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CLOSING THE CONTRACTUAL CIRCLE: INVESTIGATING EMERGENT SUBCONTRACTING APPROACHES

Salvatore Antonio Biancardo[1], Natasha Osmanbhoy[2], Jeffrey L. Ottesen[2], Giovanni C. Migliaccio[2] and Caroline Clevenger[3]
[1] University of Naples Federico II, Italy
[2] University of Washington, Seattle
[3] University of Colorado Denver

Abstract: The Architecture-Engineering-Construction (AEC) industry is shifting away from the traditional paradigm, one that places users, planners, designers, and contractors in different silos during professional practice. Other contractual schemes, which rely on contractual integration at lower contractual tiers, are emerging. These schemes close the contractual framework at lower tiers by having multiple upper-tier contractors subcontracting work to the same lower-tier entity. In these instances, subcontractors have contractual relationships with more than one other upper-tier party in the same project. A previous study on Building Information Modeling (BIM)-enabled projects revealed the emergence of these types of contractual relationships. To date, however little is known on these emergent approaches, their diffusion, criteria for adoption, or expected utilities. This research proposes a methodology to analyze the benefits of these emergent models, then applies this methodology to recent projects to quantify outcomes, and finally develops a holistic framework of integrated contracting to assess its impacts on project efficiency. The specific objective of this research is to identify and delineate new lower tier organizational relationships in today's construction practice. Preliminary results are included in the paper. Use of these emergent models for building contractors was assessed using a survey instrument. Data collection involved contractors in Washington State. After initial screening, several contractors were selected and interviewed regarding the nature of the adopted emergent subcontracting practices, the purpose for using them, and their perceived outcomes. This research contributes to a greater understanding of the occurrence, reasons, and advantages and disadvantages of these emergent contractual schemes. A discussion of their impact on overall project performance is included.

1 INTRODUCTION

Engaging subcontractors is an essential part of any construction project. While the Integrated Project Delivery (IPD) method aligns all the team members through a multiparty contract, other contractual schemes, which rely on contractual integration at different contractual tiers, are also emerging. Although procurement practices of subcontractors come in many forms and may be custom to various organizations, to date the literature lacks studies on the practices of lower-tier subcontracting.

According to Ndekugri (1988), on many individual projects, the level of subcontracting can be up to 80-90%. While general contractors hold the direct relationship with the client, they are usually not the only party involved to ensure successful completion of the works. Subcontractors are often engaged to assist

general contractors address difficulties due to the necessity to secure special expertise, resources and finances to the project (Elazouni and Metwally 2000). According to Shimizu and Cardoso (2002), subcontractors are specialist agents in carrying out a specific job, supplying manpower, besides materials, equipment, tools or design. Subcontractors act as representatives of the production system of the contractor company and are responsible only for the executed part of the workmanship.

The concept of supply chains is progressively becoming more significant to improve performance in the construction industry (London and Kenley 2001). Construction supply chain management (CSCM) refers to the coordination of distinct quantities of material delivered to specific construction projects.

Obrien et al. (2009), understanding the implications of supply chain management, to improve the effectiveness in the construction project execution. In particular they recognizes the importance of considering arrangements between the different firms involved in designing, procuring, and assembling construction, and reviews various perspectives to understanding and improving organizational issues in the supply chain. Also, they provide an overview of a range of information technologies that can contribute to supply chain performance, as well as examples of effective use.

Cox (2004) highlights the importance project managers develop different sourcing relationships depending on the different situation they are involved.

Additional impacts of subcontracting often include the spread of project risk and financing burdens across contractual parties. For example, to allow subcontractors to overcome project complexity, economical and efficiency problems, they frequently sublet a portion of their contract to other specialized firms. These specialized firms are commonly known as lower-tier subcontractors or sub-subcontractors. Engaging these specialized contractors enable them to perform their work at a quicker pace and lesser cost due to the availability of the resources as compared to general contractors. However, subletting parts of a subcontract to a lower tier subcontractor also provides an added complexity. When there are multiple levels of contractors involved in a project, the communication links between the parties - particularly the client and subcontractors - are weakened. The clients do not communicate directly with some of the firms that actually perform the work as they often do not know the identity of the lower-tier subcontractors (Choudhry et al. 2012; Arditi and Chotibhongs 2005). There are many forms of relationships between general contractor and subcontractors. Partnering is a common relationship between contractual parties at large, but partnering with subcontractors has different connotations from traditional owner-contractor forms of partnering. Hsieh (1998), affirms that more than 80% of general contractors prefers to create a durable working relationship with a particular subcontractor and material seller, also known as strategic partnership (Li et al 2000). Anyway, general contractors have a preference with a financial autonomy more willingly than any type of joint ownership. Most of the general contractors preserve a durable working relationship with an average of three subcontractors and two material vendors for any specified trade. Considering the prevalence of durable working relationship, a small number of general contractors engage new subcontractors except when forced by public procurement laws. If there is a new engagement, general contractors are influenced by the recommendations of other firms basing most of the weight of their decision on subcontractor's references and track record. Differently to ordinary conviction, financial capability and equipment ownership are not much take into account for selecting subcontractors.

Partnering has also been considered as an avoidance technique in the form of alternative dispute resolution. A variety of reasons have been brought forward as consideration prior to the decision for partnering. According to Kumaraswamy and Matthews (2000), prime contractors and subcontractors believe that there are benefits in developing partnering arrangements between prime contractors and key subcontractors.

According to Tommelein and Ballard (1997), the coordination of the specialty contractor management by the general contractors affects the quality of production management on projects. Only knowing the appropriateness of the power regime perspective on sourcing and relationship management, the coordination can be appropriate.

According to Burr and Jones (2010) and Kelly (2014), project and system complexity, coupled with piece-meal design specialization has resulted in the need for greater collaboration among project participants in order to avoid cost overruns and other negative project outcomes. A widespread lack of trust, respect and honesty in the American, Australian and European construction industries has been credited as one of the main drivers toward the adoption of partnering concepts (Kumaraswamy and Matthews, 2000).

In the last years several forms of relational contracts, contracts in recognition to the commercial "relationship" between the parties to the contract, have been implemented in the architectural, engineering, and construction (AEC) industries to improve project performance by reducing schedule duration and increasing participants collaboration (Colledge, 2005).

Building upon transaction cost economic theory, Winch (2001) propose a conceptual framework for governing processes in the construction industry. While studying the impact of BIM-enabled design on project delivery, Clevenger and Khan (2014) highlighted that there are several organizational similarities and differences with regard to the contractual relationships between the relevant parties of the projects. Similar to Integrated Project Delivery (IPD) where the main parties of a construction project are contractually linked (at minimum the Client, Consultants and the General Contractor, but often also subcontractors and vendors), there are also circumstances where the lower tier subcontractor closes the contractual circle.

This research analyzes the preliminary results of emergent subcontracting approaches in the US improving the knowledge of the occurrence, reasons, and advantages and disadvantages of these emergent contractual schemes. The outcomes develop a holistic framework of integrated contracting to assess its impacts on project efficiency.

2 RESEARCH METHODOLOGY

This research was conducted in two steps: a) an online survey was performed to provide a current overview of emergent contracting practices among building contractors in Washington. The survey was mainly used to identify and screen potential candidates for follow-up interviews; b) on-site interviews were conducted to discuss reasons and results of these emerging contracting practices. The survey was completed in fall 2014 while the interviews were completed in winter 2015.

2.1 Online survey

The online survey was created using a web-based service (questionpro.com). The target audience included contractors and subcontractors in Washington State. Prior to conducting the survey, a pilot survey was carried out with students and faculty of the construction management department in University of Washington (UW) with experience in subcontracting practices. The questionnaire was modified to incorporate feedback from the pilot survey, to adapt it for the construction industry. The questionnaire was sent to registered firms with the Associated General Contractors of America of Washington (AGC-WA) and The UW Construction Industry Advisory Council (CIAC).

The survey consisted of three parts. The first part focused on the individual's background and personal experience in the construction industry, referring to the contractor's current position in the company and the value of the largest construction contract over the last 3 years. The second part addressed information on the individual's company, such as the general size of the company, the estimated average annual revenue (in US dollars) during the last 3 years and the company's main role, either as a General Contractor or as a Specialty Contractor. This was used to provide a better understanding of the size of the company and size of the projects they deal with. In addition, the participants were asked their level of involvement in the administration of subcontracts. The last part of the survey was used to collect data regarding the delivery methods commonly used in the projects, the factors that can influence the selection of subcontractors, and, in particular, if any subcontractors have signed contracts with other any project team members.

2.2 On-site interviews

The authors decided to select as first interviewee, an individual with significant knowledge of industry practices who also serves as instructor for short-courses on contracting practices for industry organizations in Washington State. This interview was used to "calibrate" our interview guide, including our tentative list of subcontracting models. The following list includes all the subcontracting models that resulted from this first interview. They were shown and explained to all the later interviewees.

- **Traditional Subcontracting (TS):** Figure 1a reflects the traditional contracting approach where the Owner (O) engages the General Contractor (C) and the Designer (D). The Designer refers to the lead consultant, and may be the Architect or the Engineer depending on the project type; D will then engage their own sub-designers (SD), C will engage their own subcontractors (SC). There are no mandated functional relationships between SD and SC.
- **Traditional Subcontracting with Design Assist (TS-DA):** Figure 1b is similar to the traditional approach except for the presence of a mandated "Design Assist" functional relationship between SD and SC.
- **Design-Build Subcontracting (DBS):** Figure 1c reflects O engaging D and C at an early stage known an Early Contractor Involvement (ECI) and only C engages SC in a Design Build contract for the design and construction phases.
- **Integrated Design-Construction Subcontracting (IDCS):** Figure 1d refers to O engaging D and C who then engages the same SC; D engages SC for design work while C engages SC for construction work. Therefore, SC holds a contractual relationship with both D and C. However, this is unlike IPD where there is a cross of contractual relationship between every party involved. It is also noteworthy that D & C do not hold a contractual relationship.
- **Integrated Specialty Work Subcontracting (ISWS):** Figure 1e is similar to the traditional approach at the upper tier. However, in this case, C engages 2 different SC. One of these SC sublets a portion of their work to the other SC in the same project.

These subcontracting models were diagrammed as shown in Figure 1. This figure was shown and explained to all the contractors who were interviewed thereafter.

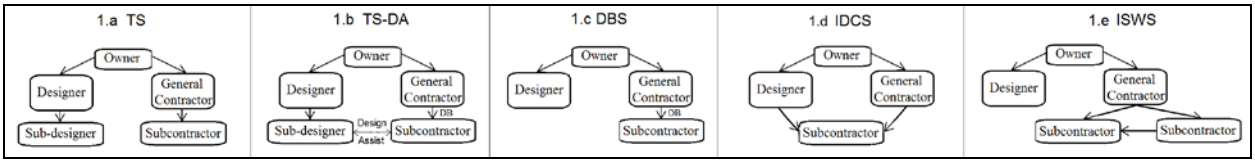


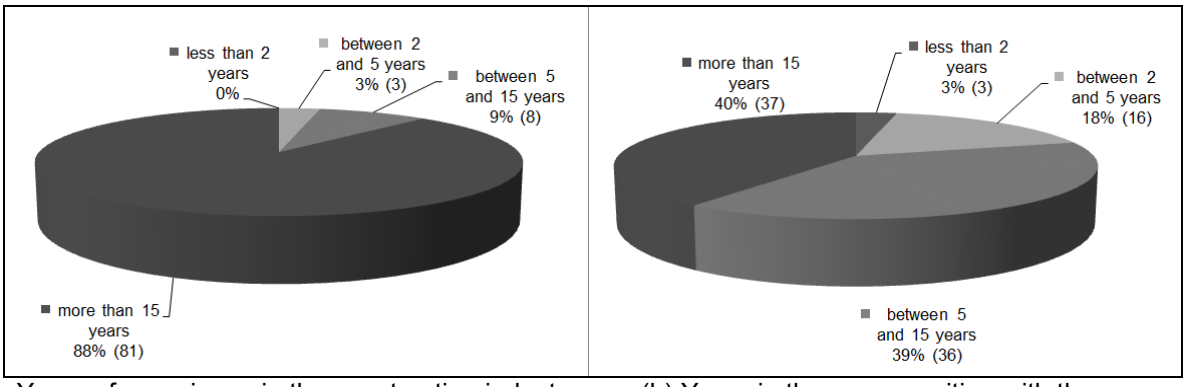
Figure 1: Organization chart

On-site interviews were conducted with selected survey participants to study in greater detail the different subcontracting approaches adopted in Washington State. In addition, the interviewees were asked if they encountered multiple roles in a project, the influence of the Project Delivery Method and Procurement Method on the decision, the advantages, disadvantages, opinion and consideration on such practices. A special focus was given to identify situations where subcontractors have contractual relationships with more than one other party in the project.

3 SURVEY DATA AND ANALYSIS

Data collection involved contractors and subcontractors in Washington State. The questionnaire was sent to a total of 271 participants using the contact list extracted from AGC and CIAC. Out of the 271 questionnaires sent out, there was a 33.9% response rate for a total of 92 respondents. Among the respondents, 65 were executives, 15 were project managers, 10 were estimators and 2 were superintendents. In particular, data indicated that 68% of the respondents worked for general contractors, 25% for specialty contractors, and 7% for suppliers. This response rate suggests the results are deemed reliable. In fact, Owen and Jones (1994) suggested that 20% would be an acceptable response rate whereas Black et al. (2000) leaned toward 30% as an acceptable response rate.

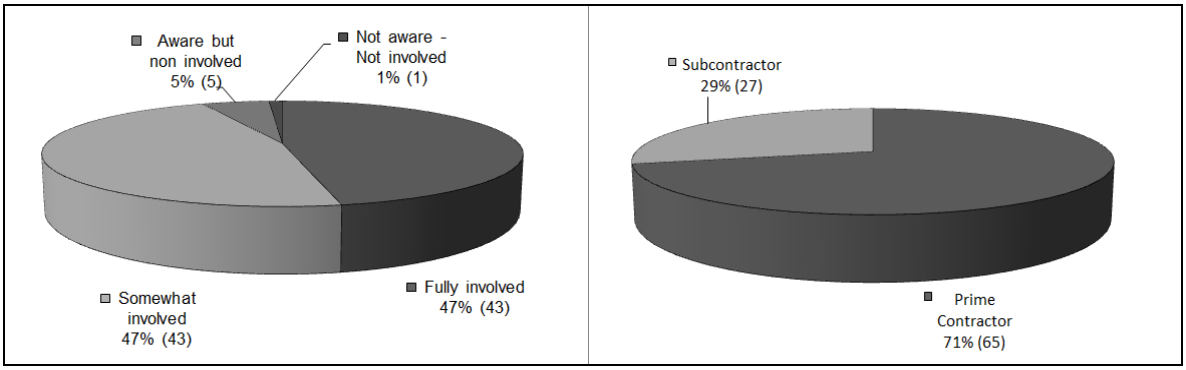
Figure 2 shows the results regarding Individual's Background. Figure 2(a) shows that contractors with at least 15 years of construction experience (senior contractors) are the largest percentage of the participants (88%). No contractors with less than 2 years' experience participated. Figure 2(b) shows that 40% of the respondents had stayed with the same company for more than 15 years, while 39% had maintained the same position for a period between a period of 5 and 15 years. This suggests that most of the respondents are well experienced in the construction industry and with their employer's practices.



(a) Years of experience in the construction industry (b) Years in the same position with the company

Figure 2: Individual's Background results

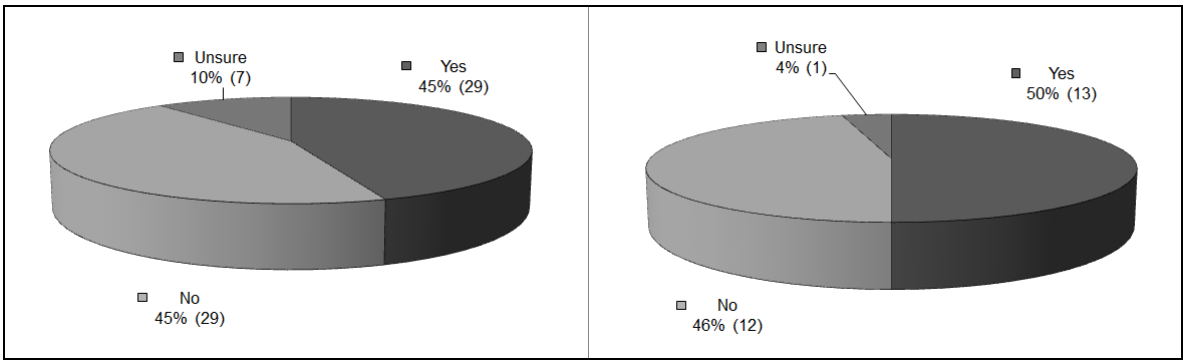
Figure 3 shows the results regarding the Individual's Company. Figure 3(a) shows that 47% of the respondents have been fully involved and somewhat involved in the subcontracting administration, and 5% are aware but not involved. One respondent was removed from the data analysis, as the individual was not aware and not involved in the process. Figure 3(b) shows that the respondent's company acts primarily as a prime contractor for 71% of the respondents, while it acts as a subcontractor for 29% of the respondents.



(a) Administrative involvement in subcontracted work (b) Major business role of the company

Figure 3: Individual's Company results

Figure 5 shows the percentages of respondents who were aware of situations where a subcontractor shared contractual relationships with multiple parties in a single project.



(a) Prime contractor (b) Specialty contractor

Figure 5: Contract signed with more than one on a single project

Last, survey participants were asked if they were willing to participate in follow-up interviews. Out of 92 respondents, 61 agreed to participate in the follow-up. Among all those who were willing to be interviewed, we selected only those who were familiar with the situation where a subcontractor shares a contractual relationship with more than another party in the project (Yes in Figure 5) or were unsure about this fact (Unsure in Figure 5).

4 INTERVIEW DATA AND RESULTS

Twenty-four respondents were invited for follow-up interviews, including 19 prime contractors and 5 subcontractors. In the end, the authors conducted 14 interviews with 11 prime contractors and 3 subcontractors. Job titles included 10 executives, a retired executive, a project manager, an estimating manager and a safety manager. Each interview lasted approximately 45 minutes. One of the interviews, a prime contractor, did not produce meaningful data because we discovered during the interview that the interviewee only had a limited involvement in subcontracting. Interviewee No.1 helped the research team to refine the list of subcontracting models, which aided in drawing Figure 1. Later interviewees were shown diagrams in Figure 1. They were asked to describe which contractual strategies were most commonly used under which circumstances.

4.1 Traditional Subcontracting (TS)

All the interviewees described the model represented in Figure 1.a as the most traditional form of procuring subcontractors and sub-consultants where the owner will hire a designer and a general contractor and they will hire their own sub designer and subcontractor respectively. According to the interviewees, this model is used commonly in public projects particularly for lump sum contracts awarded to the lowest bidder. While it may seem inefficient from a communication standpoint, most contractors curb this inefficiency by communicating directly to other contractual parties by requesting and organizing joint meetings.

4.2 Traditional Subcontracting with Design Assist (TS-DA)

All the interviewees agreed that the model represented in Figure 1.b is the most common. This is particularly true for private projects where the subcontractor and the sub designer will share a functional Design Assist relationship. According to the interviewees, this is particularly true when the contractor is on board at a later stage, which requires the sub designer to produce preliminary drawings to be included in the bidding documents for the general contractor. This general contractor will then require the subcontractor to establish a Design Assist relationship with the sub designer with the purpose of facilitating collaboration on the production of detailed design documents. This is the most preferred approach for all contractors regardless of trades. One of the interviewees also said that it works well for subcontractors who do not employ individuals who are qualified to be engineers of record, and, therefore, cannot use the Design-Build subcontracting model.

4.3 Design-Build Subcontracting (DBS)

According to most of the interviewees (8 of 13), the Design-Build Subcontracting model shown in Figure 1.c is not as common as those represented in Figures 1.a and 1.b. While all (13 of 13) interviewees encountered it, they have suggested this subcontracting model is used only for specific specialty trades, such as precast concrete structures for parking, curtain walls or Mechanical, Electrical and Plumbing (MEP) works. This model is also commonly used for smaller projects where a sub designer is typically not needed. At least three interviewees explained a variation where even the consultant designer is under the general contractor, which ultimately makes it a traditional design-build contractual strategy. Figure 1.c is also a growing trend and is getting more common in the industry, particularly in projects with early contractor involvement.

4.4 Integrated Design-Construction Subcontracting (IDCS)

The Design-Construction Integrated Subcontracting model shown in Figure 1.d describes a contractual structure where both the general contractor and the designer select the same subcontractor to perform a scope of work that integrates design and construction services. However, different from Design-Build Subcontracting, this subcontractor holds two separate contracts with the general contractor and the designer. According to 9 of 13 interviewees, this approach is rarely adopted, but it is present in the industry. At least four interviewees explained that the general contractor may have a contract with the subcontractor, similar to Figure 1.c, but the subcontractor may share a functional relationship with the designer. At least six interviewees have faced this situation. This situation happens, however, only on highly specialized projects where there is a large scope for the subcontractor.

Those interviewees (7 of 13) who had never faced this situation were asked to provide their feedback and opinions based on their personal experience. All the interviewees stated that an MEP contractor would be one who could be part of this contractual strategy. Apart from the general contractor, an MEP contractor could be contracted either by the owner or the architect or in some cases, the structural engineer. At least five interviewees stated that the next most common trade was the curtain wall or shop front contractors. Some other trades include the Structural Steel, Precast, Surveyor, Quality Assurance and Quality Checks, Kitchen Equipment, Data Cabling and Door Hardware. The majority of interviewees (9 of 13) suggested this method is commonly used for private projects rather than public ones due to its flexibility. In cases where the interviewee had experience with this situation, the decision to contract the same subcontractor is usually a joint decision between the designer and the general contractor, to provide the best solution for the project. This is where the designer will contract the subcontractor to do the design work, and the general contractor will contract the subcontractor for the construction work.

The decision to use this contract strategy is usually weighed by the relationships the different parties share. For example, the designer and the contractor agree to use the same subcontractor when they share a strong relationship with each other as well as the subcontractor. In this way, a strong relationship is necessary to carry out this strategy. It also depends on the complexity of the project. It is encouraged for proprietary or specialized works where the engineer or architect is not familiar with the system and would require a high level of expertise. The project delivery method used by the project also impacts this decision. In a Design-Build project, the parties have a greater flexibility in using this approach as compared to traditional Design-Bid-Build projects. In General Contractor/ Construction Manager (GC/CM) however, it varies depending on the complexity of the project, as it is more likely to proceed with Design-Build Subcontracting (Figure 1.c).

The interviewees were asked about the advantages of the Design-Construction Integration model (Figure 1.d). The advantages suggested by the interviewees included, but were not limited to the followings:

- **Triggers economic efficiencies** in terms of cost and resources because it encourages labour and cost efficiency due to the sharing of resources;
- **Promotes communication efficiencies** because it forces good communication between the parties due to the contractual binding. It is more efficient as it eliminates the “back and forth” communication between the subcontractor and the designer; it also eliminates the learning curve to working together

while generating detailed design due to the specialty designer having a better knowledge of the construction phase, as they are essentially the same team with the specialty contractor;
- **Facilitates lean construction**, as the designers are more knowledgeable and takes constructability into consideration when designing;
- **Provides consistency** in the project, as the party who is designing is also doing the installation and construction. There are lesser chances of scope gap as one party will be in charge of the whole system and they can highlight if there are any gaps found;
- **Improves price prediction** as all parties have a better understanding of the construction and installation process;
- **Improves project quality** by reducing amount of design and construction rework;

The interviewees also raised some concerns and provided some disadvantages of this subcontracting model. The disadvantages suggested by the interviewees included, but were not limited to the followings:

- **Misalignment between designer and general contractor**: The subcontractor may be subject to discording instructions from the designer and the general contractor due to the different expectations and intent. For example, the contractor will be focused on cost driven approaches while the designer will expect better design quality. Whose instructions take precedence? There is also potential for the subcontractor to be bias towards one party, usually the one who they share a better relationship with. Therefore, influence over the subcontractor is less as it is split between two parties. Interviewees identified this risk factor as high;
- **More paperwork and risk of contractual complication**: "who pays for what" issue between the contractor and the designer. There is also a liability issue, as there is less control over design. If a part of the project is not designed right, besides the subcontractor, who will be responsible contractually? Will it be the designer or the general contractor? There is a risk of blaming the other party;
- **Internal coordination failures**: Potential of a subcontractor who has different teams to do the design and construction within the same company and they may not coordinate as expected; therefore, the expected results may not be achieved.

While all interviewees mentioned one or more of these disadvantages, eight of the interviewees felt that these issues can be overcome through the establishment of a collaborative team that shares a trusting relationship involving trust. This strategy works well if the contractual implications are explicit in the contract and all the parties have a clear understanding of the objectives, intents and risks involved in this strategy.

Eight of the interviewees highly encouraged this model as long as there is no increased risk. This depends on having the right team with good, honest and collaborative relationships with everyone being clearly aware of the contract and the factors involved in the contractual strategy. Some interviewees feel that having the owner fully aware of the situation benefits the project while some feels that it is better for the owner to not be involved. Three of the interviewees felt that it was not ideal, as a single point of contract is preferred to avoid liability issues. These interviewees feel that there is a need to have one responsible party to be in charge of the on goings of the project rather than split responsibility. To the rest (2 of 13) of the contractors, the approach doesn't matter as long as everyone is fully aware of their scope and responsibilities.

4.5 Integrated Specialty Work Subcontracting (ISWS)

This model was found to be very common between subcontractors where a subcontractor on a project engages another subcontractor on the same project to complete part of their works. This is usually a small portion of the works and interviewees suggested there are plenty of occasions where the subcontractors do not share a contractual relationship with each other, and the works are done on a trust basis. In such a scenario, subcontractor 'A' helps subcontractor 'B' on a project, and subcontractor 'B' returns the favour on another project they work with together. Whether or not these subcontractors share a contractual relationship, most general contractors encourage this approach as it shows a collaborative relationship between their subcontractors, which in turn provides a better quality project. It also ensures

that the subcontractors with the right set of skills and resources are doing the right work. A common example from the interviewees is the electrical contractors who will engage either the earthwork or utility contractor to do trenching works for them.

This strategy is very situational where some interviewees prefers contract involvement to deal with payment and warranty issues while some interviewees feel that the lack of contracts provide less paperwork to deal with, which in turn saves time. When interviewing the subcontractors, some prefer having a change order by the general contractor rather than add on another contract, while some prefer to share the resources without getting the general contractor involved. When interviewing the prime contractors, some prefer the subcontractors to manage the contract on their own without their involvement to avoid any conflicts and additional paperwork due to change orders. However, there are some prime contractors who prefer to have control over their subcontractors.

5 CONCLUSIONS

Based on the surveys and interviews completed to date, the authors found that the subcontracting model used on a project is primarily situational, and that there are many factors involved in the decision of selecting a contractual strategy. The interviewees confirmed that all of the subcontracting models presented to them are used in Washington State. All models are relatively common except for the Integrated Design-Construction Subcontracting (Figure 1.d). Such results expand upon previous findings of Clevenger and Khan (2014) that have first identified the occurrence of IDCS. Since that previous study had linked this model to the increasing use of BIM, we explored this issue with our interviewees. When asked about the impact of Building Information Modeling (BIM), it was found that although BIM does not have a direct impact on the changes of the contractual strategies over the years, it does play a role and accelerates the changes in contractual strategies found. The general consensus of the interviewees (9 of 13) is that BIM is just another tool used in construction yet it forces collaboration and a functional relationship between the project team members involved, and that BIM provides an overall advantage to the industry.

The authors delved into the reasons, benefits and barriers of IDCS, while comparing it against the remaining models. With regards to the remaining models, such approaches have been used under different circumstances depending firstly on whether the project is a public or private project. While most public projects are less flexible, there are exceptions where the owner is willing to test out alternative contracting strategies. The project team involved, the complexity of the project and the type of building (residential, commercial etc.) also determines the strategy used.
The use of ICDS relies on many factors. One major factor is the trade of the subcontractor, which may be involved in this model. For example, while the bigger trades like MEP and curtain wall frequently practices this approach, trades with less complex scope of work, such as concrete, do not. Another factor is the complexity of the project, and a larger, more complex project is more likely to explore the different strategies as compared to smaller, “cookie cutter” projects. It was also found that while most interviewees encourage the approach of closing the contractual circle on the lower levels, its success depends a collaborative team with a good relationship, and a clear contract.

Some limitations faced by this research was that the data set is only collected based on contractors located within a 45 mile radius of the University of Washington, Seattle. It was also noted during the interviews that some contractors felt that the designers may have a resistance towards ICDS.
To externally validate the research, the authors had concurrently conducted a smaller study with contractors in Colorado. Based on the set of 13 surveys completed, three were shortlisted for an interview. An interview will be conducted to validate the responses of the existing interviewees. Based on these responses, the authors will develop a survey instrument addressed to a larger nationwide pool of participants to provide an extensive data set. We will also consider expanding the data set further by including designers and developers as part of the research to fully understand the acceptance and resistance of this contractual approach.

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