EPiC Series in Built Environment

Volume 7, 2026, Pages 1052–1061

Proceedings of Associated Schools of Construction 62nd Annual International Conference

Knowledge Transfer in Construction – Personnel Perspectives From Small and Medium General Contractors

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Knowledge transfer (KT) within construction organizations, especially small and medium-sized construction organizations (SMGCs) is often overlooked. Understanding how small and medium size general contractors utilize different methods for transferring knowledge helps organizations within this subset adapt to competitive market conditions. This research used semi-structured interviews to investigate the extent to which SMGCs utilize formal KT methods and explores the perceived benefits associated with these processes. Open coding identified 9 themes regarding the benefits of formal KT perceived by project teams. Axial coding identified 4 key themes related to KT, including employee development and engagement, continuous communication and collaboration, individual project optimization and evaluation, and organizational learning. Selective coding then suggested the need to focus on KT at different levels. Including: individual, project, and organization level to facilitate effective KT within SMGCs. The results further suggest that KT is best achieved through constant communication and collaboration between project teams. Also that development of standardized KT processes is an effective strategy.

Keywords: Knowledge Transfer, Knowledge Management, Small General Contractors, Medium Sized General Contractors,

Introduction

Knowledge plays a crucial role in ensuring an organization's competitive edge (Wang & Meng, 2021). Unlike information which is a collection of details and specifics about different things, knowledge can be defined as acquired learning for effective utilization through experience, training, and observation (Wang & Meng, 2021). Construction projects are a hub of knowledge generation (Okere, 2017). Construction projects involve lots of people in various roles (Okere, 2017) and knowledge is distributed among various individuals throughout the construction process (Zhou, Chen, Deng, Mahmoudi, 2023). However, the decentralized nature of construction project duties by subcontracting creates barriers for GCs to share information and utilize their individual and collective knowledge (Moshood et. al.,2022). So, a crucial factor in retaining knowledge or "lesson's learned" on a project lies in effective transmission of knowledge (Zhou, Deng, Hwang, & Ji, 2022).

Construction companies depend heavily on past knowledge and experience to foster knowledge integration and collaboration among project teams (Zhou et al.,2020). They are continuously trying to seek methods of better transfer of knowledge from one individual to another, from individual to organization and within different departments (Feng, Ren, & Hao, 2017). But due to the goal-oriented

nature of projects and complexity of the knowledge generated, the lessons learned are generally not documented or shared effectively, resulting in a loss of acquired knowledge (Sun, Ren, Anumba, 2019). SMGCs face unique challenges with KT, such as lack of time, resources, and clear guidelines (Shokri-Ghasabeh & Chileshe, 2014). SMGCs may have realized the importance of formal KT, but often formal methods have not been introduced in the organization. The efficient flow of knowledge among SMGCs simply doesn't have extensive use (Balaban- Ökten & Gundes, 2018).

SMGCs and large firms engage in KT initiatives differently from one another. Unfortunately, with SMGCS not doing it as well (Hartono, Sulistyo, Chai, & Indarti, 2019). For large construction firms, KT methods and techniques tend to be better developed (Shokri-Ghasabeh & Chileshe, 2014). They tend to utilize formal KT methods and practices (Muller, 2015), and often have their own knowledge management system(s) to share best practices (Balaban- Ökten & Gundes, 2018). The researchers relied on Muller (2015) to define formal vs informal KT. Where formal KT involves scheduled meetings, processes, lists, etc, whereas informal KT is characterized by casual conversation that is unintentional.

For better positioning in the construction market and to remain competitive with larger firms, adopting formal KT methods by SMGCs is increasingly important to improve their overall operations. This project sought to understand the KT processes and methods of SMGCs. More specifically it sought to explore the extent to which SMGCs use established procedures, tools, or mechanisms to facilitate the sharing, dissemination, and retention of knowledge within their organizations. The research questions for this study were:

1. To what extent do small and medium size general contractors utilize formal knowledge transfer processes or systems?
2. How do small and medium size general contractors benefit from knowledge transfer processes?

This study is needed because while KT has been studied among large construction companies, among small and medium sized general contractors KT has seen little inquiry. It is significant as small to medium sized firms are less likely to be able to absorb the cost of mistakes if they do not learn from past projects.

Literature Review

Knowledge Transfer (KT) refers to the process of sharing information from one part of an organization to another or one person to another typically for solving problems or working towards a goal more efficiently (Zhou et al., 2022). It is an essential element of any knowledge management strategy. KT is a difficult process due to the distinctive and goal-oriented nature of construction projects (Feng et. al.,2017). Effective KT among project members prevents the recurrence of similar errors, enhancing work efficiency, and mitigating the risks of failure (Ni et. al.,2018).

Muller (2015) studied KT in organizations operating in different industries and found both formal and informal methods of KT between project teams. They categorized KT into two categories: intended and not intended, where the intended formal practices were only used for challenging projects. They also identified intended informal practices such as meeting of project team leaders, interacting with colleagues in the same department, and receiving guidance on similar projects from top management as intentional informal KT, while casual conversations during coffee breaks were considered unintentional informal KT. According to Muller (2015), though projects create boundaries, employees and project teams utilize formal mechanisms and develop informal practices for knowledge sharing among themselves. Due to the intricate nature of knowledge and the unique characteristics of

construction organizations, less importance is often given to KT as firms focus on project delivery and performance.

Most research on knowledge transfer in the construction industry relies on two theories: the SECI model and communication theory. The SECI model outlines four mechanisms (socialization, externalization, combination, and internalization) for transferring knowledge between tacit and explicit forms, illustrating how knowledge flows among individuals and groups both within and outside organizations (Nonaka and Takeuchi, 1995).

Communication theory suggests that knowledge transfer involves four stages—inception, execution, diffusion, and integration—that are influenced by various factors such as the nature of the knowledge, the parties involved, and the transfer context. If every project starts from level zero and lessons learned from other projects are not captured properly, there are more chances of repeating the same mistakes (Zhou et. al.,2020).

Formal KT practices have proven to be effective in large construction companies. Hartono et al. (2019) posited that the knowledge management challenges faced by larger construction organizations are dissimilar in nature compared to their smaller counterparts and as a result, they need distinct knowledge management strategies to reap the benefits. Sun et. al., (2018) explored the knowledge transfer through a questionnaire survey sent to project stakeholders; owner, designer, owner's representatives, contractors, subcontractors, material suppliers and others. They found that, in China, the construction companies and their employees preferred to carry out their project management tasks based on their own past experiences and neglected to share their knowledge with other stakeholders. They also emphasized short-term project goals over KT.

According to Shokri-Ghasabeh and Chileshe (2014), few construction companies have formal methods of KT to capture lessons learned from projects that they undertook. For small construction contractors in Australia, they found that the larger the contractor, the more aware they were of the importance of documenting lessons learned. Moshood et. al., (2022) in their study to explore the trend and future challenges of KT in the construction industry found that many small and medium sized businesses failed to properly document knowledge from previous projects which resulted in an increase in time, cost, and effort to find out information about already finished projects.

Zhou et. al., (2022) in their study found that the initial value of knowledge stock inversely affects the proportion of knowledge transferred from projects back to the organization. This can be attributed to the fact that the larger the company, the more experienced they are with the local environment of projects. Consequently, larger companies do not have the urgency to absorb knowledge from each and every project and they can avoid knowledge transfer from all the projects back to the organization. But in the case of small and medium organizations which are still in the process of developing knowledge stock, KT is important to bridge the knowledge gap.

Existing research on knowledge transfer in construction mainly analyzes factors affecting knowledge transfer to measure other parameters such as project performance (Moshood et al., 2022), innovation capability (Kiessling, Maley, Moeller, & Dabić, 2023), firm performance (Dang, Chih, Le-Hoai, & Nguyen, 2020), and technology (Deng, Xu, Deng, & Lin, 2022). These studies help establish the importance of KT in construction. However, these studies have focused on large firms. There is minimal evidence of research on KT in SMGCs, and most of it focuses on project performance, not how it occurs. As a result, this study fills a gap in the body of knowledge on the subject.

Methodology

This research relied on Balaban- Ökten & Gundes, (2018) classification of contractor size. General contractors with 10-49 employees were considered small and with 50-249 were considered medium. The research design was considered exploratory and utilized a grounded theory approach to identify themes, patterns, and meanings within the data. Interviews, as a qualitative methodology were used for data collection. In total, 18 interviews were conducted. Interviews were the chosen data collection methods as they allow for rich exploration of perspectives and experiences.

A purposeful sampling technique was used to identify participants who are knowledgeable and experienced in the topic (Creswell & Creswell,2018). To collect in-depth information, participants from different small and medium sized general contractors were selected. Interviewees had various roles in their companies with job titles including (but not limited to): preconstruction manager, project manager, preconstruction director, CEO, and operations manager (a complete listing of interviewees is provided in the next section). Interviewees represented various general contractors and differing years of experience. In total, 23 individuals were solicited to participate (selected sample), 20 responded to the solicitation and 18 Interviews were conducted (actual sample), equaling a 78% participation rate. Firms represented were all commercial general contractors who pursue both public and private work. They ranged from 14 to 130 employees, with revenues ranging from $12 to $530 million dollars. All interviews were voluntary and no incentives were offered.

Interviews were conducted virtually using Microsoft teams and followed a semi-structured format. Each interview lasted about 30 minutes and were recorded. All interviews were conducted by the same researcher to ensure consistency. Following initial introductions and descriptive questions about the participant and their company, interviews included seven main questions, with optional additional probing questions for each. The interviews were transcribed and analysis was done using Strauss and Corbin's (1998) coding strategy. That process includes a three step process for coding data (open, axial, and selective coding), where each step builds on the previous. However a additional step "precoding" was also utilized prior to open coding. Pre-codes were assigned to represent concepts in each segment of the interviews. Themes were then generated in open coding, axial coding was used to consider relationships between themes, and then selective coding was used to identify core categories.

The coding process was led by one researcher, the same who conducted the interviews. The themes identified in the coding process, by the lead researcher, were documented in a spreadsheet and then reviewed in detail by the second researcher. When disagreement occurred between the researchers, relating to the coding of any given theme, electronic communication/discussion and a series of in-person meetings were used to find consensus regarding those specific codes and themes.

Analysis & Discussion

The analysis revealed a surprising level of diversity in the formal KT methods used by SMGCs. It also highlighted three levels of benefits of formal KT.

Table 1. provides a more detailed profile of each interviewee. In general, the 18 participants represent 14 different general contracting firms. Six are considered small, while eight are considered medium sized based on Balaban- Ökten & Gundes (2018) parameters. Participant experience ranged from three to 41 years and encompassed a variety of job titles.

Table 1. Profile of Interviewees

#	Title	Experience	Co. Revenue	Co. Employees
1	Pre-Construction Manager	15 years	$24 M	20
2	Project Manager	11 years	$375 M	130
3	Operations Manager	32 years	$20 M	20
4	Pre-Construction Manager	8 years	$30 M	20
5	Project Manager	15 years	$250 M	100
6	Project Manager	12 Years	$530 M	105
7	Pre-Construction Manager	12 Years	$65 M	65
8	Senior Project Manager	15 Years	$65 M	65
9	Senior Project Manager	41 Years	$75 M	40
10	Operations General Manager	32 Years	$40 M	35
11	Project Manager	3 Years	$12 M	14
12	Project Manager	26 Years	$50 M	75
13	Assistant Project Manager	4 Years	$150 M	130
14	CEO	25 Years	$14 M	30
15	Project Manager	13 Years	$50 M	75
16	Executive Project Manager	22 Years	$125 M	125
17	Project Manager	11 Years	$100 M	85
18	Pre-Construction Manager	16 Years	$40 M	30

Interview results indicated that KT from preconstruction to project teams was mixed among participants. A majority (61%), use formal KT processes. Seven reported that there was no formal KT between preconstruction and project teams, but eleven indicated that their firm did used formal KT processes.

Analysis of the types of formal KT revealed a dynamic nature of KT practices at SMGCs. A spectrum of approaches were reported including; formal periodic meetings, mentorship sessions, Standard operating procedures/structured handoff checklists, use of the same team during pre and post-construction reviews, and using the same project team on different projects were all reported.

The eight interviewees who reported no formal KT processes, indicated that perceived bureaucratic barriers deterred them from adopting formal KT processes. Despite the absence of formal KT processes, they all utilize informal processes to varying extent. Common informal approaches reported include: storytelling, ad hoc meetings, brainstorming sessions, word of mouth, and lunch sessions. additionally, email, instant messaging, social media, and collaboration platforms are used to share unexpected site and market conditions. While only three firms specifically reported utilizing both formal and informal processes, the data suggests that all firms are utilizing informal KT practices.

Through the open coding process, nine themes relating to the benefits of KT were identified. Table 3. Presents these themes and content analysis of their frequency among interviews.

Table 2. Open Coding Themes

Themes	Frequency Count	Frequency %
Increased engagement of managers in KT process	12	67%
Promote collaborative learning	11	61%
Promotes organizational learning	10	56%
Individual project optimization	10	56%
Individual employee development	7	39%

KT promotes innovative approach	6	33%
Adapting to changing company dynamics	6	33%
Improves individual project evaluation	1	6%

Following the open coding process, axial coding was conducted and four themes emerged. Table 4. displays these themes and their frequency based on content analysis. A great deal of alignment occurred in axial coding as the themes are primarily distinguished from one another based on the benefits of KT and how it is adopted by SMGCs at different levels: individual, project and organizational.

Table 3. Axial Coding Themes

Themes	Frequency Count	Frequency %
Employee development and involvement due to KT	14	78%
Continuous communication and collaboration due to KT	13	72%
Individual project optimization and evaluation due to KT	11	61%
Organizational learning due to KT	10	56%

The theme *Employee Development and Involvement due to KT* addressed the role of KT processes in fostering employee growth, and thereby workforce capabilities and retention. Responses like, "And all through that process, I'm delivering to them the knowledge that I've got the experiences, good or bad, and I'm trying to instill that knowledge in them" and "And we want the manager to be able to recognize that, present it and to be able to talk about it", suggest it can flatten a learning curve by filling experience gaps. Further, that formal KT encourages employees to share which improves communication, collaboration, and enhances leadership abilities. Despite this evidence, interview responses like "they sit there and say, I've been doing this for so many years and it works, Why do I need to change it?" also suggests resistance to formal KT in more experienced employees, if they have not been trained to do it. This theme harkens to the SECI model for KT, supporting socialization and externalization specifically in KT.

Although the first axial coding theme encouraged communication and collaboration, *Continuous communication and collaboration due to KT* emerged specifically as the second. Throughout the interviews a recurring response was that formal KT enables frequent communication and collaboration between individuals within project teams in a project and with the functional departments within SMGCs. They reported that regular meetings such as: lookaheads, kick-offs, monthly check-ins, coordination, and job recaps emerged as the preferred method for formal KT and facilitated this communication and collaboration. Responses like, "It's a way to get really concise information without overloading the estimators with tons of stuff that they have to sort through" support this theme as the meetings provide a formal opportunity for operations and preconstruction to interact and learn from one another. They also have the added benefit of developing consistency at a firm: "You have to try to create as much standardization as possible to allow the most efficient and effective use of time and experience" and "if across the company, we standardize the way we do this, it allows us to have just a lot of integration, a lot of consistency from manager to manager". As a result, formal KT methods not only improve knowledge sharing but also develop healthy relationships between both the functions involved. This theme also supported the findings of Zhou et al. (2020) regarding communication theory and KT.

The third theme, *Individual Project Optimization and Evaluation due to KT* shifted from more individual to project benefits. Responses like, "I think if there were just a set structure for that whole transition on that project….., we would have made the transition to the new project team a whole lot better" and "that just kind of keeps everyone on the same page so that you never know it being a

holiday or someone maybe decide ,hey, I need to take off, or someone gets sick something like that, someone could easily step in and have a good idea of where you know that project manager was or is on that current project" suggest there are direct benefits to projects from formal KT. Interviewees also noted: ability to track progress, enhanced milestone checks, and improved change order logs, facilitating the streamlining of bid packages/scopes of work, preventing the signing of incorrect contracts, and enhanced post-project evaluation through in-depth discussions, documentation of lessons learned, and the integration of feedback into these lessons learned.

The fourth axial code, *Organizational learning due to KT* encompassed both organizational learning and adapting to changing company dynamics. This theme specifically identified the benefits of knowledge transfer between pre-construction and operations, leading to improved organizational learning. The responses: "if I share something, and it's not needed on their project it doesn't hurt for them to know it because maybe on the next project it will become relevant" and "We've been able to kind of share the knowledge from each project so that with each one you're hopefully getting a little better" illustrated this theme well. The data also pointed to KT from project management team to preconstruction helping in organizational learning by informing them about the code changes and inspection updates, assisting in subcontractor selection process based on performance, and providing information updates on general conditions items specific to different site conditions. According to interviewees, KT as it related to these things contributed to increased organizational efficiency.

Among the themes that emerged from the data in the selective coding process was that beyond the clear benefits of formal KT, there is also need for informal KT. Balance in utilization of both KT processes is needed. Responses such as "Yeah, I think having something more formal, not 100% formal would be good", "Formal is great for some experience and informal is great for little less experience", "I think both can be successful, but there has to be good oversight", "I would say we do have kind of a formal process, it's not super formal" support the need for both formal and informal approaches at SMGC's.

At some SMGCs formal KT occurred from the Pre-construction team to operations, but KT in the opposite direction (from operations to pre-construction) was informal. As such, this theme suggests the need for developing a nuanced and holistic approach to KT for SMGCs. The value for pre-construction teams was perceived as helping in vetting subcontractors and optimizing future project selection, while the value for operations was in prediction of risks during project execution.

Of interesting note, all interviewees expressed their willingness to collaborate and contribute their knowledge and experience to develop a comprehensive approach to KT. As such, even at contractors where KT is informal and additional structure may not be welcomed, a desire to share experiences appeared to be universal.

Conclusions

SMGCs utilize different knowledge transfer methods internally, making it challenging to find a one-size-fits-all approach. However, by examining the existing methods used and gathering the perspectives of project members involved in the KT process, SMGCs can pinpoint areas where they should concentrate efforts to either formalize or streamline processes for their advantage. The audience who benefits from KT process are the ones who utilize it. Selective KT or transmitting only useful knowledge is a need of every GCs. Recognizing the advantages of the KT process through the lens of its users enables small and medium GCs to grasp the significance of KT in sustaining their organizations. The perceived benefits identified by SMGCs should encourage SMGCs to focus on

formal knowledge transfer, beginning at the individual level and progressing to the organizational level.

The data indicates that SMGCs prioritize KT for employee development and engagement as their top priority. By providing formal platforms and mentorship opportunities, KT empowers employees to enhance their skills, knowledge, and engagement levels. This, in turn, can lead to a more skilled and motivated workforce, better equipped to tackle project challenges, and contribute to organizational success. Moreover, involving employees in KT initiatives can foster a sense of ownership and commitment, driving greater participation and buy-in across the organization.

KT enables individual project optimization and evaluation by providing access to relevant information, lessons learned, and best practices. By capturing and disseminating knowledge across projects, teams, and departments, SMGCs can improve decision-making, identify areas for improvement, and mitigate project risks. Moreover, KT facilitates the evaluation of project performance, allowing SMGCs to assess the effectiveness of their strategies and identify opportunities for improvement. By integrating KT into project planning, execution, and evaluation, SMGCs can drive continuous improvement and achieve better project outcomes.

By leveraging KT to facilitate organizational learning, GCs can drive continuous improvement, innovation, and long-term success. All these levels of KT are possible only through constant communication and collaboration between all the involved project teams with varied levels of experience and expertise in different types of construction. In a sense, the constant collaboration and communication necessary for success is facilitated by KT.

The existing literature suggested that small and medium-sized construction firms (SMGCs) have poor knowledge transfer (KT) processes, resulting in a failure to document and transfer knowledge effectively (Sun et al., 2019; Hartono et al.,2019). However, it is noteworthy that 61% of the sample have formal KT processes in place, suggesting that SMGCs are in fact using these methods. Furthermore, the observed benefits highlight the interest of SMGCs in not only developing formal KT methods but also streamlining existing ones. These findings challenges the notion that only large construction firms are taking advantage of KT processes (Shokri-Ghasabeh & Chileshe, 2014).

This study underscores the importance of formal knowledge transfer processes in driving organizational learning, innovation, and project success within SMGCs. The findings indicate that SMGCs should utilize both formal and informal KT methods for effective transmission of knowledge from one functional department to the other. But, SMGCs should focus more on formal KT to enhance their competitive advantage and position themselves for greatest success. Formal practices such as regular meetings, mentorship sessions, structured handoff checklists, selecting the same team during preconstruction and postconstruction for reviewing projects, and using the same project team in different projects are all effective strategies for formal KT, assisted by informal ones.

The benefits of formal KT, identified in this research, provide SMGCs a guide for the development of better KT practices within their company. SMGCs should focus on KT, particularly between pre-construction and operations, at individual, project, and organization level to maximize the benefits of KT. Ensuring existing KT practices are effective should not be overlooked either.

This study was limited to SMGC's operating in Oklahoma, with offices in the Oklahoma City Metropolitan area. As noted, participants do represent a purposive sample which is a type of convenience sampling. The convenience sample and limited location could certainly skew the data collected. The researchers acknowledge these limitations but note the saturation that occurred in the

data's prominent themes as evidence the results are reliable and generalizable at least within Oklahoma.

This study's focus was on the benefits of formal KT, as such negative aspects of KT were not considered. However, given the open nature of the interviews the researchers point out that beyond reluctance to change or adding bureaucracy no negative aspects of KTs emerged. Nevertheless future research could appropriately explore negative aspects of KT. Research considering the obstacles and facilitators of formal knowledge transfer would be appropriate. Subsequent studies could also further explore the differing perspectives of pre-construction and operations teams, as they relate to KT. Finally, the influence of emerging technologies on KT and collaboration within construction companies should be undertaken.

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