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DEVELOPING A MULTI PROJECT-COLLABORATION BASED IPD FRAMEWORK FOR SMALL & MEDIUM SCALE ENTERPRISES IN THE CONSTRUCTION INDUSTRY

Raviteja Vaitla[1], Vrinda A. Gaikwad[2], Abhinav Reddy S.[3], & Jong Han Yoon[4]

ABSTRACT

Small and medium enterprises (SME) in construction projects frequently struggle to manage labour, materials, finances, and equipment. The Integrated Project Delivery method (IPD) has the potential to solve these challenges. However, the existing IPD framework has a low feasibility rate in SMEs due to technological, financial, and managerial challenges. This is because IPD is a project delivery system that requires adequate capital, communication channels, software, training for workers, etc. which are usually available with large-scale construction projects but not with SME-based projects. Accordingly, this paper proposes a new IPD framework more specific to small and medium scale construction projects by improving the existing framework in terms of resource management and cross-validation of stakeholders. The proposed framework enables the SME projects to acquire and manage the resources for conducting IPD through the concept of "Multi-Project collaboration". In the collaboration, multiple contractors with individual projects cooperate with one another for achieving a positive impact on their performance through the IPD method. This study contributes to the body of knowledge by enabling the construction industry to understand the effective application of the IPD method to SME projects.

KEYWORDS

Integrated Project Delivery (IPD), Collaboration, Alliancing, SME, Challenges.

INTRODUCTION

We are all aware of the fact that not only the construction process is complex, but also the contracting systems used in the industry are complicated. Although much of the innovation and advancement in technology is heavily absorbed by the large-scale companies and SMEs lag behind in adopting such innovation, SMEs still play a key part

[1] Graduate Student, Building construction and Facility Management Department, Georgia Institute of Technology, Atlanta, USA, rvaitla3@gatech.edu, orcid.org/0000-0002-6518-2314
[2] Graduate Student, Building construction and Facility Management Department, Georgia Institute of Technology, Atlanta, USA, vgaikwad7@gatech.edu, orcid.org/0000-0002-3783-4100
[3] Graduate Student, Building construction and Facility Management Department, Georgia Institute of Technology, Atlanta, USA, asingireddy7@gatech.edu, orcid.org/0000-0001-6344-9516
[4] PHD Candidate, Building construction and Facility Management Department, Georgia Institute of Technology, Atlanta, USA jyoon337@gatech.edu, orcid.org/0000-0002-6303-6241

in providing a broader choice for clients and thus are an important part of the construction supply chain ecosystem. For instance, IPD is heavily used in large-scale construction with limited usage in SMEs as there are many costs involved with implementing IPD that SMEs cannot afford. If SMEs are boosted with integrating new technology and innovation, they can drive better performance providing specialist capabilities, agile ways of working, and often independent views & approaches (UK construction media, 2018). In most countries, on average more than 95% of Construction contracting companies are SME however the revenues are barely around 50% of the total economy from the construction sector, this number can be increased if various challenges of SMEs are solved using an integrated project delivery system (Prasad S, 2020).

This paper addresses SMEs in general and not specific to any country. Furthermore, there is hardly a universally accepted definition of SMEs because the classification of businesses on a small and large scale is a subjective judgment (Ekpenyong & Nyong, 1992). The criteria to define SMEs include various combinations of the following: number of employees, financial strength, sales value, relative size, initial capital outlay, and types of industry (Carpenter, 2003). For example, in Ghana SMEs are classified in terms of a number of personnel; micro-enterprise - less than 5 employees; small enterprise - 6 to 29 employees; and medium enterprise - 30 to 99 employees (Oppong et al., 2014). In India, it is in terms of revenue; small-sized - investment up to US$1.3 million, turnover up to US$6.62 million; medium-sized - investment up to US$2.6 million and turnover up to US$13.24 million (Vasundhara R, 2020). In the European Union, it is a combination of a number of employees and revenue; small-sized enterprise - fewer than 50 employees; and medium-sized enterprise - less than 250 employees & annual revenue of fewer than 50 million euros (Liberto, D., 2019). The definitions of SMEs vary both between countries and between continents. However, the managerial and financial challenges almost remain the same except for a few local challenges. Hence, in this paper we are focusing on major challenges in the SMEs, how we can solve those problems using IPD and further changes to the IPD to make it feasible for the SMEs.

LITERATURE REVIEW:

CHALLENGES IDENTIFIED IN SME CONSTRUCTION PROJECTS

A literature review has been conducted on the failure of the SME construction companies in over 6 countries namely the USA, Ghana, Gaza strip, South Africa, UK, and India all of which have different demographics and economies. Although the definition of SME construction in these countries slightly varies, the challenges almost remain the same. The challenges faced by the SME construction companies can be categorized primarily into a) Acquiring the project and b) Handling the project. With thousands of small construction companies starting each year, acquiring the projects in the initial stages is a big challenge for the SME companies due to heavy competition and retaining loyal customers is another big challenge due to contractors' poor standard of delivery in the previous projects (Thwala & Phaladi, 2009). In addition, the lack of support from the government and change in the policies makes it even more difficult for them to survive. The second one is Handling the project which is dependent upon how efficiently the contractor can deliver the project to the owner and how effectively he can earn profits for his company to survive without compromising the quality of the project. This article focuses mainly on the challenge of handling the project as this is particularly where IPD could effectively solve the problems.

The challenge of handling a project is further categorized into Financial and Managerial aspects:

Financial Challenges:

Based upon the research by Bassam Tayeh and Wesam Alaloul, financial challenge is the biggest challenge for the small scale constructions (Tayeh et al., 2019). Delayed payments are very common in small-scale construction projects, where the owner delays the payment to the contractor and the owner is not conscious that most of the small and medium scale construction companies/contractors struggle to survive and fail during the initial years of their establishment (Eke et al., 2015). It was observed that a chronic delay in payment for the work done compounds the problems of small-scale contractors to a whole new level. It hurts their profitability which in turn affects their ability to meet deadlines (Offei et al., 2019; Thwala & Phaladi, 2009). Such cost of payment delays has been a major challenge with these small-medium enterprises. Unlike large construction companies, small-scale contractors operate on shoestring budgets (Offei et al., 2019). They do not have the financial pull to counteract challenges, expand their operations, hire skilled workers and full-time experts. Thus, the SMEs become subject to the limited working capital. This setback with the capital not just exists with the company, but with the owner as well. Owners do not have fixed capital at the beginning of the project which leads to the sudden halt of the construction, delay in the constructions, or delay in the payments which eventually becomes a challenge for the contractor to meet the financial needs of his company (Eke et al., 2015; Thwala & Phaladi, 2009).

These financial issues have been prominent in the SMEs. In the construction industry, where your work isn't likely to take place in a steady, predictable manner, cash flow problem is even more pronounced. Additionally, most contractors end up losing track of their daily transactions and do not account for their expenses & profits at the end of each month resulting in damage caused by poor accounting practices (Thwala & Phaladi, 2009). These SME contractors also bid desperately for a lower price to win the bid which usually has very high competition and are thus left with inadequate profits to run the company leading to low-profit margin. Coupled with this issue, The contractors often do not have funds to invest in the software licenses and infrastructure upgrades, which means they must manage with the older methods like spreadsheets and old-era client-server applications.

In addition to this, serious fluctuations in material costs were noted. For instance, ING research in European commission states that material inflation for cement, concrete and bricks on an average stands at 40% in 2021 (Maurice, 2021). These material cost differences with time affect the contractor financially to a great extent as increased material cost would be a burden for the contractor as it leads to reduced margins or project halts. Furthermore, the external stakeholders like bank and financial companies often do not give credit or charge heavy interests to the contractors due to less consistency in the success of the projects in SMEs (Thwala & Phaladi, 2009), thus lacking them access to credit.

Managerial Challenges:

It was analyzed that there has been an absence of comprehensive business plan during early stages of the small & medium construction businesses. The SMEs fall behind the large-scale companies in terms of supply chain management and investment in training of personnel (Kath et al., 2014). Due to lack of training and lack of experts in the team, small contractors experience difficulties in managing the workers, managing finances,

and site monitoring (ILO, 2020). This happens due to the insufficient knowledge, experience, unreliable material supply base and lack of proper planning before the construction stage that leads to huge losses and causes failures (Offei et al., 2019; Thwala & Phaladi, 2009). This showcases the poor project management skills. It is also observed that contractors often claim unethical change orders just to make profits at the expense of the client which leads to loss of trust by the owner and eventually loses a loyal client (Thwala & Phaladi, 2009). Oftentimes, this results in owners trying to manage the construction process and are adamant to listen to the contractor's opinion which leads to trust issues among stakeholders (Raghavan, 2015; Thwala & Phaladi, 2009). The classification of different challenges can be clearly observed in the figure-1.

A big part of the managerial issues arises from the lack of technical expertise. On average, most of the contractors in the SMEs lack a degree and lack an in-depth understanding of the construction process which leads to errors and project halts. Furthermore, Small scale contractors either do not have adequate funds to afford skilled workers or train the unskilled workers and there is a lack of availability of skilled labor due to migration (T.G. Mofokeng, 2012). Communication problems were one of the notable issues with SMEs. Sharing of information is very critical in construction however it seldom happens in small-scale projects due to poor management of skills and lack of

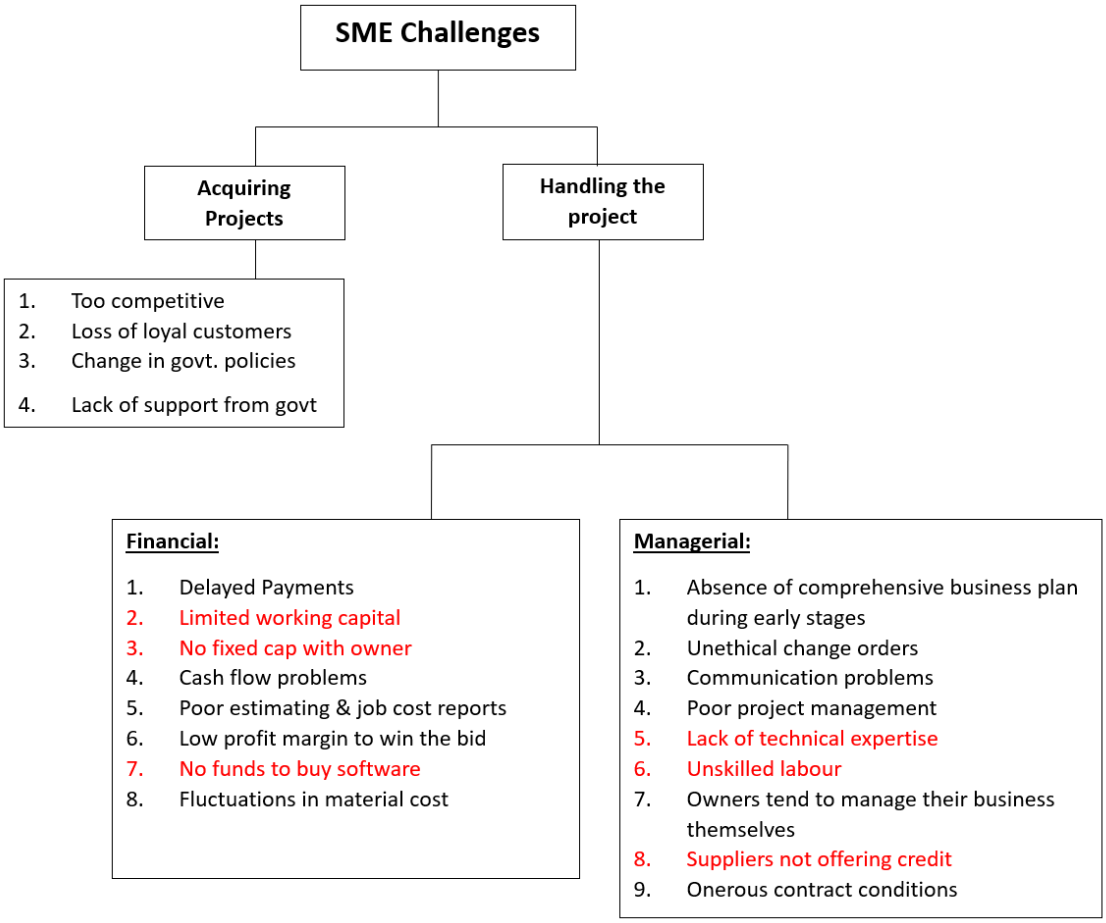

Figure 1: Classification of Challenges in SMEs

funds for IT tools (T.G. Mofokeng, 2012). Because of these factors, suppliers often do not trust the abilities of the small-scale contractors to give credit which leads the contractor to look for alternative methods of financing for supplies (T.G. Mofokeng, 2012).

Traditional contracts in which unavoidable costs required to fulfill the agreement is higher than the financial benefit to be obtained from it. This creates pressure on the contractor because of those onerous contract conditions (Offei et al., 2019). Figure-1 shows different types of challenges in the SMEs. Especially the challenges which are marked in the red are the one's which cannot be solved with the usual IPD framework which will be explained in later sections.

THE IPD FRAMEWORK

IPD is defined by all participants' early involvement, close collaboration, and the combination of each participant's unique contribution to the development and decision-making process, all to optimize the entire project rather than seek the self-interest of their respective organizations. The most typically seen benefits of IPD, include fewer change orders, improved cost savings, shorter schedules, and fewer requests for information (Roy et al., 2018). IPD framework defines the relationships among the project participants and guides their actions. The IPD framework functions on two interdependent levels, Macro-framework, and Micro-Framework (Khanzode et al., 2017). Macro-framework consists of the contract terms & business structure and a Micro-framework consists of the processes used to implement the project. They are together a road map to IPD (Khanzode et al., 2017). In this section, we shall first mention the different elements in the normal Macro & Micro IPD frameworks, and in the later sections, we shall propose possible changes to the frameworks to make them more specific to SME projects.

IPD Micro Framework:

The Micro-framework is a process and not a fixed formula that evolves during the project and is developed by the team based upon their capabilities and needs. The three major concepts which must be incorporated in all the projects are 1) Team design, 2)Work design, and 3)Information design (Khanzode et al., 2017). The team design tells that an efficient team should be formed to implement the IPD effectively and work should be divided to fit the size & competency of the IPD teams (Khanzode et al., 2017). The Work design focuses on how project tasks are divided, grouped, organized, and also about identifying different techniques to efficiently execute these tasks. Lastly, the Information design is about how the information will be created, exchanged, and managed (Khanzode et al., 2017).

IPD Macro Framework:

A full IPD project has five major structural elements which are 1)Early involvement of key participants, 2)Shared risk and reward based on project outcome, 3)Joint project control, 4)Risk allocation, and 5)Jointly developed & validated targets (Khanzode et al., 2017). All of these elements lead towards a successful implementation of the IPD at a macro level.

Now that we have described about the existing IPD frameworks, we shall now describe about our proposal of new IPD framework model specific to SME construction projects which could possibly solve challenges particular to SMEs.

PROPOSAL OF NEW IPD FRAMEWORK SPECIFIC TO SME SHOECONSTRUCTION PROJECTS

Some critical challenges identified in SME construction projects could be solved with the usual IPD framework. For instance, the problems such as delays in payments, cash flow problems, poor accounting practices, unethical change orders, and communication problems could be solved through collaborative working conditions offered by the normal IPD macro and microframeworks as explained in the previous sections. However, there are a few problems and constraints which challenge the implementation of the IPD framework itself in the first place. Unlike the large construction projects which have adequate capital and resources to implement the IPD, many of the small and medium scale constructions lack basic resources such as access to healthy credit, funds for the software license, funds for infrastructure upgrade, hiring qualified personnel, access to skilled labor, access to expert consultancy, high tech equipment and funds to train their personnel (Offei et al., 2019; Thwala & Phaladi, 2009). Considering these factors and including them in the IPD framework becomes necessary for the all-around success of SME construction projects.

Proposed new IPD Micro-Framework specific to SME:

As mentioned earlier, the usual IPD micro-framework contains majorly 3 elements namely Work design, Team design, and Information design. However, the newly proposed IPD framework specific to SMEs has an addition which is "resource management". The procurement of the resources, efficient resource planning to meet the project deadlines, and maximizing the resource utilization from project to project is of utmost importance for the successful implementation of the IPD. The resource management includes managing the financial resources, inventory, human skills, procurement systems, equipment, insurance, training, etc. The efficient management of resources is much more critical for SMEs compared to large-scale projects due to limited access to resources and shoestring budgets (Offei et al., 2019). Figure-2 shows how a new Micro framework has been developed from an existing one.

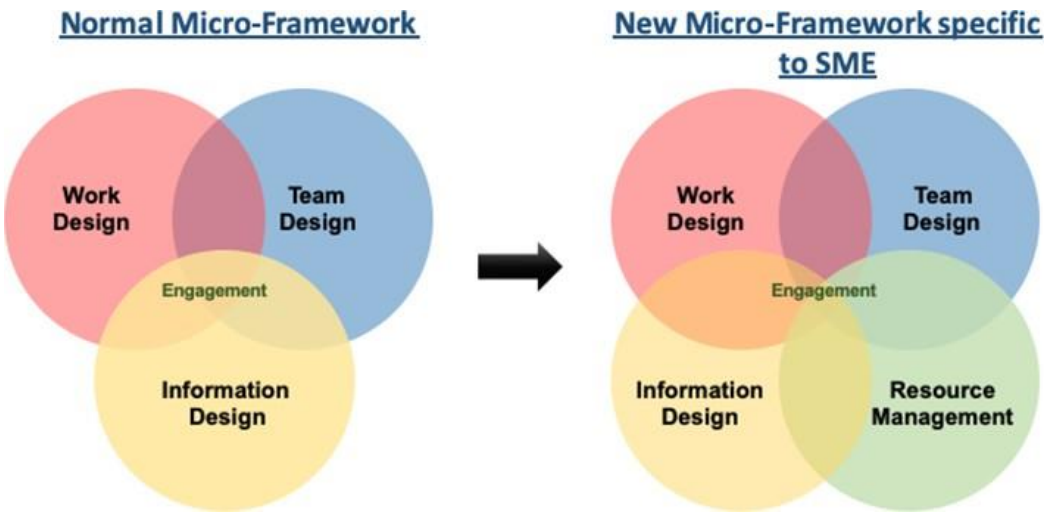

Figure 2: New Micro-Framework specific to SME

Proposed new IPD Macro-Framework specific to SME:

The normal Macro framework is shown to contain 5 elements namely early involvement of stakeholders, risk allocation, the joint share of risk/reward, joint project management, and joint validation of goals. The proposed new framework has a new addition which is "Acquiring Resources". This particular element is not included in the usual IPD framework which restricts the IPD framework to only large-scale projects. As arranging for adequate resources, as mentioned earlier, is crucial for implementing IPD in SME construction projects, adding "Acquiring resources" as a new element is significant. The acquiring resources include effective & affordable ways of acquiring bank credits, software licenses, skilled labor, experts, procurements, infrastructure, and expertise (Thwala & Phaladi, 2009). There could be multiple ways to solve the challenge of acquiring the resources in SMEs. One such possibility is multi project-collaboration which is presented in further sections of this paper.

In addition to that, cross-validation during the early involvement of stakeholders has been added to the new framework as transparency is key to the success of the IPD and eventually the project (Ashcraft, 2012). Hence, disclosure of available funds & assets by all the stakeholders is important for the smooth progress of the project. Especially in SMEs, owners start the projects without securing adequate finances for completion of the project which leads to sudden halts of the project causing losses to contractors. Hence cross-validation of the stakeholders before forming a team is very crucial for the project's success. Figure-3 shows the additions – Shared resources & cross-validation along with addition of new element "acquiring resources" to the existing 5 elements. In the next section, we shall discuss about a new proposed concept "Multi project collaboration" and how it could help SME contractors build access to adequate resources required to successfully implement the IPD.

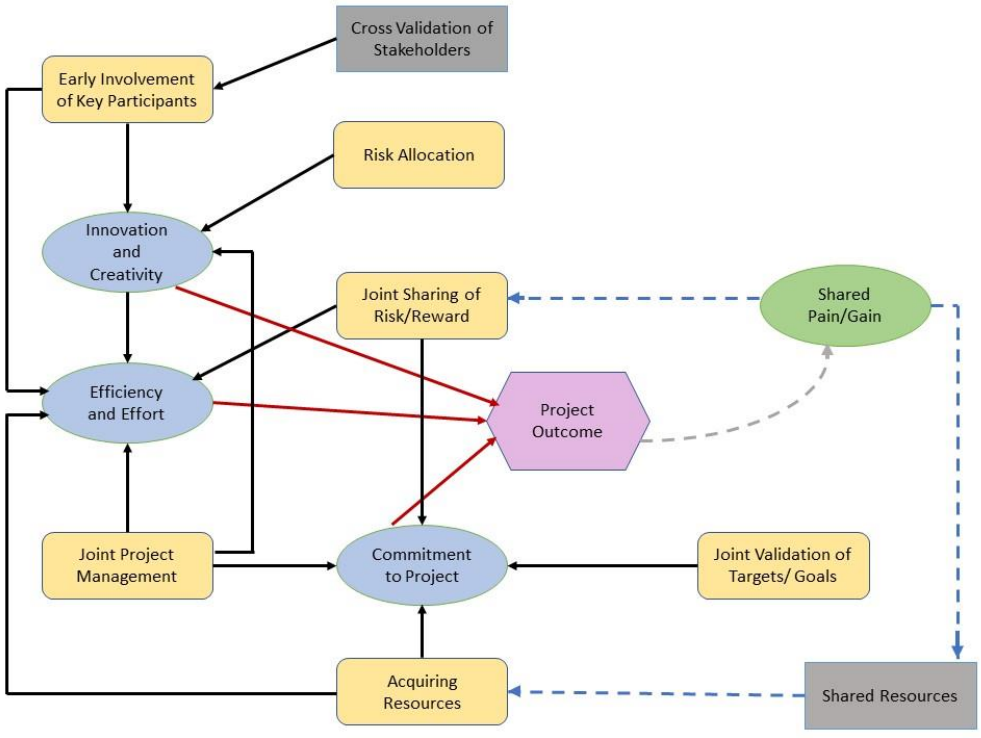

Figure 3: New Macro-Framework specific to SME. "Adapted from (Ashcraft, 2012)"

MULTI-PROJECT COLLABORATION: SOLUTION TO THE CHALLENGE OF "ACQUIRING RESOURCES" IN SME CONSTRUCTION

Multi-project collaboration is a system in which a few contractors, possible within certain area limits, with similar interests come together to form a "pool of contractors" in which they share the resources such as skilled labor, equipment, inventory, software, expert consultants, suppliers, finances, and expertise in their individual projects for the benefit of each contractor in the pool. This association increases the value of each contractor individually as they are able to access the resources which they were not able to access before. In addition, this collaboration could possibly share the profits and risks to some extent and utilize the shared savings to purchase software in bulk at affordable prices, train their unskilled labor, update their infrastructure. Furthermore, this added value helps the contractors and associated owners to get credit from the banks for their individual projects due to increased trust and stability of the contractors due to the pool.

Figure-4 shows different contractors of separate projects collaborating together. Contractors in the pool can take advantage of the resources offered which otherwise are only restricted to large contractors. For example, a contractor whose project is going on away from his own office can make use of some other contractor's office space (which is nearer to the project location), as colocation space where the contractor is part of the pool. One more example is that all the contractors can buy the software or advanced equipment in bulk together where they can get it for a lower price. They can even share the expensive equipment and communication tools.

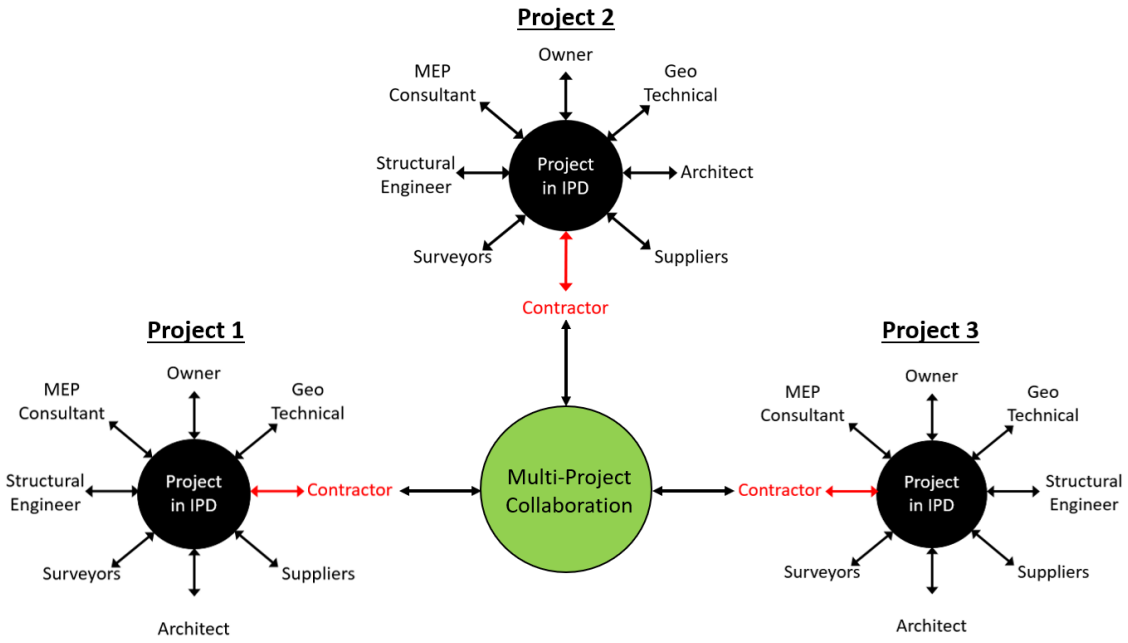

Figure 4: Multi-Project collaboration

Figure-5 explains how when the pool of contractors come together can share resources and create a value that is equal to a single large contractor. A single contractor in an SME project alone is in no way comparable to the kind of resources & financial stability that a large-scale contractor enjoys (Thwala & Phaladi, 2009). However, when some of the SME contractors come together to form a pool through Multi-project Collaboration, they

are more stable financially, have access to shared resources, have access to credit to buy advanced equipment and overall generates a value which is equal to a single large contractor. For example, consider a city in which there is a pool of contractors many of whose individual small projects are going to start in few months. Here, when a single SME contractor purchases materials from a supplier, his buying power would be low as he procures in small quantities, whereas when a pool of contractors together orders materials, their buying power increases and could bring down the prices of the materials to some extent.

Figure-6 shows a comparison of existing AIA IPD contracts with the proposed IPD contract. The proposed contract system towards the right side of the figure has risk and profit share by the pool of contractors. The profit shared could be used to update the office infrastructure, buy software, equipment, communication tools, etc. At the same time whenever there is a loss occurred with a certain project, instead of the contractor shutting down his office, the pool could help him/her survive for a longer time by taking some part of the risk. In this concept of multi-project collaboration, it is necessary that all the projects are delivered in IPD to ensure transparency, mutual understanding, and collaboration among several stakeholders at the multi-project level.

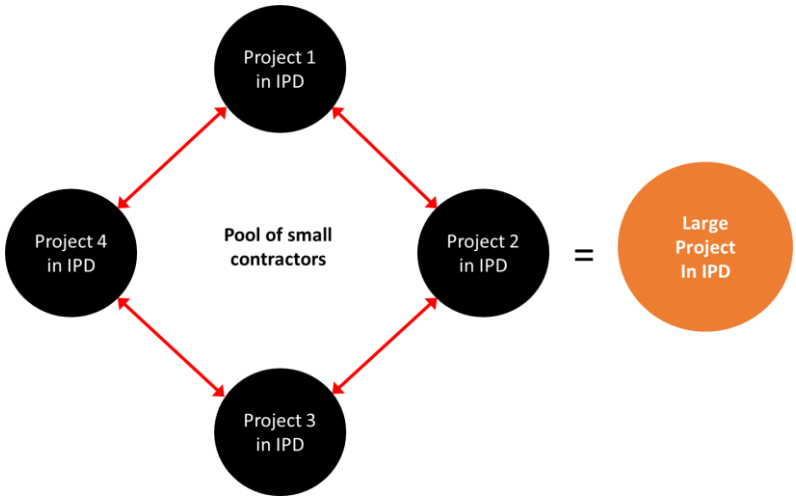

Figure 5: Formation of Pool of SME contractors and its equivalence to one large scale contractor

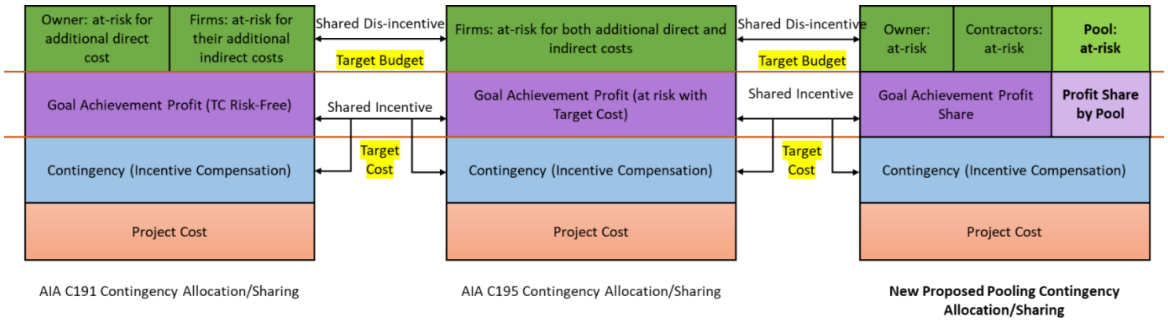

Figure 6: Comparison of proposed new pooling contracting system with the AIA contracting systems

CONCLUSIONS

The application of the IPD method by large construction companies leads to a profitable outcome, however, this isn't a solution for Small and Medium-size Enterprises, owing to the fact that SMEs are constrained by considerable financial and managerial limitations. Hence through this paper, we tried to find out the challenges which hamper the implementation of IPD in SMEs. Through this paper, we have also identified that Resource Management and Cross-Validation of the Stakeholders needs to be added to the framework to acknowledge the challenges specific to SME construction projects. Along with the identification of the challenges, we went one step ahead and have proposed possible solutions through multi-project collaboration. It demonstrates how the pooling collaboration can help SME contractors with resource sharing and allocation while at the same time sharing both risks and profits at the individual project level. This proposal thereby contains "Developed IPD framework for Small and Medium Size construction projects" and further "Multi-project collaboration for the projects delivered in IPD". The findings contribute to the body of knowledge by enabling the construction industry to understand a practical application of IPD method to SME construction projects. Consequently, this study facilitates and promotes the use of IPD for better productivity and collaboration in the construction industry.

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