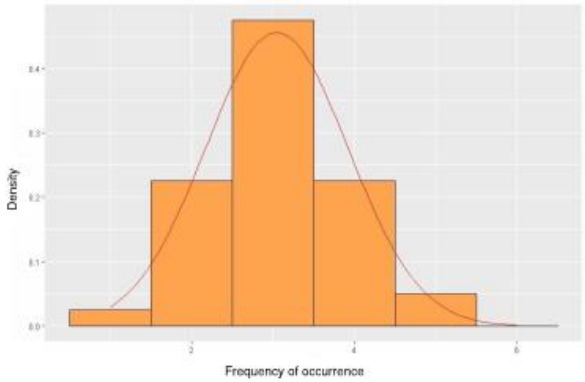

Figure H47: Normal Curve 'Quality' Lack of Construction Knowledge

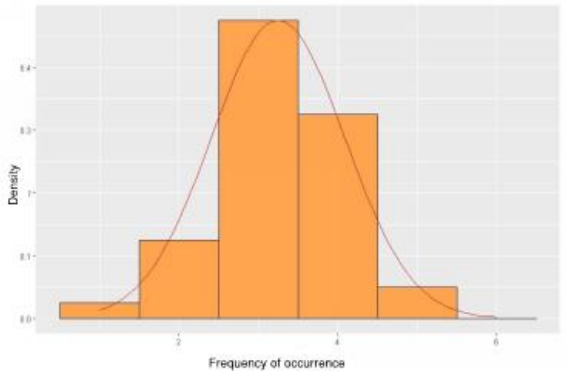

Figure H48: Normal Curve 'Quality' Material Choice

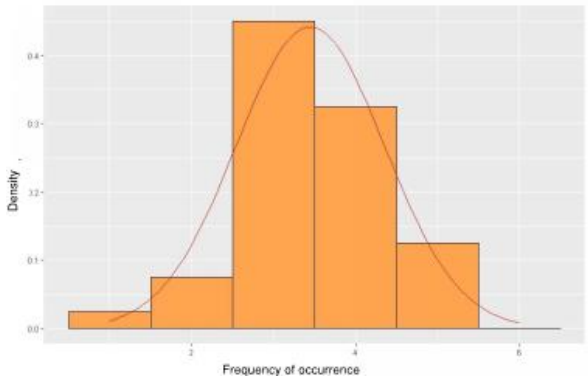

Figure H49: Normal Curve 'Quality' Quality Control

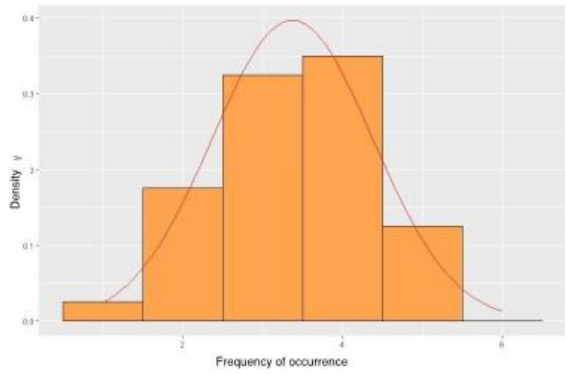

Figure H50: Normal Curve 'Quality' Scope Definition

Citizenship Behavior Normal Distributions

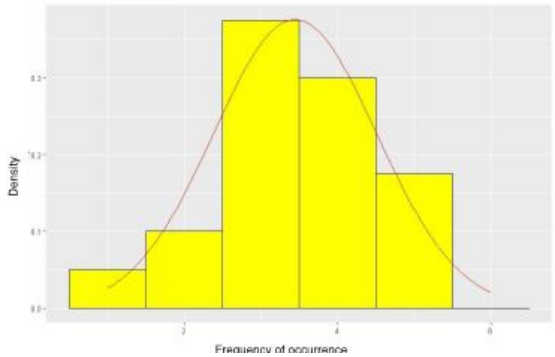

Figure H51: Normal Curve 'Citizenship Behavior' Changes

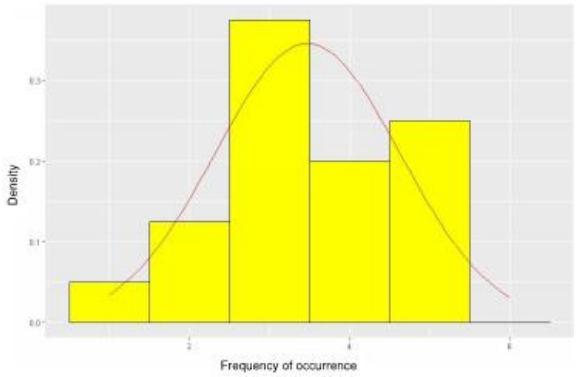

Figure H52: Normal Curve 'Citizenship Behavior' Character Traits

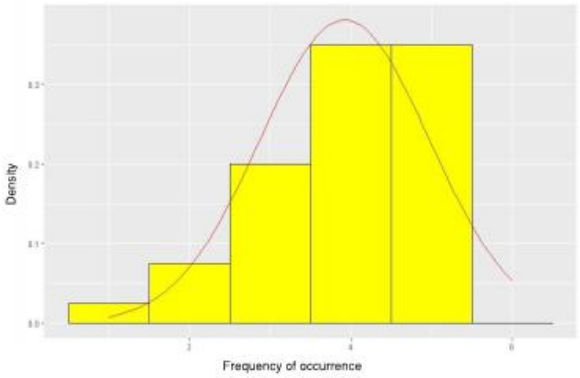

Figure H53: Normal Curve 'Citizenship Behavior' Communication

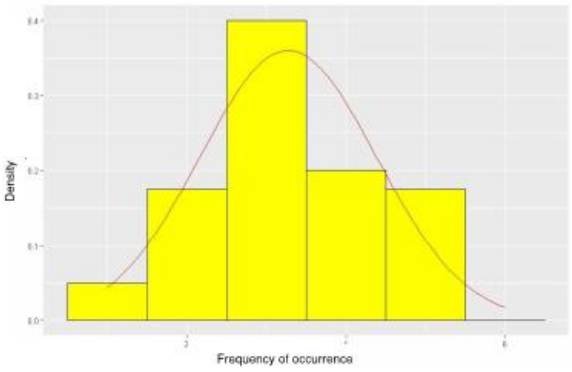

Figure H54: Normal Curve 'Citizenship Behavior' Expectations

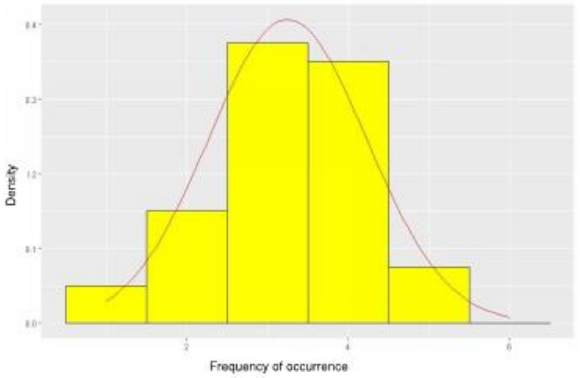

Figure H55: Normal Curve 'Citizenship Behavior' Owner Reps

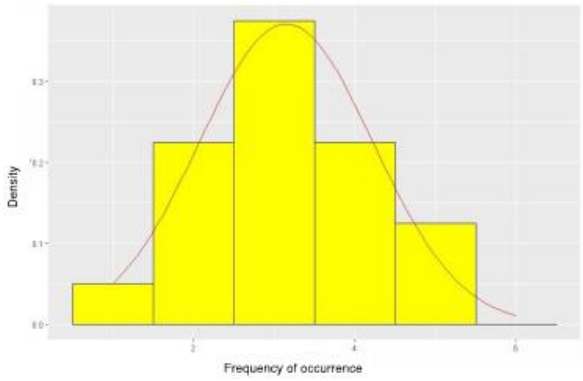

Figure H56: Normal Curve 'Citizenship Behavior' Payments

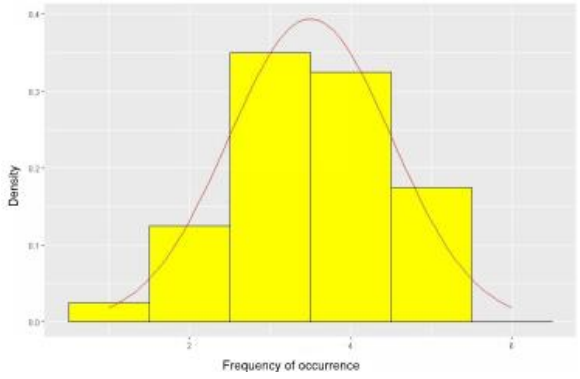

Figure H57: Normal Curve 'Citizenship Behavior' Teamwork

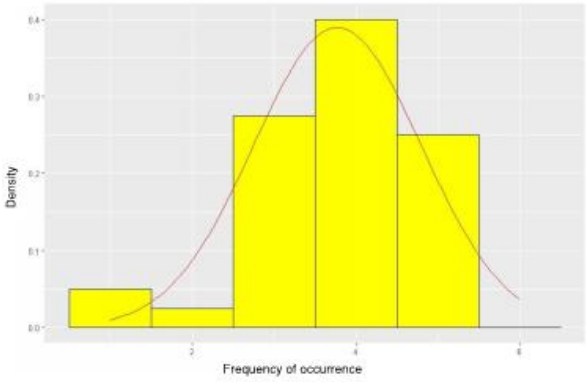

Figure H58: Normal Curve 'Citizenship Behavior' Timeliness

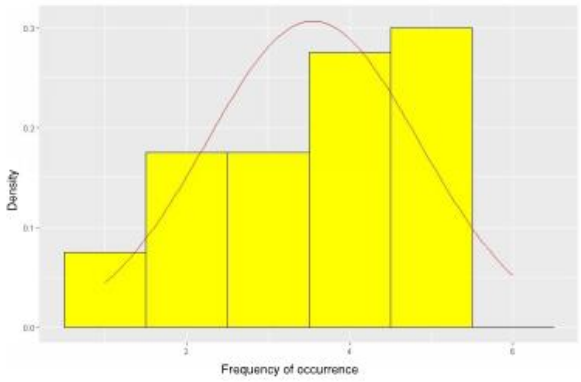

Figure H59: Normal Curve 'Citizenship Behavior' Trust

APPENDIX I. IRB APPROVAL LETTER

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
2420 Lincoln Way, Suite 202
Ames, Iowa 50014
515 294-4566

Date: 03/22/2019

To: Angela Christensen Jennifer Shane

From: Office for Responsible Research

Title: **Identifying the inefficiencies of private construction project owners that affect project goals.**

IRB ID: **19-106**

Submission Type: Initial Submission **Exemption Date:** 03/22/2019

The project referenced above has been declared exempt from most requirements of the human subject protections regulations as described in 45 CFR 46.104 or 21 CFR 56.104 because it meets the following federal requirements for exemption:

2018 - 2 (iii): Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) when the information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a LIMITED IRB REVIEW to [determine there are adequate provisions to protect the privacy of subjects and to maintain confidentiality of the data].

The determination of exemption means that:

- **You do not need to submit an application for continuing review. Instead, you will receive a request for a brief status update every three years. The status update is intended to verify that the study is still ongoing.**
- **You must carry out the research as described in the IRB application.** Review by IRB staff is required prior to implementing modifications that may change the exempt status of the research. In general, review is required for any *modifications to the research procedures* (e.g., method of data collection, nature or scope of information to be collected, nature or duration of behavioral interventions, use of deception, etc.), any change in *privacy or confidentiality protections*, modifications that result in the *inclusion of participants from vulnerable populations*, removing plans for informing participants about the study, any *change that may increase the risk or discomfort to participants, and/or* any change such that the revised procedures do not fall into one or more of the regulatory exemption categories. The purpose of review is to determine if the project still meets the federal criteria for exemption.
- All ***changes to key personnel*** must receive prior approval.

APPENDIX J. TEAM MEMBER SATISFACTION SURVEY

We are requesting your valued input on this brief survey.

When the survey refers to "project goals" this implies having a quick schedule, low cost, high quality, and effective citizenship behavior.

Citizenship behavior is defined as each team member's time spent working towards team goals, rather than only their individual goals.

Name:
(Option for Anonymous)

What impact do we have on achieving the project's schedule goals?

Often delay the project schedule	○	○	○	○	○	Often help accomplish a quick project schedule

Comments regarding our ability or inability to help produce an expedited project schedule:

_____

What impact do we have on achieving the project team's cost/budget goals?

Often produce added or unnecessary costs for the project team	○	○	○	○	○	Often help stay on budget or reduce the costs for the team

Comments regarding our ability or inability to help produce a low (added) cost project:

_____

What impact do we have on achieving the project's quality goals?

Often decrease the project's ability to achieve high quality	○	○	○	○	○	Often help to produce a high quality project

Comments regarding our ability or inability to help produce a high quality project:

_____

Citizenship behavior is defined as the ability to work towards team goals and not only on your personal goals. What impact do we have on achieving the team's citizenship behavior goals?

Often cause harm to the team's citizenship behavior	○	○	○	○	○	Often show positive citizenship behavior

Comments regarding our ability or inability to help produce effective citizenship behavior:

_____

How frequently do we make changes on our projects that negatively affect the project team ability to achieve its goals?

Almost Never	○	○	○	○	○	Almost Always

How satisfied are you with the frequency of changes that occur on our projects?

Very Dissatisfied	○	○	○	○	○	Very Satisfied

How do these changes affect your ability to achieve project goals:

_____

How frequently do we request unrealistic or compressed schedules?

Almost Never	○	○	○	○	○	Almost Always

How satisfied are you with our ability to develop realistic project schedules?

Very Dissatisfied	○	○	○	○	○	Very Satisfied

If dissatisfied, what do you find most difficult about our project schedules?

_____

How frequently do we develop incomplete or ill-defined project scopes?

Almost Never	○	○	○	○	○	Almost Always

How satisfied are you with our ability to develop completed project scopes prior to bid documents, or equivalent project milestones?

Very Dissatisfied	○	○	○	○	○	Very Satisfied

Which aspects of the project do you believe require further scope definition future projects?

_____

How frequently do we create unrealistic budgets for our requested project scopes?

Almost Never	○	○	○	○	○	Almost Always

How satisfied are you with our ability to define a realistic budget in relation to our project goals?

Very Dissatisfied	○	○	○	○	○	Very Satisfied

What could be improved to help keep the projects on budget?

_____

How frequently does our process for communication hinder, or negatively affect, project success?

Almost Never	○	○	○	○	○	Almost Always

How satisfied are you with our ability to conduct proper communication with you throughout the project?

Very Dissatisfied	○	○	○	○	○	Very Satisfied

How can we better communicate with you, and/or the project team as a whole?

_____

How frequently do we miss or alter deadlines that we have previously agreed to meet?

Almost Never	○	○	○	○	○	Almost Always

How satisfied are you with our ability to meet our own task deadlines?

Very Dissatisfied	○	○	○	○	○	Very Satisfied

How has our ability or inability to meet deadlines affected past projects?

_____

How frequently do we cause trust issues among the project team?

Almost Never	○	○	○	○	○	Almost Always

Do you believe we are a trustworthy project team member?

Not Trustworthy	○	○	○	○	○	Very Trustworthy

In which ways do you believe we are (not) worthy of your trust?

_____

How frequently do you believe we make project decisions based off the initial costs only (materials, equipment, team members)?

Almost Never	○	○	○	○	○	Almost Always

How satisfied are you with our ability to make project decisions in ways other than purely looking at the initial price tag?

Very Dissatisfied	○	○	○	○	○	Very Satisfied

What project aspects do you believe we need to conduct more research before choosing an option?

_____

What do you believe are our greatest strengths?

_____

What do you believe are our greatest weaknesses?

_____

Other suggestions for improvement:

_____

APPENDIX K. CASE I

Consequences of Late Value Engineering

Introduction

It was a late afternoon on a Friday in June, as Senior Project Manager Todd Hunter (names and locations changed for privacy) received a disappointing email from a local design consultant. Just last week, Hunter and his team had sent in a list of 20 cost savings opportunities for a large commercial project. The email correspondence he received had indicated that the project designer would only consider using less than five of the 20 options Hunter had submitted.

Hunter's team had been tracking this commercial project, initially called Project X, for approximately one year. He knew his team of skilled engineers could benefit the project's success, while also producing a healthy profit for his company, Clark Corp. Hunter knew that the project's owner would like to have the mechanical, electrical, and plumbing (MEP) subcontractors participate in the design stage to aid the local designer in creating the MEP systems. The Clark Corp. engineers and managers involved in chasing the project dedicated great time and effort into learning the ins and outs of Project X. The goal was to be as prepared as possible to immediately contribute to the design once they were awarded the contract.

As they were tracking the project, time began to drag on and Clark Corp. had still not been awarded an official contract to join the project. Initially, Hunter believed he would have a signed contract by the beginning of February. It was not until early June that Clark Corp had finally been awarded the contract. Now, two weeks later, the expectation was that Hunter and his team would still contribute to the design. Yet, now

that contribution became tricky, as most of the design had already been completed.

Hunter stood true to his word, and his team completed a lengthy cost savings list that could save Project X over $500,000. He submitted this list to the project owner and project designer for their review. As previously indicated, the project designer had written Hunter back indicating that they would accept less that five of the 20 options submitted. The choice of settling on less than five options was determined due to the fact that the design was too far along and it was not possible to make all 20 changes.

"Too late?" Hunter thought, he had submitted his cost savings ideas only one week after he had been awarded the contract. The project owner now needed to decide if he would rather stay on budget and significantly delay the construction schedule, or stay on schedule and come up with a way to increase the project funds.

Commercial Construction

Commercial construction is just one of the many construction sectors. Construction is split into various sectors to allow expertise and concentration among owners, designers, and builders. Typical building construction sectors include commercial, residential, industrial, healthcare, and education. Commercial construction primarily includes creating spaces for retail and offices. These spaces could be purchased to own and operate, or leased out to individual businesses.

Project Owner

The definition of a project owner can vary, even in the commercial construction industry. However, typically projects owners identify as "individuals, businesses, partnerships or any combination thereof" (Klinger & Susong, 2006, pp. 56). There are also three roles that the project owner could represent.

The first role is an individual or company that legally owns the property, and plans to occupy the space after project completion. An example of this could be a private company wishing to expand their office building to the neighboring property. The company would purchase the land and then use the building once the project is completed. The next role is for the owner to be a development company purchasing the land and funding the construction, with the intent to sell or lease the project at completion. In this case, developers would specialize in turning over empty land and creating projects that other entities wish to own or occupy.

The final option is for the owner to be the building occupant, while having no ownership rights to the land or building. The project would most likely be designed specifically for this project owner, however they would pay a contractual lease to the property owner, to occupy and use the space. This case would occur when an owner does not have the capital to construct the project, or does not want to take on the financial risk of owning the property. A separate private company may own the land, with no preference on design or function, but has the capital to fund the project and is interested in reaping the rewards of the leasing agreement. An example could be a large retailer in need of a new warehouse. The retailer may wish to only rent the property. The company that owns the land would allow the project to be designed based on the retailer's needs. Most likely there would be a long-term contract in place to provide the property owner with financial security.

The project owner is the legal representative and initial member of the project team (American Society of Civil Engineers, 2012). The owner chooses the remaining project team based on the project's needs. Ideally, the owner is researching contractor

and designer expertise to find the best possible fit in correlation to the project goals. Of course, each project has a unique set of goals, but typically they consist of having low cost, quick schedules and high quality of work (Clark, 2005). The owner initiates the project, bringing it into existence. All projects are conceived by the presence of a 'need' of space and function. The first responsibility of the owner is to determine what the purpose of the project is, and how the project will be used.

Once the project is selected and the intent is perceived, the owner's responsibility does not end there. Major decisions need to be made in regards to the project delivery system, contract type and procurement method (Levy, 2010b). These decisions help identify the remaining team members for the project. Oftentimes owners may not be aware of the benefits and faults of each pre-construction option. This can greatly influence the project's framework and can impact the success of project goals.

According to the American Society of Civil Engineers (2012), "the owner should be familiar with basic project management concepts and practices, such as preliminary planning, design, life-cycle cost analysis, peer review, alternative studies, value engineering, construction, contract administration, and the shop drawing review and approval process" (pp. 9). Owners are expected to contribute to the process throughout the design phase and construction phase, adding valuable opinions and approvals to the design and materials. Leaving the design solely to the architect and engineer can have severe consequences related to costs and schedules. Architects and engineers are capable of designing very unique and aesthetically pleasing results, however if the owner does not properly communicate his or her intentions, the design may quickly blow out of cost proportion.

In the case of Project X, Jason Withers is considered to be the lead owner, and point of contact for the development company PeriMax. Withers has worked at PeriMax for 12 years as a developer and has been the lead owner on numerous commercial projects. PeriMax is the developer for Project X, and they plan to continue to own and operate the building once it is complete. The company will lease out individual retail spaces in the building and receive rent.

Design-Build vs Design-Bid-Build

A project delivery method is a complete outline of the design and construction process for a particular project (Shane, 2018). The chosen delivery method will provide a framework for the contractual partnerships, and information and communication tunnels. The two most commonly used delivery methods are design-bid-build and design-build. Each method provides certain advantages and disadvantages, in which the project owner must weigh to choose the appropriate framework for the given project.

In the design-bid-build delivery method, the project owner enters into a contract with an architect and engineer. These designers produce plan sets and a specification book, which will be used by the owner to bid out the project to a construction company (Hale, Shrestha, Gibson, & Migliaccio, 2009). The owner then enters into a separate contractual relationship with the general contractor, who then hires subcontractors to perform various trade work.

In contrast, the design-build delivery method eliminates the separation of design and construction contracts. The owner enters into a contract with one firm who is considered a 'design-builder', where the company takes on both the design and construction roles. The company may also subcontract out missing design or

construction roles themselves to supplement their contract with the owner (Klinger & Susong, 2006). Either way, the owner is only bound to one major contract. A significant advantage to this method over design-bid-build is the streamlined communication between the designers and the prime contractor, since they would operate in the same company. The ease of flow for communication, and perhaps the incentive to better cooperate, may eliminate potential issues otherwise dealt with by the owner. To counter this point, the streamlined communication may also give opportunity to cover problems or withhold information that the design-builder may not want the owner to otherwise be aware of.

Oftentimes, design-bid-build projects have a longer project schedule compared to design-build, due to the added steps required to bring all project team members onboard, and the inability to begin construction until design is fully complete. By saving time on the project schedule, this proves as an advantage to the design-build method to save on project costs (Shane, 2018). As for the project owner's decision in the delivery method process, experience level will play a key role. Design-bid-build projects require owners to deliver complete and accurate plans to the bidding contractors, implying the contractor has no input into the project design (Shane, 2018). If the owner would like the designer and contractor to work together on design, as in design-build, the owner may be able to take a backseat role in the design and logistics development periods.

Clark Corp

Clark Corp is a mid-sized design-build mechanical, electrical, and plumbing (MEP) contractor. The company started as a small plumbing contractor over 50 years ago prior to expanding into the mechanical and electrical trades. When Clark Corp. serves as the

MEP designer, the company's typical project bids range anywhere between $100,000 to $5,000,000; whereas when the company serves as solely the supplier and installation subcontractor, projects bids can range between $20,000 to $3,000,000.

Clark Corp employs over 200 people, as they service the Midwest from four main offices. Headquarters is located in St. Paul, Minnesota, however the Iowa branch office services Project X, as the project is located in the eastern Iowa region. The MEP market in Iowa is relatively small, implying competitors and owners are all very familiar with each other's work. Therefore, business relationships become extremely important and can highly influence future work opportunities.

A central portion of the company's mission statement is to build long lasting relationship. Engineers and project managers at Clark Corp. understand that every opportunity to talk with industry members is a chance to perform business development. No matter what issues may come about on a construction project, their project teams would discourage any type of battles that could jeopardize the company's relationship with the project owners or other trade companies.

Project Owner Relations

There are two types of communication paths that Clark Corp. has with any potential project owner. The depth of interaction between the two parties depends on the type of delivery method chosen for the project. If the project is delivered as design-bid-build and Clark Corp. is hired as a subcontractor, this relationship is called 'owner indirect.' Likewise, if the project is delivered as design-build and Clark Corp. is hired as the designer and installer, this relationship is called 'owner direct.'

In the case of owner indirect, Clark Corp. is most likely contracted under a general

contractor who is hired by the project owner. The general contractor will be involved in all communication efforts, and rarely will the MEP subcontractor bypass this chain of command. These efforts have less day-to-day, or one-on-one, discussions between the MEP subcontractor and the project owner. However, while serving as the design-builder, Clark Corp. expects extensive one-on-one and daily communication with the project owner, especially in the design stage. It is important for the MEP designer to fully capture the project owners needs and expectations for the project.

Mechanical / Electrical Contracting

Clark Corp. has been hired as the mechanical and electrical subcontractor for Project X. Many components of MEP equipment are installed within the walls of a building and are unknown to the typical occupant. However, this equipment keeps the building 'alive and running' to fulfill occupant comfort and needs. Mechanical needs can highly vary depending on the construction sector of a project. Healthcare and industrial projects may require very expensive and complex systems, while residential and commercial equipment is less involved.

Mechanical systems include items such as the heating, ventilating, and air conditioning. Electrical systems include lighting, outlets, and supplying power to all the mechanical, fire sprinkler and some plumbing systems. Both mechanical and electrical equipment has a broad range of expenses depending on the range of quality, size of the occupied space, and the energy efficiency desires. Many of these choices are customizable, as major decisions need to be determined by a project owner. Mechanical and electrical designers will determine all the building needs as stated by qualifying codes and standards.

Senior Project Manager

Todd Hunter began his career as an electrical engineer after graduating with his bachelor's degree. He completed many successful projects during his eight-year reign as an engineer before being promoted to a project manager, and then senior project manager. Now, with 23 years of project management under his belt, Hunter is dedicating his time to be highly involved in Project X. At Clark Corp., project managers are involved in projects from 'cradle to grave.' The past year included chasing Project X in pre-construction, and now Hunter will be involved in overseeing the day-to-day operations of the project. Hunter's team includes himself, along with a senior engineer, an engineer-in-training, and a construction project coordinator. His engineer's will become less involved as construction on Project X begins, and then he will become the primary Clark Corp. representative for the project. He will manage the time and efforts of the on-site electricians, HVAC technicians, and laborers.

Awarding Contracts Early

There is great benefit into bringing a contractor and subcontractor onto a project early in pre-construction. Two primary efforts include contributing to the value engineering process and determining the constructability of the design. This option is not always viable to a project owner, as the contractor and subcontractors would most likely be hired out of quality standards and reputation, compared to specific bid values. Since the project design would, by intent, not be complete, the contractors could not bid on specific content of the project. Instead, business relationships play a large part in awarding contracts.

Value Engineering

It is not uncommon for a construction project to be estimated higher the ideal budget in the pre-construction phase. Oftentimes, project owners desire impressive, innovative, and lavish buildings, but do not have the funding to support these aspirations. The Whole Building Design Guide of the National Institute of Building Sciences defines value engineering as a "creative, organized effort, which analyzes the requirements of a project for the purpose of achieving the essential functions at the lowest total costs (capital, staffing, energy, maintenance) over the life of the project" (Cullen, 2016).

Some key elements from this definition include the achievement of essential functions and the cost savings over the entire project lifecycle. Value engineering does not simply imply the team should cut the most expensive portion of the project, because that component may be a major piece that adds to the everyday function of the building. Project teams, primarily project owners, need to determine which aspects of the project are considered 'needs' and which are considered 'wants'. A 'want' is something that could be eliminated if necessary, however the project 'needs' should be analyzed in depth to determine alternative options for various products or installation procedures.

Project lifecycles costs can be vastly overlooked by an owner's looming necessity to meet initial project budgets. A project owner must work tirelessly with banks, lenders, or investors to come up with the money to fund the project. This is inevitably a long and challenging process. Yet, the initial sticker cost of the project could only end up being less that 30% of the total project life cycle costs (Smith, 2018). Energy consumption, equipment maintenance, and product replacement are common costs that occur after the construction portion of the project is complete. These costs continue to grow, so long as the building is up and running. Performing in depth research on equipment and materials

in the pre-construction phase can help save some of these post-construction costs, even though they will initially cost more than competing products.

As shown in Figure A38 in the Case Appendix, the value engineering process can be performed at any stage in a project, however the monetary benefit of the process is dramatically different. The earliest attempts of value engineering will bring the most financial assistance to the project; while finding alternatives once the project has already been designed can either be irrelevant to saving costs, or actually hurt the project budget.

Constructability

The term 'constructability' speaks for itself; can it be built? The Construction Industry Institute (CII) describes constructability as "the effective and timely integration of construction knowledge into the conceptual planning [and] design, […] to achieve the overall project objective in the best possible time and accuracy at the most cost-effective levels" ("Constructability", n.d.).

It is possible that different engineers will create the mechanical, electrical, and plumbing designs for one project. If these engineers do not work with the contractor early on in the project, then it is possible for them to design components on top of each other, or have piping running through each other. This would be a disaster to discover in the field, which is why having someone with a high level of construction knowledge aid in the design early on could help eliminate these issues.

Those without extensive construction experience may not be aware of abnormal cost items. For example, glass comes in a variety of shapes and sizes, however once the design creeps outside of standard orders, costs can become exponentially higher than anticipated. Many of these skills come purely from extensive experience in the industry.

Becoming aware of these items early on in a project can reduce budget misalignments later on.

Trouble on the Horizon

Jason Withers, the project owner, determined design-bid-build would be his delivery method of choice. Wither's hired a local design consultant, Jeffery Design, to produce design documents for the mechanical and electrical scopes of the project. Wither's also hired a general contractor, Collins Contracting, to manage and hire out the construction portion of the work. Clark Corp. was hired to purchase and install the mechanical and electrical equipment that would be designed by Jeffery Design.

Withers hired Collins Contracting in January of this year. The intent was to have Collins quickly and effectively hire key subcontractors such as the mechanical, electrical, plumbing, concrete, steel, and excavation. Soon after contracts were signed, PeriMax and Collins had a multitude of issues related contract scope definition and the construction schedule. Scope and deadlines were miscommunicated early and it took approximately four months to work through the contract issues.

In May, Collins began working through the bidding process and hired the key subcontractors first. The original mid-September construction start date was quickly approaching, so Collins also began hiring all necessary subcontractors at the time as well.

Project Design

The project's design initially began in the summer of last year. Withers and his team hired Jeffery Designs to help create a vision for the commercial building, and then expand to the full design of the project. In late fall of last year, Jeffrey Designs began determining the MEP needs of Project X. The Jeffery team worked closely with the owner

as they narrowed down and eventually agreed upon major mechanical and electrical systems.

When the full project design was nearly complete in April of this year, Collins performed an engineer's estimate, which showed the project over budget by nearly $2,000,000. PeriMax was in shock and knew they needed to cut their costs. Initially, they asked Jeffery Design to revise the design; however Withers was unwilling to give up any major scope items to make a real dent in budget cuts.

Owner Goals

Jason Withers was an experienced project owner and knew there could be some benefits to bringing on contractors early on a project. His intent was to have the MEP subcontractors on the project in early months of this year. At this point, he knew Clark Corp. was a top contender for the mechanical and electrical positions. He had even made suggestions to Collins to hire Clark due to the fact that they were a design-build contractor by trade, and could aid in the design process.

The construction phase is set to begin in three months, September of this year. The construction portion of the project is projected to take 18 months to complete. The PeriMax team is already signing contracts with multiple future tenants of the building. The tenants have signed deals to begin move in right away after the agreed upon construction end date. For every month that the project is delivered late, PeriMax owes each tenant one month free of rent, while also having to pay for the clients to occupy a separate temporary location.

Withers knows that delivering a late project would significantly hurt PeriMax's development reputation and relationship with retail and office clients. Also, giving 'free

rent' and paying for temporary retail space would be highly expensive and a route he cannot afford to take. He knows pushed back the construction schedule would not be a viable option.

Designer Goals

Jeffrey Designs had a team of five architects and designers working on Project X. Their MEP design was lead by Mark Roberts. Roberts was disappointed to hear the Collins projection was so high over the initial budget. However, he did not feel at fault since the owner had determined a final budget after design had started, and due to the fact that Withers was significantly involved in the MEP equipment design choices.

Roberts had repeatedly asked Withers for a tangible expectation of what the MEP scope of work would be budgeted as, but the response was always unclear. In April, the entire Jeffrey team was asked to value engineer the project in order to determine cost savings areas. Roberts made a few adjustments, but he knew if he made too many changes, this would dramatically begin a slippery slope of change in other trades. At the end of the first round of value engineering, Jeffrey Design had already put in more hours than their pre-construction fee allowed. Any more design adjustments would significantly hurt their profit margins.

Once Clark Corp. was brought onto the project, it was clear PeriMax had no choice but to make major design adjustments in order to lower project costs. Clark Corp. had sent Jeffrey Designs 20 cost savings ideas. Roberts reviewed the list and determined that less than five of the options would be viable at this point in terms of design time available, in order to still begin construction in September of this year. Roberts was receiving a lot of pressure from Withers to make more design adjustments, but what Withers did not

understand is the time and effort, and frankly the cost, that goes into making these late changes.

As an example, one of the items on the value engineering list was to choose a smaller sized air handler than is currently scheduled to be installed on the roof. On the surface, this reduction in size would save over $100,000; however, this would mean that the size of supportive structural steel would change, the concrete pad would change, and the screening around the system would change. The structural steel supplier had already made material orders, since the material required a long lead-time. So changing the steel requirements now would only add project and team costs.

Essentially, Roberts thought each of the major 'cost savings' ideas would now have a large multi-domino effect. Roberts had briefly mentioned to Withers that making these changes would require an added design fee, but Withers was unwilling to discuss that topic at this point. This caused Roberts fear of losing money for his company.

Mechanical/Electrical Subcontractor Goals

Hunter felt he was placed in a very uncomfortable position. On the one hand, he was excited that the owner had put in so much effort to getting Clark Corp. hired onto the project. He felt that his company's expertise was well known and they were called to action right away and proved their capabilities. Withers had put his faith in Hunter. On the other hand, he was hired to adjust, and essentially critique, Roberts' design and make dramatic cuts. "If only we were a part of the design process last winter," Hunter thought. He knew his team could have significantly helped make easy cost adjustments earlier on. He questioned why Project X seemed to have the 'Lamborghini' of mechanical systems in place, when the building only required the 'Ford' or 'Chevy' version.

Hunter would have started the project with a very typical and standard mechanical system, and then gave the project owner alternatives to choose from in order to bump up the longevity and energy efficiency of the product. Possibly, the owner did not fully understand the costs and benefits of mechanical systems when he chose the original equipment.

Hunter was willing to do whatever he could to help the owner with this challenge. He has had a long-term relationship with PeriMax and hopes to keep a positive relationship for the future. He understands that Roberts and his design team are also stuck in the middle of this Project X roadblock. Roberts had designed a project that PeriMax had envisioned. Since there was no going back in time to adjust the design early, the project team needed to work together to develop a creative solution.

Demonstrated Owner Inefficiencies

This case study was developed as part of a larger research study with the goal of identifying construction project owner areas of improvements. From the research study, many areas of in need of improvement were discovered in relation to obstructing the achievement of the four common construction project goals of obtaining a quick schedule, low cost, high quality, and present citizenship behavior. Eight areas of improvement were identified as occurring most frequently on a construction project. Out of the eight most frequent improvement areas, changes to the project, unrealistic schedules, missed budgets to due unclear goals, and lack of timely decisions were all demonstrated in this real industry event.

This case study focuses on the late contract award to the project contractor. Although not listed as one of the most frequently occurring areas of improvement for

project owners, it was a part of the 4th most commonly mentioned improvement area under the project cost goal category. The project team has made it clear that bringing the contractor onto the team earlier has great benefits, which include reducing the need for value engineering and solving constructability issues quicker. Lack of construction knowledge is another common area of improvement mentioned by the project team, which was demonstrated in this industry case.

To read more about which skill areas the project team believes the owner needs to improve upon, read "Identifying Private Construction Project Owner Inefficiencies That Affect Project Goals," a dissertation written by Angela Christensen. This is a dissertation created with the goal of recognizing these improvement areas in hopes of more direct and focused training topics for construction project owners.

Discussion Questions

1. What could the project owner have done differently to avoid these budget and design issues?
2. If you were in Todd Hunter's position, how would you respond to the owner and designer's acceptance of less than five of your 20 cost savings options?
3. If you were Mark Roberts, how would you structure your argument to increase your fee?

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Case Appendix

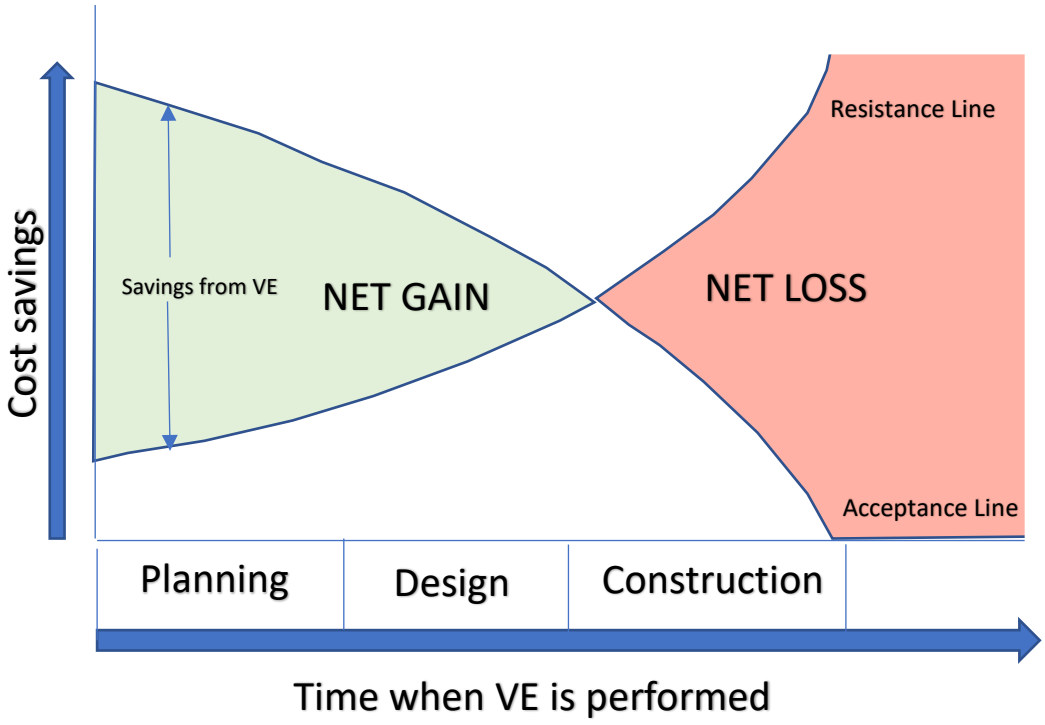

Figure K60: Cost Savings Abilities Based on the Time of Changes (Adopted from WBDG)

APPENDIX L. CASE II

Multiple Changes to the Project Scope

Introduction

The aura in the conference room was so tense it felt like the walls might burst open from the pressure. It was almost as if there was a big red button in the middle of the table and everyone's hand was reaching and hovering. No one was able to push the button because the fear of what was to come next was too big to risk. Amy looked around the table, she typically leads these weekly cost meetings, but this one was unlike the others. Usually, the only attendees beside herself were her boss, and the owner's financial rep. She knew it wasn't her place, but she couldn't take the pressure anymore and didn't understand why these five people, all each with at least 20 years of experience, would not just speak directly. She thought, maybe they are avoiding the question because they knew the outcome was not going to be favorable to any of the project team members in the room. She pushed the button. Unfortunately, it did not come out as confident and firm as it had in her head.

"I think we are just wondering if, um, you are going to pay in full for these change orders even if you are unable to get the Rams to pay for them," she directed to the project owner named Thomas Meyers. As she was speaking, she could feel her boss's fierce glare burn into her. Although he desperately wanted to know the answer, he knew it would be indirect, and most likely produce a false promise. Meyers was surprised by the sudden forward approach, but was quick on his feet to assure the team he was going to "figure it out with the Rams" and the team would "work through these change order requests". Both topics seemed incredibly vague and inconclusive to the people in the room.

Amy sat back down and kept a calm, straight face while her body was heated and at edge. The financial owner rep sat across from her with his head down buried in paperwork, avoiding the conversation. The management owner rep sitting on her right was the most quiet and calm she had ever seen him. He began to play on his phone, a move she assumes was to also avoid eye contact in hopes to not become a part of this discussion. The architect, who she had until recently forgotten was even in the room, was sitting on her left and had not said a word all day. He stayed engaged, but rarely spoke in any of these types of meetings.

Amy's boss, Mr. Harrison, was considered the lead general contractor, and continued the conversation with the project owner. Harrison began raising his voice and things became very heated. He too, wanted to know if the owner was going to express his devotion to pay for the outrageous amount of change order requests, in which the majority had already been completed on site. The owner continued to dodge questions and provide vague and insufficient responses, blaming most of the issues on the building tenant, the North Dakota Rams.

These change order requests were very atypical compared to other projects ATB Construction, Amy's employer, had worked on. This project already had over $5 million worth of change orders alone. Just over $2 million had already been reviewed, vetted, and approved, however the other $3 million were still on the table. As the project was nearing a close, ATB could see the change order negotiations being pushed to the back burner for the project owner team. They too felt the level of change orders were absurd and although most was due to the request of the North Dakota Rams, the owner lost control of the design and the changes in which they were ultimately responsible for

paying.

ATB and the Rams did not have a contract; ATB's only contract was with the project owner company Randall Development. ATB had been self-funding most of these change orders, while their subcontractors were banging on their door looking for the remaining payments. Although the contract was guaranteed maximum price (GMP), there was not a penny left to spend in any cost line item if they would not get compensated for the remaining change orders.

ATB was placed in a very challenging seat on the project team. On the one hand, they could not continue to fund the project's changes, as it was taking a huge hit to the company's financial being. On the other hand, the North Dakota Rams were a very prestigious tenant, and the whole city and state was rallying around the team, as they were to open their new practice facility in less than a month. The building was already so far from the originally intended design, that the only way to finish the project on time was to incorporate the remaining changes. ATB was faced with footing the bill, or becoming the center of a state-wide media frenzy.

Masaba

The project is called Masaba, and is located in Bismark, North Dakota. This will be the new home of the NFL football team the North Dakota Rams' practice facility. The facility was once used as an industrial warehouse, and is now being renovated into a mixed-use space including the major sports team's field.

Randall Development originally hired a different firm, Jacobs Construction, to be the construction manager on the project. It was a negotiated contract and Jacobs was brought onto the project early in the process. While design was being performed, Jacobs

began demoing the inside of the building to prepare for the reformation. Unfortunately, Jacobs had mismanaged the job and did not follow the demo plans. Their team had removed vast amounts of piping and ducting that was to remain on site, while also leaving old equipment in place that was intended to be removed. This put the project off to a terrible start, as owner would now have to replace mechanical and plumbing equipment that he originally thought he could reuse.

Randall and Jacobs could not come to an agreement on how to move forward on the project, and Jacobs was let go. During this mayhem, ATB was hired as a consultant to help guide the owner through these tough demo negotiations. ATB had provided so much guidance to the owner that he asked them to provide a price to take over the construction of the project. The job was negotiated, and ATB was officially hired on.

The project was split into two smaller contracts; one was called Masaba 'Base Building', valued at $18 million, in which the project owner would retain ownership and lease out space. The other portion, valued at $14 million, was called Masaba 'North Dakota Rams', Rams for short, and the sports team would take over ownership of their space within the building after the project was completed. ATB had two separate contracts with Randall, one for each portion of the Masaba project.

The Base Building would consist of all common areas in the building, along with any leasable area. Randall had one healthcare clinic, two restaurants, one event center, two retail spaces, and one workout gym already signed to occupy the building. There were still some remaining spaces available to lease. The Rams' space consisted of the indoor football field with a narrow track around it, locker rooms, sauna and steam rooms, equipment storage, strength training and workout areas, training pools, a lounge,

executive offices, and a private parking ramp.

ATB Construction

On site, ATB had one project manager, two project engineers and two project superintendents to work on both the base building and Rams. ATB had also been hired by various tenants to complete the interior build out of their spaces, however separate ATB project teams were created for these projects. Amy was one of the project engineers, and even though she worked with the project manager daily, her direct boss was project executive, Mr. Harrison, who was also on site part time.

ATB has been performing construction management and general contractor work for over 35 years in the Midwest, especially North Dakota. The company specialized in healthcare, commercial, community, and institutional projects. They had built many high school and city football fields, but this would be their first professional sports team field.

ATB's gross income is over $200 million annually. Common project delivery methods they use include design-bid-build, construction manager at risk, and construction manager agency. Most of their jobs are negotiated, as they make client and partner business relationships a high priority. ATB's upper level executives own the company, and their mission is to make all employees feel valued and like family.

Randall / Ram Contract

Randall Development had owned the empty warehouse for two years before their initial conversations with the North Dakota Rams began. Once negotiations started to become reality, a signed contract came in place. The Rams agreed to pay a lump sum of $14 million to renovate their new space. When the project was completed they would rent the space but have full facility management abilities. The Rams were contractually

able to rent out their field to host city events such as high school football games.

Clear and direct scope language is vital, and unfortunately was greatly missing from the contract between Randall and the Rams. The two entities had come up with a final lump sum price for the project that essentially came down to Randall delivering the Rams a 'Class A' professional stadium. This statement would become a thorn in all Randall's future legal negotiations with the Rams. The contract also indicated a final project completion date, in which the Rams would use to prepare and plan for their grand opening events held in the new space. These events would be used to showcase the team's new facility, while also allowing the public to view potential rentable space. If Randall did not deliver the project on time, the Rams would receive compensation in terms of free rent, which could be negotiated up to one year in rent depending on how late the project was completed.

The contract did not include a full detailed list of specific scope items that would be included and excluded from the Rams space in the building. There was a set of preliminary drawings that were agreed upon by both entities. It was determined later on in the project that the exact definition of 'preliminary' was vastly different for the Rams than it was for Randall. The Rams did not understand the documents well enough and signed the contract with the intent that they would significantly update the plans once they determined exactly what they were looking for in a final design. The Rams had legal and upper executive level executives making many of the initial agreements. Randall agreed the plans could be called 'preliminary' with the intent of filling in a few gaps that were missing, but they were not expecting to make any changes per say.

Design Documents

Randall hired Greenery Architects to design both the base building and the Rams projects. Greenery reviewed the contract scope between Randall and the Rams, and used their prior football stadium projects as a guide to develop a proper design. Both the Rams and Randall Development verbally approved the design prior to the start of construction. It wasn't until well over five months into the project construction phase that the Rams facility manager became critically involved. His name was Paul Mollatol and he served many roles with the Rams for over 15 years. He currently manages the team's professional game stadium. He knew exactly what he was looking for in a new Rams practice facility, and he believed the current design documents were far from it. The design continuously became more influenced by Mollatol as he hand drew new designs for Greenery to change, and as he made demands in the field to the subcontractors to follow. ATB and Greenery believed Mollatol's changes could have been reasonable if there were made in the early design phase, but changing major components deep into construction would completely alter the course of the project.

Greenery thought they were slowly pulling their way off the project as most of their labor was complete, when instead their time and efforts were quickly ramping up against their will. It became clear that the project could no longer proceed with the original design due to the Rams' new needs. Greenery desperately wished Mollatol had been more involved in the design phase; now his efforts were causing sharp pains for each of the project team members. The design changes never stopped and the team quickly learned Mollatol was the type of team member who could never sign off on a completed design. He was always making costly 'improvements'.

Again, Randall Development was the only project team member company that had a contract with the North Dakota Rams. So, the project team was often mislead who held the true cost and change making authority. On the one hand, it was the Rams' space, and they were the ones who needed to guide the 'needs' of the building. On the other hand, Randall was legally obligated to pay the other team members for their time and efforts. Randall essentially handed off their authority to Molattol by not stopping him from making changes. Unfortunately, this would cause a lot of hardship to the project once the cost consequences of these changes were realized.

ATB and Greenery came to a late conclusion that they may not be compensated for the project's astronomical changes. Essentially, Meyers had verbally indicated that the design and construction needed to follow the Rams' requests, and needed to be complete by the original grand opening date. However, the team knew they shouldn't move forward with changes without first vetting through a change order negotiation process, but unfortunately the pressure from the schedule demands gave them no hope on stopping to recoup costs now. Yet, continuously making changes would make achieving the completion date impossible, a concept that the Randall group and the Rams refused to acknowledge.

Change Order Negotiations

After many requests by ATB, Randall agreed to make time to review the long list of change requests. Randall hired a third party owner rep named Vincent Pella to aid in the change order negotiation process. Pella was brought into the project late and was asked to meet with ATB to vet through the numerous change order requests and determine which he believed were acceptable for Randall to pay. Pella had a construction

and financial background and seemed like an intelligent rep, according to ATB. The trouble however, was that Pella added another barrier between Meyers and ATB. The process was already challenging enough, but Randall demanded ATB to provide more information per change order compared to other projects. The process continued as ATB would vet through the documents with Pella which typically took between 1-3 consecutive weekly meetings depending on his requests, then Pella needed to discuss them with Randall, then all three entities would come together to decide if the change order was approved or not. Unfortunately, the Randall group did not give Pella the time he needed to discuss these requests with him, so the process seemed to come to a halt far too frequently. ATB believed Meyers had been so in denial of the changes and the costs that if he avoided them long enough they would just disappear. Of course, this only caused more costs and more problems. Although Pella remained on the project, he lost faith in the project owner and their relationship was burned. He felt his time was valuable and that he was being improperly used on the project.

Meyers kept up a naïve and in denial front while dealing with the project team, however behind the scenes he had begun legal negotiations with the North Dakota Rams demanding that they pay for the abundant changes that their own facilities manager, Paul Mollatol, had made. Although ATB and Greenery were not directly involved in these discussions, they knew the relationship between Randall and the Rams was rapidly erupting. The Rams' lawyers reminded Randall that the contract had indeed described the project deliverable as a 'Class A' professional stadium, in which they believed the changes represented. Randall was appalled that the team would not take responsibility for the millions of dollars worth of added cost.

Unfortunately, team dynamics faded and citizenship behavior was lost long ago. Everyone was now only looking out for themselves and not willing to work well as a team. Teammate cuts dug deep, while Randall decided to decrease the size of their base building generator that would originally serve the Rams' space as well. The Rams would now need to purchase their own generator, adding fuel to the already blazing fire.

None of the team members took fault for the changes or the cost of the changes. Blame was pushed on everyone. Randall held contracts with all parties, putting them in a liable position. Randall did not feel as if they should pay for the Rams' changes. The Rams' felt Randall owed the team the cost of the changes since the project would not have been in 'Class A' condition without them. ATB and Greenery had already spent the time and money to make all of the changes, and there was no going back in time. Both ATB and Greenery completed the changes prior to full payment because Randall had asked them to, with the promise to review and pay later. Once 'later' arrived, the Meyers indicated that he never actually gave approval for each of the changes and that ATB and Greenery should have refused Mollatol's adjustments. At this point, the negotiations were running in circles.

Next Steps

Due to ATB's abundant involvement in community and city projects, their reputation is well known and respected in the State of North Dakota. In fact, their dedication to the community is a main factor influencing their current challenges with the Masaba project. Amy walked into her boss's office to discuss a new strategy. Mr. Harrison showed her the draft of a letter he was sending to Randall Development informing them if they do not agree to pay for the current outstanding change orders

within 14 days, he will have no choice but to fully stop construction on site. This is a letter he wished he would never have to write, but frankly things are out of control. Randall Development has avoided and pushed off paying for change orders that occurred many months ago.

Stopping construction is Mr. Harrison's last resort. He has sat in many meetings with Meyers and various owner reps and put in countless hours of effort into resolving their never-ending meeting negotiations. The owner team was creative in their ability to continuously question and comment on changes that ATB had proved already occurred on site. Stopping construction would mean the project would further push back its completion date and the North Dakota Rams would miss their public opening events. Mr. Harrison thought to himself, "would the public blame ATB for the cancellation of the events? Or could they understand the result came from the conflicts between Randall and the Rams." Of course, Harrison knew his company's name would be plastered over media outlets for ruining the heavily anticipated family events. The public was not aware of the internal project conflicts, which means they would most likely place blame on the contractor. He truly did not want this to occur, but he knew taking a $3 million hit from this project would not be an option for the company's wellbeing.

Demonstrated Owner Inefficiencies

This case study was developed as part of a larger research study with the goal of identifying construction project owner areas of improvements. From the research study, many areas of in need of improvement were discovered in relation to obstructing the achievement of the four common construction project goals of obtaining a quick schedule, low cost, high quality, and present citizenship behavior. Eight areas of

improvement were identified as occurring most frequently on a construction project. Out of the eight most frequent improvement areas, changes to the project, compressed schedules, ill-defined project scopes, and lack of proper communication, delayed responses, and lack of trust among team members were all demonstrated in this real industry event.

This case study focuses on the effects of late design changes on a project. The topic of 'changes to a project's design and scope' was discovered to be between the first and fourth most common project owner areas of improvement in all four of the construction project goal categories. According to the project team, it is the most common area of improvement that negatively affects a project's cost, which is drastically portrayed in this case study. The added costs due to the changes caused numerous other problems for the project team.

To read more about which skill areas the project team believes the owner needs to improve upon, read "Identifying Private Construction Project Owner Inefficiencies That Affect Project Goals," a dissertation written by Angela Christensen. This is a dissertation created with the goal of recognizing these improvement areas in hopes of more direct and focused training topics for construction project owners.

Discussion Questions

1. If you were in Mr. Harrison's position, how would you strategize to finish the project?
2. How could the project owner have avoided occurring so many change orders for the Masaba Rams project?
3. What steps could the project team take to restore citizenship behavior to and achieve team goals?