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Strategies Construction Managerial Leaders Use to Counteract Material Cost Overruns

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Walden University

College of Management and Technology

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Daniel J. van der Kuyp

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Walden University
2018

Abstract

Strategies Construction Managerial Leaders Use to Counteract Material Cost Overruns

by

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Kort-HBO Informatica, Hogeschool Zuyd, 2002

MBA, Business School Nederland, 2011

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Business Administration

Walden University

December 2018

Abstract

The project cost overruns instigated through the loss of construction materials lowers the profitability of each stakeholder significantly. The purpose of this single case study was to explore strategies managerial leaders of a large construction firm used to counteract material cost overruns successfully. The diffusion of innovation theory was the conceptual framework for this study. The target population consisted of 6 managerial leaders with experience in large construction projects adhering to waste management standards and industry certifications. Data were collected using semistructured interviews and review of company documentation. The data analysis approach involved the content analysis research method to interpret and code the verbatim transcriptions of interviews into categories. The 2 principal categories from the study data were material management and planning and the supply chain and logistics. The results of the study yielded evidence of 2 strategies to counteract the material cost overruns, which were to strengthen partnerships with the suppliers and to hold regular audits at the project sites. The implication of this study for social change includes the potential to conserve depleted land minerals and valuable land reserves from becoming landfill by providing construction managers with information about strategies to counteract material cost overruns.

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Dedication

I want to take the opportunity to dedicate this doctorate in Business Administration to my family, especially my late father who believed in me throughout his time on Earth. The night before my father entered eternity, he smiled on the fact that I would pursue a masters and doctorate. His example in life helped me persevere my calling in life to excel in all things. A doctorate is the highest award conferred by a university.

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I want to thank my family for their moral support, especially my mother for hearing me out when I progressed and stalled during my journey towards academic excellence. I want to thank my fellow students and everyone at Walden University for being a great team player and helping me achieve this terminal degree. Far and beyond all, I thank the God Almighty for helping me pursue and obtain a higher purpose in life.

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Section 1: Foundation of the Study

Even though the construction industry's contribution to society and the national gross domestic product of the United Kingdom is evident with its high employment and other economic aids (Ajayi et al., 2016), there is a downside. The activities of the U.K. construction industry have consumed up to 40% of the total energy consumption (Alwan, Jones, & Holgate, 2017). The construction industry's consumption of exhausted mineral fossils caused a severe loss of biodiversity, carbon pollution, change in land use, and climate change (Alwan et al., 2017). The effects of waste may cause project failure through an increase in operational cost, employee safety risk, and less productivity. Thus, construction managerial leaders may receive help from this research with a perspective on material cost overruns affecting the construction industry.

Background of the Problem

Construction material waste is a contemporary business problem around the globe (Niazi & Painting, 2017). In the United Kingdom, construction companies have been among the largest consumers of natural resources, and they have polluted the air, soil, and water significantly (Opoku & Ahmed, 2014). Countering construction material waste is significant because influential environmental organizations and governments around the world have been pressuring the industries for more sustainable outcomes (Yusof, Abidin, & Iranmanesh, 2016). Construction material is the most expensive and neglected asset in a construction project. This material waste problem deserved new research because for decades experienced, advanced, and certified companies that manage these

large construction projects experienced project failure (Upadhyay, Gupta, & Pandey, 2016). Heeding the construction material waste problem can lead to cost saving benefits and increased profitability (KalilurRahman & Janagan, 2015). The reduction of construction waste was also an important social contemporary issue as the growth rate of construction waste has been larger than the growth rate of urbanization (Wahi, Joseph, Tawie, & Ikau, 2016). To counteract material cost overruns during large construction projects is a significant business opportunity.

Problem Statement

The complexities of the construction industry have caused many projects to suffer from the loss of building materials and its profit (Kulkarni, Sharma, & Hote, 2017). Construction cost overrun has been a frequent problem that affected nine out of 10 megaprojects worldwide with shortfalls of over 50% (Flyvbjerg, 2014). The general business problem was that project cost overruns undermined profit. The specific business problem was that some construction managerial leaders lacked strategies to counteract material cost overruns.

Purpose Statement

The purpose of this qualitative single case study was to explore strategies successful construction managerial leaders used to counteract material cost overruns. The targeted population consisted of six managerial leaders from a single construction company in northwest England, whose company exceeded industry profitability standards. The implication for positive social change includes the potential to conserve

valuable natural land reserves from ending up as landfill. To prevent construction material from ending up in landfill implies more biodiversity through the consumption of fewer mineral resources. Mitigating the exposure of dangerous and toxic substances on landfill will create a safer and healthier environment for both society and wildlife. Counteracting the material cost overrun problem successfully might also increase the firm's profit and contribute to communities by making their essential need for buildings more accessible.

Nature of the Study

Three research methods available for researchers are (a) qualitative, (b) quantitative, and (c) mixed methods (Cunningham, 2014). Researchers use the qualitative method to obtain an in-depth understanding of a contemporary phenomenon for answering the *what*, *why*, or *how* from the participants (McCusker & Gunaydin, 2014). I discarded the need for a quantitative method because its analysis did not include the inner meanings of human action and situations in its interpretation (Abro, Khurshid, & Aamir, 2015). Similarly, I discarded the mixed method because this design was useful when studying new questions or when either the qualitative or quantitative method would not suffice to answer the research question (Sadan, 2014). The appropriate approach was the qualitative method because I interpreted the interviewees' points of view thoroughly without the need for quantitative results (Cope, 2015).

I considered four prominent qualitative research designs for this study (Lewis, 2015). The ethnographic design entails observing the behavior of participants in a culture

and within a specific social setting (Gehman et al., 2018), but this would not have allowed thorough exploration on the material cost overrun in a real-world context. The narrative researcher gains a thorough understanding of the participants' lived experiences (Thurgill, 2017). The narrative design was not appropriate because the approach excludes organizational memory and fails to capture the situation. The phenomenology approach builds its analysis on the lived experiences of the subjects and how their behavior determined the phenomenon (Sloan & Bowe, 2015), which was not the intent of this study. The single case study was the most appropriate design because material cost overrun was broad and complex and required a robust and flexible data collection approach for in-depth analysis (Murale & Preetha, 2014).

Research Question

What strategies do successful construction managerial leaders use to counteract material cost overruns?

Interview Questions

1. What strategies do you and your organization use to counteract material cost overruns during construction projects considering stakeholders who practice traditional construction?
2. What obstacles did you encounter when implementing the strategies?
3. Based on your experience, which strategy do you employ to mitigate material cost overruns when onsite construction material waste is unavoidable or present?

4. How do you or your organization assess the effectiveness of these strategies over time?
5. What additional information about strategies to counteract material cost overruns would you like to share that we have not discussed during the interview?

Conceptual Framework

Everett M. Rogers first published the diffusion of innovations theory in 1962, identifying four constructs: (a) innovation, (b) communication channels, (c) time, and (d) the social system (Rogers, 1962). The diffusion of innovations theory served as the conceptual framework for this study because the theory helped explain why project cost overruns are a contemporary and frequent problem in construction projects. Strategies that have achieved major cost savings and an improved bottom line for construction projects have been difficult to implement (Opoku, Cruickshank, & Ahmed, 2015). The construction industry's fragmented supply chain and project-based nature make adopting and diffusing innovations during these building projects a challenging task (Shibeika & Harty, 2015). The diffusion of innovations theory offered the researcher an in-depth understanding of how managerial leaders in the construction industry have counteracted material cost overruns through the adoption or rejection of innovation in a construction project (Lindgren & Emmitt, 2017). The diffusion of innovations theory provided a lens for examining effective strategies to counteract material cost overrun during construction projects to understand why construction projects kept using the same practices despite increased project cost overruns. The diffusion of innovations theory also enabled me to

understand why most construction projects have failed to adopt strategies to counteract material cost overruns over time (Aizstrauta, Ginters, & Eroles, 2015).

Operational Definitions

Business sustainability: Business sustainability is the development that considers the "triple bottom line" of people, planet, and profit (Opoku, Ahmed, & Cruickshank, 2015).

Cost overruns: Cost overruns are the change of the ratio in the original contract amount to the original contract award amount (Ahady, Gupta, & Malik, 2017).

Sustainable construction: Sustainable construction involves reducing the effects that construction activities have on the environment and enhancing its economic viability by providing safety and comfort (Opoku & Ahmed, 2014).

Sustainable development: Sustainable development, according to the World Commission on Environment and Development, strives to meet the needs of the present generation without reducing the potential of future generations (Stasiak-Betlejewska & Potkány, 2015).

Sustainability innovation: Sustainability innovation tries to help the environment or society using innovation as the tool (Pulkka & Junnila, 2015).

Assumptions, Limitations, and Delimitations

Assumptions

Research assumptions can lead to invalid analysis whenever a researcher analyzes data from a perspective or inference perceived as truth (McCusker & Gunaydin, 2014).

To increase research robustness, the researcher must consider the influence assumptions had on the outcome (McCusker & Gunaydin), as a researcher's worldview can affect assumptions because of personal inference on a specific phenomenon. Researchers inherently explored assumptions inadequately because most are general assumptions (Ajayi et al., 2015). I assumed that most large construction projects suffered from material cost overruns because these projects lacked sustainability incentives and construction technology. Another assumption was that there should have been a single standard or protocol for construction technology to compensate for the diffusion problem encountered in the construction industry.

Limitations

A common problem that limits research is bias. Limitations are always presented in research and can take different forms, such as lack of knowledge or work experience, and the implemented research method can restrict the researcher at times. One limitation of this study is that a single case study does not allow for internal validity such as the cause and effect relationship found in quantitative studies, including the bias presented during the data collection phase that may have led to inaccurate interpretations and outcomes (Murale & Preetha, 2014). The biggest limitation of this case study was its inability to generalize its findings (Maritotto, Zanni, & Moraes, 2014). The way to overcome these limitations started with recognizing them followed by using scientific measures to circumvent these weaknesses. In this inquiry, I was the only individual

charged with collecting the required data, which may have influenced the outcomes of the study.

Delimitations

Delimitations of the research are the boundaries set by the initial purpose of the investigation and its research method (Mănescu, 2014). The initial objective of this inquiry was to explore the strategies successful construction managerial leader used to counteract material cost overruns. The single case study offered an overview of how a single construction company employed strategies that successfully counteracted the material cost overrun problem that often occurred during mega construction projects. The research method allowed a thorough understanding of the complexities the company faced and how the strategy counteracted the problem. I explored strategies to counteract material cost overruns in large construction projects so that other managerial leaders can implement these strategies in their respective environment.

Significance of the Study

Contribution to Business Practice

Business leaders in the construction industry could use the findings from this study to understand the benefits of developing and implementing practical strategies that managerial leaders could use to counteract material cost overruns. The result of using these strategies can increase the opportunity for contractors to gain government contracts or global opportunities. These strategies could help avoid contractors from paying up to twice as much for construction materials (KalilurRahman & Janagan, 2015).

Construction firms that have delivered sustainable construction results have promoted their brand-image and secured business continuity. Mitigating material cost overrun may lower the waste of materials, which is of business value because onsite material waste increases the risk of injury that increases loans and insurance. Enhancing the safety of the project's onsite location could improve employee morale and reduce employee turnover. The findings of this study can help improve the business practice because the safety of construction sites may increase. The results may also increase the managerial leaders' knowledge on how to cope with the stakeholders who practice the dominant traditional construction techniques, which are prone to increase the production cost factors and threaten projects with financial losses and failure (Anerao & Deshmukh, 2016). Knowing how to overcome the barriers to innovation with stakeholders who practice traditional construction can improve business continuity for firms (Nayak & Pandey, 2016).

Implications for Social Change

The implications for a positive social change include safer, cleaner, and healthier working conditions because counteracting material costs implied less onsite material waste. Less material waste to landfill and air pollution such as carbon emissions should serve society's interest in improved social health and well-being for the current and future generations (Stasiak-Betlejewska & Potkány, 2015). The construction industry has consumed more than half of the world's natural resources (Ajayi et al., 2016), and the findings of this study may lead to the preservation of these consumed rare minerals.

Results from this research can contribute to social change because the volume of the construction industry's material waste output has surged faster than the growth rate of urbanization (Wahi et al., 2016). Countering material cost overruns in the building sector has increased the chance for a project to end within budget and on time (Upadhyay et al., 2016). Project success may improve society's living standards because its outcome would increase the number of homeowners. Less project failure can reduce the number of unfinished buildings, making communities safer, pleasant, and more attractive with more nature.

A Review of the Professional and Academic Literature

This literature review is a comprehensive synthesis and analysis of various sources on material cost overrun and its contemporary influence in major construction projects. The current economic and political environment has influenced construction stakeholders involved in a project to reach sustainable results because that would deliver economic, social, and environmental benefits. Subsequently, the topics included in this literature review informs the reader about the central research question and present important strategies business leaders have used to counteract construction material cost overruns.

The sources that I used in this professional and academic literature review consisted of peer-reviewed journal articles from academic and scholarly journals, e-journals, seminal work, and reports from government sources. Most of the peer-reviewed journal articles originated from Walden University's online business and management

library, followed by Google Scholar, and ResearchGate.net. I used Google to search for specific raw data in my preliminary research phase and government documents and reports. I only used peer-reviewed journals and controlled them for authenticity at Ulrichsweb, a global serials directory that specializes in confirming refereed sources.

The strategy that guided this search for literature began knowing the difference between the need for literature and the research question this study tries to answer (Randolph, 2009). The goal and the focus of the search strategy enable the researcher to gather primary sources needed to investigate the research question (Randolph, 2009). The reports and statics used during the preliminary research led to the inference that the construction industries' material cost overrun problem frequently appeared in large projects. When a project encountered obstacles to diffuse innovation that could solve inefficiencies, the stakeholder tended to rely on traditional practices that usually contributed to material cost overrun.

Evidence during the preliminary research implied that the diffusion of innovation theory was an acceptable conceptual framework for this study. The construction industries' complexities were the root cause of its unsustainable loss of materials. This discovery in conjunction with other evidence found in the literature led to the conclusion that there was a need to study effective strategies to counteract material cost overrun. The criteria that guided the inclusion and exclusion of this literature review search strategy was the use of a primary constructor in conjunction with a secondary theme that refined the search query. The primary terms used in this search strategy were the *construction*

industry, *construction innovation*, *material cost overrun*, and *project cost overrun*. I used the secondary topics together with the primary terms to do refined searches. The most significant secondary terms included *procurement*, *employee behavior*, *leadership*, *supply chain*, *diffusion of innovations*, *legislation*, *construction waste*, *knowledge management*, *material management*, and *managerial practices on environmental management systems* (e.g., waste management, International Organization for Standardization [ISO] 14001, life-cycle assessment, social change). This literature review consisted of six government reports, two seminal work, and 146 peer-reviewed articles. Ninety-two percent of the articles were not older than 5 years to graduation. This outcome succeeded the Walden University doctoral rubric expectation that required at least 60 peer-reviewed articles, of which 85% were within 5 years to the anticipated completion date of graduation.

To improve understanding of this literature review the terms *innovation*, *sustainability*, and *stakeholders* are important to describe. In this study, the term *stakeholders* refers to the owner, design consultants, project management consultants, general contractors, subcontractors, labor subcontractors, equipment suppliers, and others involved in a construction project (Shreena Shankari, Ambika, & Kavithra, 2017). Regarding innovation, most disciplines have defined innovation as a technology or a procedure that improves performance (Traube, Begun, Okpych, & Choy-Brown, 2017). For example, Weidman, Dickerson, and Koebel (2015) described innovation as a significant improvement in a product, process, or system that was new to the user. Vitezić and Vitezić (2014) described innovation as a change that produced a triple bottom line

that helped economic, social, and environment stakeholders. Companies have used innovation as a tool to gain a competitive advantage, especially in a turbulent market. However, innovation depends on the cooperation of several stakeholders on diverse levels (Bygballe & Ingemansson, 2014). For most professional organizations, such as social work, a change was innovative only if the outcome improved the current way of doing things (Traube et al., 2017). Rogers (1962) also explained that for innovation to diffuse successfully, the stakeholders need to adopt the change, especially in the value chain. The adoption rate of any innovation was its compatibility with the values, beliefs, and past experiences of the social system (Rogers, 1962). Managerial leaders depend on innovation to solve intricate problems when pursuing the triple bottom line, and sustainability can be a solution to counter the obstacles encountered during construction projects.

In addition to innovation, sustainability is important when counteracting material cost overrun because many construction firms certify their processes. The outcome of pursuing sustainability in the construction industry has resulted in lowered material cost overruns, which means less material waste to landfill. These companies that pursued certification have been able to redirect their efforts to work with stakeholders with a project's strategy to lower in a project. Counteracting the loss of material cost overruns happens in a construction project when the involved stakeholder use their innovation freely without interruption. However, the process of integrating and implementing sustainability in organizations is intricate because of no clear definition of sustainability

(Rodríguez-Olalla & Avilés-Palacios, 2017). Sustainability in the construction industry is used to find harmony with the natural environment that improves business continuity (Lai, Lin, & Wang, 2015). To achieve sustainability means to prevent waste and created more value and profit in time for the stakeholders involved (Opoku, Cruickshank, & Ahmed, 2015). For a construction project to end sustainably is more difficult, especially when stakeholders in the supply chain have a different meaning on the term sustainability (Opoku & Ahmed, 2014).

The Construction Industry Cost Overrun Problem

The construction industry is a significant economic indicator for any economy. The construction industry is involved in the arrangement, implementation, and monitoring of all types of civil works such as communication and energy, water supply and sewerage, and buildings that affect the socioeconomic development of any nation positively (Nayak & Pandey, 2016). Government and statistical reports have classified firms involved in building and civil engineering as a part of the construction industry (Stasiak-Betlejewska & Potkány, 2015). The construction industry has been an important economic indicator, but the industry's waste generation have had negative social and economic implications for decades. Literature has indicated that the causes to project cost overruns are 96.88% correlated with the construction material waste (Ibrahim & Shakantu, 2016). Exploring the causes that lead to material waste was important and helped understand how construction material cost overruns occurred. For example, there is a relationship between the construction industry's waste output and the depletion of

valuable mineral resources (Seneviratne, Rameezdeen, & Amaratunga, 2015). The construction industry is a large consumer of natural resources and energy-intensive products such as steel, iron, glass, and copper, which has depleted scarce mineral resources and transformed conservation land into landfills.

Waste to landfill is an environmental problem and product cost instigator for construction projects (Seneviratne et al., 2015). Proper material management is essential to increase the total profit of a company because materials made up about 60% of the total project cost (Patare & Minde, 2016). Successful strategies to counteract material cost overruns should increase the probability for a construction project to end on budget and on time. Knowing how construction projects suffer from material cost overruns may show who, where, and how financial losses occur. Counteracting construction material overruns can help construction businesses, construction clients, and the environment significantly, and obtain a "triple bottom" outcome that was essential for business continuity.

One of the ways to counteract material cost overrun is sustainability practices. Most business leaders have reported that implementing sustainability-driven activities could increase the company's brand logo, profit, and its market value (Kiron, Kruschwitz, Haanaes, Reeves, & Goh, 2013). Sustainability correlates with innovation significantly (Staub, Kaynak, & Gok, 2016). For example, digital technology has increased workforce productivity and converted manual processes into business processes to counteract material waste. Digital technology in construction projects may help collaboration among

actors, which drive innovation and reduce waste (Infrastructure and Projects Authority, 2016). Sustainability has affected business operations and is an integral part of the construction industry (Opoku, Ahmed, & Cruickshank, 2015). To obtain sustainable development in the construction industry requires investing in innovation (Pulkka & Junnila, 2015), and achieving sustainability through innovation depends on strong leadership to organize, motivate, and assign tasks to all stakeholders involved (Opoku, Cruickshank, & Ahmed, 2015). Stakeholders that combine and pursue sustainability and innovation create a synergy to counteract material cost overrun. But four barriers to innovation that have affected the construction industry are low levels of collaboration, lack of investment in innovation, organizational learning, and knowledge sharing (HM Government, 2013). The obstacles that pose barriers to innovation have also affected achieving business sustainability in the construction industry.

The nature of the construction industry has caused barriers, making coordinating stakeholders involved in a project a challenging task. One complication is the fragmented supply chain that made adopting new processes in construction projects difficult (Walasek & Barszcz, 2017). Coordinating stakeholders has produced many unforeseen problems for intra-organizational leaders because each of these stakeholders has distinctive characteristics and goals. Additionally, a survey by Karthikeyan and Manikandan (2017) showed that differentiation-related factors, such as the priority of a goal and aim, had the most influence on conflicts in construction projects. But the differences in these strategies, goals, and use of technologies make managing materials a

challenge. Construction projects complete many activities with stakeholders who are interdependent at the project level and completed through multilevel operations of specialist stakeholders from different organizations (Sackey & Akotia, 2017). Stakeholders involved in a construction project always encounter new challenges because of the industry's fragmentation (Ajayi et al., 2016). The result of these complexities entails a lack of cooperation, underinvestment in innovation, and mistrust among stakeholders. The lack of trust among stakeholders limits innovation, which is a precursor to lowering the waste of materials (Allen, Adomdza, & Meyer, 2015). Oyewobi, Windapo, and Rotimi (2015) assessed the strengths and weaknesses of contracting organizations for continuous improvement and proved that construction projects were non-innovative and traditional because the industry was complex and fragmented. Complexities make the ability for stakeholders to change difficult because of the increased risks involved.

The construction industry creates buildings and builds civil engineering work on a project basis, which also creates obstacles and barriers that make them prone to cost overruns. The long gestation period, heavy instruments, and inability to trade the output are risks that make construction projects susceptible to cost overruns (Rastogi & Trivedi, 2016). The experience gained from prior projects are not entirely applicable to new projects because the challenges are always different and require new sets of learning (Håkansson & Ingemansson, 2013). Companies may struggle to transfer learned knowledge or experience into organizational memory (Sergeeva, 2016). The lack of

innovation limits productivity in construction projects (Mariano & Casey, 2015). Another obstacle to organizational memory is the little time between projects to transform experiences into learnings (Håkansson & Ingemansson, 2013). The lack of learning has caused most construction projects to fail during times of economic recessions (Yoo & Kim, 2015).

Another challenge to counteracting material cost overruns is during the planning phase because the designers and the contractors need to find time to come together and discuss sustainable designs. What makes the meeting between the contractor and designer not feasible is that during the designer's phase most of the time the contractor is not employed because it was the designer's work that influenced which contractor to hire. Another problem that limits the planning phase is that the responsibilities of contractors and designers are different (Bygballe & Ingemansson, 2014).

Construction Project Cost Overrun and Material Waste

Many factors have caused project failure during construction projects, but the material waste factor has caused most problems compared to other factors combined. The factors that have incurred project cost overruns have been 96.88% related to the loss of construction material (Ibrahim & Shakantu, 2016). Two types of construction waste are physical and nonphysical waste. Nonphysical waste, such as asbestos, affects project cost overruns more than physical waste because nonphysical waste materials are hazardous and posed serious health risks to employees (KalilurRahman & Janagan, 2015). The physical waste is less hazardous to the environment because most included natural

material such as sand, bricks, steels, bamboo, wood, paper, vegetation, and other organic materials (KalilurRahman & Janagan, 2015). Construction waste is the collected by-product extracted from the construction work site (Shreena Shankari et al., 2017). Material waste on construction sites requires more labor, time, and capital to dispose or handle the waste, which increases project cost overruns (Patel & Patel, 2016).

A project cost overrun results whenever the closing sum at the end of a project surpassed the agreed initial amount with negative effects on the profitability (Ahady et al., 2017). Construction material constitutes about 70% of the total project cost (Kulkarni et al., 2017), and have been the biggest cost factor in a construction project; preventing material waste can lead to project success (Kulkarni et al.). Material cost overrun caused by a lack of effective management and planning results is a worldwide problem (Nayak & Pandey, 2016), with construction waste being the main concern to counteract project cost overruns. An expensive factor when dealing with onsite waste was the handling cost. Offsite project members, such as the architect, could prevent material cost overruns from happening despite that waste materialize onsite. The existing relationship between onsite and offsite factors was essential to this study's exploration of material cost overruns.

Material waste from a construction project that causes cost overruns materializes primarily at the construction site. The contractor is a leading onsite stakeholder (post-contract phase), and the designer is the offsite (pre-contract phase) leading project member that has the most influence in minimizing construction material waste. Both stakeholders play a fundamental role in preventing material waste from materializing.

Both stakeholders should consider which partner in the value chain was the best supplier for the construction project to counteract material cost overruns. The procurement stakeholder is important because at the end of the project there can be a considerable amount of unused construction material left that causes cost overrun. The lack of collaboration and coordination can cause material cost overruns between stakeholders, as the effects of design errors, scheduling mistakes, and the lack of dimensional coordination are onsite errors that cause project cost overruns (Ajayi et al., 2015). Another step to counteract material cost overrun is to partner with the supply chain network of stakeholders that accept the return of unused goods. Such an arrangement where the seller refunds returned goods is valuable because approximately 13% of the waste generated in the U.K. construction industry has been unused materials (Garba, Olaleye, & Jibrin, 2016). Both offsite and onsite strategies are effective in counteracting the material cost overruns problem in construction projects. The following section includes strategies that managerial leaders can use to counter the waste of materials and other elements that instigate material cost overruns.

Strategies

Exploring how managerial leaders used strategies to counteract material cost overruns was important. If clients continue to have dissimilar needs, and governments continue to push regulations that demand change (sustainable development), the construction industry must pursue a differentiation strategy to meet with these new demands using innovative products and services (Yoo & Kim, 2015). The fragmented

nature of the construction industry made coordinating and standardizing processes difficult because the stakeholders have differing goals, responsibilities, and strategies. The pursuit of a differentiation strategy signified the need for more specialists which in turn caused the industry to fragment even more. Tansey, Spillane, and Meng (2014) explained that a firm's strategy affects how it reacts in its environment. The literature did not publish a single article that proved or even suggested that the construction industry's fragmented nature would mend itself in the nearby future. The infrastructure of the construction industry presented many obstacles and barriers that increased material cost overruns.

The construction industry's project-based nature causes many obstacles and barriers to innovation. Knowing how the construction industry's non-innovative and traditional practices cause material cost overrun is vital to find meaningful material on the subject of counteracting material cost overruns in the literature. The outcome of project success depended on the commitment and cooperation of the stakeholders as a team to overcome obstacles together during interconnected processes. Innovation contributed to excellence once the stakeholders adopted it. Firms increased their ability to adopt innovation successfully when they started to innovate (Rajapathirana & Hui, 2018). Stakeholders involved in a construction project must have the same level of innovation capability to become effective (Rajapathirana & Hui, 2018). The relationships or the nodes between enterprises consisted of complexed interaction and cooperation (Chen & Li, 2014). Project-based work generated complex interactive patterns that consisted of

many stakeholders. This complexity caused that innovation leaders must negotiate with the stakeholders (Bygballe & Ingemansson, 2014). At times, firms must adopt a new strategy without consulting their partners to ensure survivability, which would result in increased cost overruns for projects (Karthikeyan & Manikandan, 2017). To overcome incompatibility, a company may opt to employ an open innovation strategy during projects with new stakeholders or in a new environment. Open innovation is an excellent platform to increase the understanding needed to employ skills using unique or modern technologies while absorbing the partner's skills and capabilities (Pilav-Velić & Marjanovic, 2016). Examining strategies was important for this literature review because its lack of integration among stakeholders in the construction industry was the main reason for this industry's low profitability (Udawatta, Zuo, Chiveralls, & Zillante, 2015). Stakeholders should be aware of strategies to overcome obstacles that prevented the successful diffusion of innovation during interconnected activities.

Waste management. This concept deals directly with the waste problem that affects the environment negatively. The topic of waste management was important for this study because its practices lessened the negative effects of waste that helped counteract material cost overruns. Regardless, this concept of waste management was a good strategy because its primary objective was to pursuit cost-saving strategies that affected the contractors' profitability (Shreena Shankari et al., 2017). Waste management control minimized the impact that construction activities had on the environment (Hwang & Bao Yeo, 2011). Social responsibility had increased in importance lately as a business

issue because of the many negative footprint impact industries had on the environment (Wahi et al., 2016). The application of waste management countered projects cost overruns with lowering cost. Successful waste management that eliminates waste properly increase construction site safety (Shreena Shankari et al., 2017). Projects that adhered to environmental waste management strategies reduced project cost and increased its quality (Shreena Shankari et al.). Construction firms that did not consider managing their waste lost their opportunity for growth (Yoo & Kim, 2015). Waste management avoided the exorbitant cost incurred through handling, logistics, taxes, and tipping (Seneviratne et al., 2015). Project success depended on how effective the managerial leaders controlled construction material waste because its effect required more time, effort, and capital to process. The successful application of such waste management was one such strategy that directly affected the outcome of project success. Waste management is a good business strategy and topic to counteract material cost overruns because unavoidable waste has a residual value that lessens the loss of disposed waste.

Waste management was a waste minimization technique that helped both the environment and the business with increased firm profitability. Waste management, eventually, enhances project quality while lowering cost, increase operational productivity, firm profit, and brand-image (Hwang & Bao Yeo, 2011). The social benefit from waste management was about reducing the demand for landfill spaces, which was a business concern because landfill taxes raised considerably. From 1996 to 2017, the

estimated landfill tax in the United Kingdom increased from 7 GBP to 86.10 GBP per ton of non-soil waste, which was a nonphysical waste (HM Revenue and Customs, 2017). This increase in tax cost continued to grow and multiplied more than 12 times because of landfill shortages experienced in the United Kingdom and across the globe. The need for more landfills threatened the need for valuable land reserves. The exponential growth in tax cost burdened construction companies' profitability.

Waste management has the potential to lower construction project cost overruns with up to 87% (Ibrahim & Shakantu, 2016). Exploring waste management was essential to this study because on average 94.67% of any material waste contributed to construction project cost overruns considering both physical and nonphysical waste in both the pre- and post-contract phases (Ibrahim & Shakantu, 2016). KalilurRahman and Janagan (2015) presented valuable construction waste minimization techniques from those materials that lowered the amount of waste that occurs during reuse or recycling activities. Waste management knows numerous models (e.g., the average cost estimation model, an equivalent method of cost estimation, activity-based costing model, site space for performing waste management, eliminating waste, the 3R strategy, prefabrication) that help managers with decision-making processes (Dajadian & Koch, 2014). Considering these models presented by Dajadian and Koch, the most prominent 3R strategy was the most applied model in use by the construction industry (Huang et al., 2018). The 3R strategy presented ways to counteract construction material waste effectively.

The 3R strategy. The 3R strategy helps project members with ways to reduce and prevent material waste. The theme of this study was to counteract material cost overruns, and the 3R strategy presents a practical way to deal with inevitable material waste. The 3R strategy reduces project cost overruns because construction material waste was the biggest cost factor (Patel & Patel, 2016). The objective of the 3R was to deliver sustainable results while reducing the cost that increased the lifespan of the limited landfills available (Wahi et al., 2016). The 3R framework was simple to understand and used the *reduce*, *reuse*, and *recycle* steps to deal with waste. This list followed in the order of importance while newer versions of the 3R strategy included the recovery and disposal activities in its hierarchy (Hwang & Bao Yeo, 2011). The 3R strategy is a widely adopted and effective operational strategy that lessens the effects of material waste once it happens.

The Australian government uses a modified version of the 3R strategy for its projects (see Figure 1). The processes found in Figure 1 helped lower material cost overruns through waste reduction, reuse, recycle, recovery, and dispose of techniques (Seneviratne et al., 2015). Industries in Australia need to acquaint with the 3R strategy as a part of a legal act that demands ethical practices because of the negative consequences of waste to the natural environment. This model, see Figure 1, was useful as a strategy that contractors applied to counteract material cost overruns (Hwang & Bao Yeo, 2011). Figure 1 projected a set of priorities for the efficient use of resources that the New South Wales Environment Protection Authority (2015) endorsed for use in its state-sponsored

government projects. This modified 3R strategy started from the top with the most preferred to the least preferred method on the bottom. This model represented an effective way that increased stakeholders' awareness in counteracting material cost overruns. These decisions usually motivated the stakeholders to select the right material for the project that lessened waste, increased longevity, and promoted reusability.

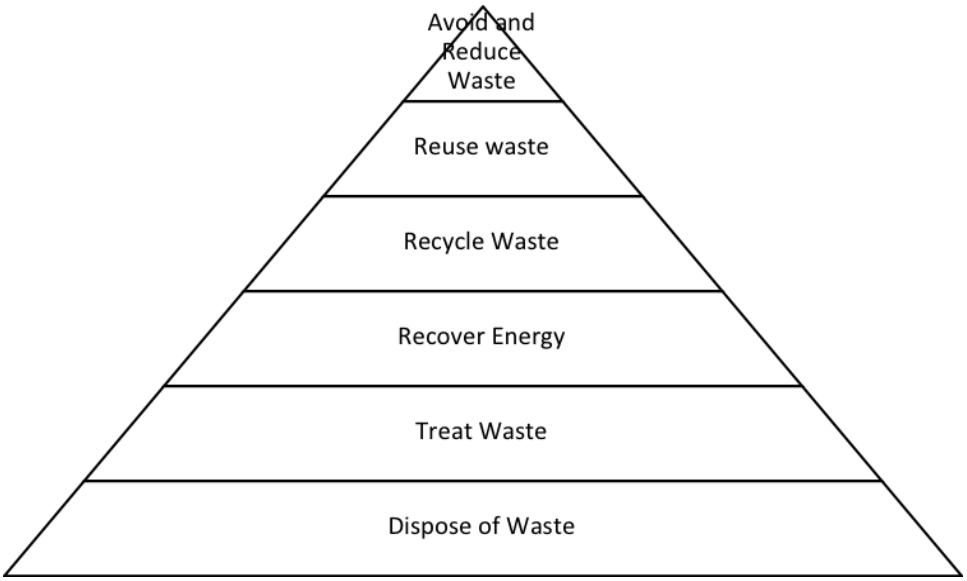

Figure 1. The waste hierarchy. The preferable option for construction projects was not always to use a recycled or synthetic material that saved on purchase capital. Sometimes the best option to counteract material waste was to select materials that created the least waste, and these options were sometimes natural materials like wood.

The reduce strategy was a waste prevention technique that prevented materials from ending up as waste. Most of the time it was the preferable course of action to take to counteract material cost overruns. Most of the time, the reduce option is the best choice because the cost incurred once waste materializes at the construction site is greater than

its prevention. Construction site waste required more resources and activities to nullify the waste effectively. Managerial leaders sought to end a project under budget and on time. The disadvantage of the reducing choice was the increased design cost that consumed more time through planning. Planning was an effective way to lower material cost overrun because most projects at the end have a surplus of about 20% of unused material left-over and end up in waste. (Dajadian & Koch, 2014). The 3R strategy presented a practical way to limit material cost overruns with its effective order of importance because construction waste was not completely avoidable.

The second option on the 3R waste hierarchy, reuse, does not consider the residual of material as waste. To use the residual material for another purpose bypassed the high cost of handling waste. The cost to store the residual material for another project was less than the accumulated cost of handling waste. This possibility prevented higher cost such as recycle or dispose of processes. Steel was a good example because its reuse did not suffer degradation in quality (Hwang & Bao Yeo, 2011). A survey conducted presented 72 factors that affected the quality of construction to a population, and the results indicated that material reuse ranked as the seventh factor and proved of value for construction processes (Jamadagni & Birajdar, 2017). Reuse of waste materials potentially reduced the cost of construction projects (Premalatha, Pavithraparvathi, Aparna, Jasmine Rubya, & Jeeshma, 2016). The reduce option prevented the contractor from buying more material. The collaboration between the designer and contractor before the start of a project may reduce the possibility of construction waste dramatically.

Recycling waste was a valuable alternative because after the processes were complete, the end-product was ready for reuse. The cost of recycling material residual may cost as much as buying new material, nonetheless, overcoming the waste problem was the same as the central research question of this study. Companies also adopted this activity for its branding strategy that aims to increase their chances on the international market or win government contracts. The recycling activity resides on the third layer of the 3R waste hierarchy, where avoidance or reuse was not feasible. Recycling avoids the cost of landfill taxes that increased exponentially in the United Kingdom for the last two decades (HM Revenue and Customs, 2017). Counteracting material cost overruns through recycling is effective and reduces most of the existing waste (Kucukvar, Egilmez, & Tatari, 2014). The recycling process was valuable because construction waste used natural minerals and costly materials like sand, aggregate, and cement found in physical waste (Mandlik, Mohammad, Morey, Malik, & Khan, 2017). The mentioned elements up to now were the original 3R strategy, and the following elements stemmed from the modified 3R strategy. Starting with the recovery of energy as the fourth option that functioned to prevent the wasting of energy that lowered project cost overruns.

The recovery of energy was a valuable way to reduce cost in the post-contract phase. A study by Rosenbaum, Toledo, and González (2014) revealed that during the execution stage, the management of pollution proved to be a cause for concern. The United Kingdom spends up to 40% of its energy consumption to activities that pertain to the construction industry, and this result has caused the U.K. Government to employ its

zero carbon policy by 2020 (Alwan et al., 2017). The unsustainable outcome of the construction industry's activities causes carbon emissions, climate change, waste generation, and loss of biodiversity, which is a threat to societies' health, and economic assets (Alwan et al.). The analysis of the energy efficiency investment costs should influence project decisionmakers with what construction technology to use, supplies of construction material, and the type of renewable energy through comparing the investment costs with the maintenance costs (Stasiak-Betlejewska & Potkány, 2015). Lean and green construction considered using devices that conserved or used renewable energy and its practices were efficient (Anerao & Deshmukh, 2016). Reducing energy during construction projects potentially served to limit project cost overruns from happening. The next element, the treatment of waste, proved itself to benefit the safety of a project at times.

The treatment of waste at times was more expensive than the repurchase of the material itself because of the accumulated cost that came with dangerous wastes like asbestos that threatened the safety and health of the employees. This option fell in line with the recovery of energy and was useful because disposing of some construction material required more water and energy, which was the precursor to global warming and project cost overruns, to make the waste safe to dispose of (Kucukvar et al., 2014). The least preferred option, which is the dispose of waste an element in the 3R strategy was the costliest of all other options in the 3R strategy and instigated the most material cost overruns.

The last level on the 3R Strategy Figure is the disposal of waste and was the least preferred option on the bottom of the waste hierarchy because the total loss of material value and the accumulated cost of eliminating the waste undermines project success through material cost overruns. The accumulated cost of eliminating the waste includes the following costs, which were handling, storing, health risk, logistics, effort, waste tipping, and waste taxes (Udawatta et al., 2015). Even advanced economies like the United Kingdom experienced about 15% on project cost overruns where construction firms pay levy tax of up to 200 million GBP yearly (Dajadian & Koch, 2014; Ibrahim and Shakantu, 2016). The bottom layer was the biggest material cost overrun instigator and the least preferred choice. The 3R strategy is a model that showed important steps to nullify construction waste.

Standardizing work processes. Standardization of work processes was a subject for this study because its application enhances consistency and circumvent unsustainable practices even in a complex social system present in large construction projects. Standardization was a topic of concern to material cost overruns because its application may help make incremental innovation feasible because of its consistency hidden problems may become more transparent. A construction project consisted of several stakeholders that worked together as a team through a temporary partnership. The uniqueness of each construction project made standardizing processes or activities in the construction industry difficult. Acquiring standardization may help solve a barrier to innovation because the stakeholders involved may build on their experiences and

learnings from prior projects. Standardization of procedures could render the traditional construction industry more innovative, which was a sustainability enabler (Vitezić & Vitezić, 2014). Standardization facilitated the diffusion of innovations and was an innovation-enabler (Yu, Zhang, & Gao, 2014). Consistency is a critical enabler of knowledge-sharing, which in turn is an innovation-enabler that lowers inefficiencies in practices consistently (Yu et al., 2014). Standardization may help support government and company policies having to do with waste management practices, which is a corporate social responsibility topic for most organizations that pursue sustainability. Maintaining a platform of openness was essential among stakeholders because most processes were interrelated (Grant, 2016). Studying these relationships between stakeholders had the potential to reveal how the construction industry complexities affected cost overruns. When partnership in a construction project encountered a synergy, standardization may stabilize construction operations. Standardization knows many benefits for partnerships and disadvantages for firms because standardizing processes may threaten a firm's competitive advantage.

Standardization of processes was of business importance because its success helped companies differentiate their product on the global market. The global market was an opportunity for firm growth, expansion, and new wealth. The problem with investing in standardizing processes in the global market came with the possibility that competitors could copy these procedures (Epuran, 2015). Competitors that copied these procedures obtained a competitive advantage without investing in research and development.

Regardless, these best practices improved the competitive advantage needed to compete in this highly competitive environment (Horta & Camanho, 2014). Construction firms must distinguish themselves in their respective business network (Lipiäinen & Karjaluoto, 2015). The competitive behavior was an essential topic for industries that were in a turbulent environment (Tansey et al., 2014). Differentiation offered firms the flexibility needed to compete in the global market and win these lucrative public contracts because the U.K. Government is the single biggest client for the construction industry (Infrastructure and Projects Authority, 2016). Construction firms in the United Kingdom that did not invest in innovation risk losing the opportunity to win lucrative public contracts because a new policy demands the use of digital solutions such as building information modeling (BIM) for all government construction projects from 2016 onward (Eadie, Odeyinka, Browne, McKeown, & Yohanis, 2014). Firms differentiated and became innovative even in their local market to become successful. Not all activities can standardize because each project is unique and comes with new challenges.

Standardization could eliminate traditional practices and dissolved a prevalent material cost overrun problem in large construction projects. Standardization can cause a domino effect throughout the whole stakeholder's network where the interconnected activities performed in a project require the involvement of other stakeholders to adopt or adapt to new practices. The knowledge needed to introduce innovation was important because the firm may obtain a competitive advantage over competitors. Timing was important to consider because if the stakeholders were not ready for the change and the

innovation failed to diffuse across the social system that signified that the company lost its initial investment (Myreteg, 2015). The construction industry is a complex network of nodes that connect during a project, and any change in norm or tradition will disrupt the workflow that causes project delay and conflict. Changes that reflect certified standards like the ISO-14001 has more chances to succeed in a complex network and will overcome many potential barriers and conflicts because the involved stakeholders understand and are aware of its implication (Żemigała, 2015). The leaders of the construction industry appreciate the positive outcome of using standards, such as ISO-14001, throughout their business network.

Managerial leaders could counteract material waste in many ways. Lean management tools such as Total Quality Management, Just in Time, and Six-Sigma increase the project management efficiency (Rosenbaum et al., 2014). These systems were essential because productivity in the construction industry has been in decline for over 40 years (Borse & Attarde, 2016). Dealing directly with material waste received a higher priority in countering the project cost overrun problem, according to Dajadian and Koch (2014). Regardless, most of these philosophies were like the steps found in the 3R strategy. The time, cost, and quality criteria were too simplistic to benchmark the success of projects (Naoum & Egbu, 2015). These requirements also conflict with each other, according to construction managers because quality compromises the cost and timeliness factor (Shanmugapriya & Subramanian, 2015). To gather relevant topics from the literature to answer the research question was essential. Material management was the

topic that followed and showed how managers could counteract the material cost overrun phenomenon effectively.

Material management. An important concept for this literature review was material management because its outcome influences material cost overruns directly. Most of the activities of material management fell under operations management that concerned itself with the input, process, and output of the firm's product as its primary objective. Material management considered planning, procurement, logistic, and inventory activities that influence the optimal use of resources and lowers operational downtime (Patare & Minde, 2016). The purpose of material management was to assure that the right materials were in the right place, in the correct quantity, and when needed (Nayak & Pandey, 2016). Managerial leaders in the construction industry could use the *Just in Time* philosophies to sustain its material management strategy because this strategy offered the ability to organize and monitor the production, which would lower project risk and optimize the use of resources (Dakhli & Lafhaj, 2018). Patare and Minde (2016) indicated that material management was a scientific process that dealt with planning, organizing, and controlling the flow of materials from the supply chain procurement partners to the location of the construction project. The primary objectives of material management are the processes of managing the distribution, selection, quality, procurement, logistical functions, and departmental efficiency of construction materials (Patare & Minde, 2016). The secondary objectives of material management concerns with planning, simplifying, standardizing, and classifying materials (Patare & Minde,

2016). Ibrahim and Shakantu (2016) stated that material waste and cost overruns were problems that caused difficulty for many construction projects to finish under budget. Discarding the proper management of materials in a construction project may result in a shortage of materials, the delivery of wrong articles, and several storage problems that undermine project success (c.q., project delay, project cost overruns) (Nayak & Pandey, 2016). Project delay increases the cost of a project and its risk. Poorly administrating material management potentially causes project delay which incurs project cost overruns.

Project delay incurs project cost overruns because operational costs are continual regardless of inactivity. Most construction projects experience project failure because they exceed the budget and do not finish on time (Niazi & Painting, 2017). Construction project delay is a widespread phenomenon around the world and firmly relates to how well managerial leaders perform material management (Upadhyay et al., 2016). Upadhyay et al. disclosed that the topmost significant delay causing factors are planning and scheduling, that is a secondary objective of material management. This list of causes of schedule delay presented two of the nine, which was the equipment associated element and the material associated element. Equipment associated factors include the shortage of equipment, frequent equipment breakdowns, and its low efficiency that has to do with the secondary objective of planning and the primary purpose of selecting the right material (Upadhyay et al., 2016). The material associated factors are modifications in material varieties and specifications during construction, destruction of arranged materials, late delivery of materials, and a shortage of construction materials (Upadhyay et al., 2016).

Strategies that deal with these risks are indispensable to manage for the outcome project success. Lowering delay through material management lowers project cost overruns because time equals money (Upadhyay et al., 2016). The benefits of material management are diverse and relate to the study's objective to counteract material cost overruns.

Material management was not a single activity and knew numerous tasks and responsibilities. The advantages of contributing to effective material management in a construction project apart from reducing direct costs include an increase in labor productivity, the improved timing between tasks, time management, quality control, better relations with suppliers, and better relations with customers (Kulkarni et al., 2017). These activities to keep productivity high and costs low compares to the outcome that operations management favors. The firm's profitability depends on the efficiency of project management that strives to obtain optimal use of their resources to counteract material cost overruns, schedule delays, and unsatisfied clients. Material management was an essential component to counteract material cost overruns successfully.

Interface management. The managerial approach of interface management is important for overcoming project complexities because large construction projects contain a large set of interconnecting activities with multiple actors. A notable problem that obstructs sustainable construction is when managerial leaders need to coordinate several stakeholders in numerous activities to finish a project. To lower the repercussion of unanticipated effects, intra-organizational leaders need to negotiate with the

stakeholders involved in a project (Bygballe & Ingemansson, 2014). Sharing responsibilities, tasks, and risks was a complex task that burdens project leaders. An intra-organizational leader could coordinate these complex activities among the stakeholders employing an effective interface management strategy. The mediocre performance of this managerial activity leads to material cost overruns because design errors, mismatched parts, systems performance failures, coordination difficulties, and construction conflicts lead to project failure (c.q., project delay, project cost overruns) (Keerthana & Shanmugapriya, 2017). Interface management helps project managers with creating realistic scheduling, safety, quality, and cost management (Keerthana & Shanmugapriya, 2017). Standardizing activities and long-term relationships are essential in overcoming this complexity problem (Bygballe & Ingemansson, 2014). The successful use of interface management counteracts material cost overruns and promotes project success. A need for knowledge exists that aims to understand this complex network of players, relationships, and communication (Moon, Han, Zekavat, Bernold, & Wang, 2016). The interface management is an important activity to secure project success during large construction projects.

The Diffusion of Innovations Problem in the Construction Industry

The diffusion of innovations is a good conceptual framework for this study because the theory describes and explains *how* and *why* material cost overruns have been a frequent problem for large construction projects. The diffusion theory explains and provides insights on factors that influence the adoption of innovation, decisions, and

actions that influence the outcome of a construction project (Lindgren & Emmitt, 2017). A similar adoption theory was a middle-range theory that explained the outcome across situations through a causal mechanism (Wisdom, Chor, Hoagwood, & Horwitz, 2014). A different theory to the adoption of innovation is the multi-level framework that focuses on the bi-directional relationship between individual and organizational level across the stages of adopting innovation (Wisdom et al.). The diffusion of innovation theory is more appropriate because the relationship perspective that these theories offer are narrow to project the *why* and *how* the construction industry fails to deal with the material cost overrun problem. Aladag, Demirdögen, and Isık (2016) proved that construction companies that diffuse innovation with stakeholders increase their chances of surviving or thriving in a competitive market. The diffusion of innovation diminished the causes that lead to material cost overruns more than any other factor. The diffusion of innovation theory considers the processes where new products and services disperse into a social network (Huhtala, Mattila, Sihvonen, & Tikkanen, 2014). The concepts of this theory presented by Rogers (1962) are innovation, communication channels, over time, and the social system. Each of these concepts is important to understand why the construction industry is slow to adopt innovation or did not change its noninnovative ways for decades.

Innovation and the construction industry's material cost overrun. Innovation was the first concept in the diffusion of innovations theorem. Often traditional practices did not consider efficiency to counteract cost overruns because the workers' mentality, in

general, was about getting the job done. Innovation was not popular in construction projects because its implementation was risky and difficult. Davidson (2013) stated that members of a project usually dealt with several stakeholders throughout the value chain where a conflict of interest existed. The diffusion of innovations theory could monitor how digital innovations diffused across complex firms (Shibeika & Harty, 2015). Still, the construction industry was witnessing a rapid escalation for the demand to exploit digital innovation for its projects (Shibeika & Harty, 2015). Zheng (2014) stated that innovation required leadership because the effects of change could cause a ripple effect throughout from the top, middle, and lower layers of an organization. Sepasgozar, Loosemore, and Davis (2016) presented innovation as a tool that could transform the industry's traditional processes. The successful diffusion of innovation could support operational performance and increases construction site safety (Delcamre, 2014). Despite Delcamre's report that innovation could reduce cost, only 45% of construction companies in the United Kingdom were active in innovation (U.K. Department for Business Innovation & Skills, 2014). Stakeholders need to meet with new project objectives, which required careful management of innovation (Bygballe & Ingemansson, 2014). Most employees had implementation problems with innovation because of the effort to streamline the old way of working with digital instruments that could overwhelm the senses of the average worker (Tarafdar, D'Arcy, Turel, & Gupta, 2015). Overcoming the barriers to innovation knew many obstacles and enhanced operational performance, which counteracts material waste naturally in this study's context.

Construction companies turned to innovation to enhance operational performance and for a competitive advantage over competitors. Construction technologies had that ability to mitigate waste, or even avoid the loss of construction material that leads to material cost overruns (Udawatta et al., 2015). Udawatta et al. studied the factors that improved the objectives of waste management, with the result that construction technology was the most significant way to minimize the generation of waste material followed by the selection of materials, which was an aspect of material management. Despite innovation abilities to improve the performance in construction projects its application suffers from many barriers of entry, and this incurs discontinuous sustainability innovation that steadily halts sustainable development in a business network with delays and over-investment in construction materials (Pulkka & Junnila, 2015). The lack of diffused innovation was morbid for organizational performance (Mariano & Casey, 2015). Discontinuous sustainability innovation halts progress to change or adapt. Another problem with innovation is the lack of skilled and knowledgeable workers with the ability to communicate and coordinate new and unfamiliar information over its business network (Huang, Wu, Lu, & Lin, 2016). The nature of the construction industry obstructed the stakeholders from developing the needed skills to collaborate and improve good relational interactions (Jelodar, Yiu, & Wilkinson, 2016). Collaboration and partnership are important aspects of this element communication channels.

Communication channels and the construction industry's material cost overrun. The second element in the spectrum of the diffusion of innovations theory is the *communication channels*, which is pivotal for project development. Communication channels, according to Rogers (1962), was the process where stakeholders shared information to reach a mutual understanding. Collaboration is the process where the dissemination of information reaches a mutual consensus between partners. Poor collaborative practices distorted the meaning of the information captured and goes lost through misinterpretation of data (To & Ko, 2016). For decision-making in a project, passing the right information to the right stakeholders was vital.

The inability to communicate with stakeholders was a precursor to material waste and counters project development and cause project delay. Communication channels are essential for material and interface management because these activities depend on transferring information to the right people, place, and time (Moon et al., 2016). The managerial leaders of a construction project need to spread the obligations, responsibilities, and risks for the project to succeed among the stakeholders (Mendis, Hewage, & Wrzesniewski, 2013). The lack of collaboration among stakeholders during a project produces a disruption that creates a lack of trust that in turn spurs more material waste (Pulkka & Junnila, 2015). Research by Moon et al. (2016) indicated that the mistrust among stakeholders involved in a project limited collaboration. Thaseena and Vishnu's survey revealed that 45.7% of the respondents blamed that poor communication

stimulated project cost overruns (2017). Without collaboration, there is more risk through a lack of transparency among the actors.

Successful collaboration among the stakeholders increases their awareness, which is the first step to counteract the material cost overrun problem. Collaboration between partners in time may raise stakeholders' awareness, especially among the construction workers, regarding its colossal construction waste and consumption problem (Udawatta et al., 2015). Collaboration enhances organizational learning and individual learning, especially during cross-functional teams (To & Ko, 2016). The success of a project depends on adequate cooperation between stakeholders with the aim to accomplish the work successfully (Moon et al., 2016). More knowledge and understanding could increase awareness among the members of the project because of the lack of awareness impedes innovation (Shi, Zuo, Huang, Huang, & Pullen, 2013). There is a need to create more awareness among project members to spur solutions that mend the problems of a fragmented social system through collaboration, learning, and synergy.

The time factor and the construction industry's material cost overrun. The time element mentioned by Rogers (1962) was the most overlooked factor to understand this adoption theory. The time aspect is closely related to the communication process because without time there was no beginning or end (Rogers, 1962). Any sequence of order in the decision-making process or development of the social system is a process with a beginning and an end that represents the time factor. Material cost overrun was a process that occurred over time and not at the end of the project. The time aspect was a

dependent factor, and yet indispensable dimension in the innovation-decision process (Rogers, 1962). Diffusion in time was both time sensitive and context-specific (Lindgren & Emmitt, 2017). The lack of time management causes the most common cost overrun in the construction industry, which is project delay (Shinde & Mata, 2016). Those involved in project control use the time factor for scheduling control purposes because project delays and project cost overruns are present everywhere around the Earth (Olawale & Sun, 2015). The investment in construction was a significant capital expenditure that required considerable effort in planning to ensure value for money (Shinde & Mata, 2016). Time is a factor that does not exist on its own and becomes tangible with processes that have a beginning and an end. The last concept of this conceptual framework of diffusion of innovations was the social system, which could represent the value chain, the construction site, or where the stakeholders hold reunions.

The social system and the construction industry's material cost overrun. The final element of the diffusion of innovations theory entails the construction industry's social system, which is any platform where the stakeholders collaborate or share activities, responsibilities, tasks, and roles among each other. The construction industry's fragmentation made introducing innovation in its social system a challenging task and explains why most projects tended to exceed its initial stipulated budget (Kulkarni et al., 2017). The social system was the platform where the stakeholders do business and make decisions. The supply chain was a network of facilities where stakeholders came together and supply customers with construction materials (Hosseini, Rameezdeen, Chileshe, &

Lehmann, 2015). In the diffusion of innovation spectrum, the social system needs to negotiate innovation through certain channels over time (Weidman & Damsgaard, 2001). The outcome of a project depends on how well this complex social system worked together to overcome the obstacles encountered. Without proper intra-organizational leadership and effective interface management, this social system would not function properly.

One method to reduce complexities was by embracing the differences and commonalities among stakeholders. Dadhich, Genovese, Kumar, and Acquaye (2015) reaffirmed that the complications found in the construction industry knew many complications that made achieving a triple bottom line difficult. How well these parties worked together dictated the realization of project success. Failure of one stakeholder in the supply chain may cause a ripple effect throughout the whole project. Active collaboration in a partnership increases the chance of creating synergy during a project that in turn helps optimize standardization and the alliance. Rogers (1962) disclosed that the complexities encountered in the social system created barriers to entry to innovation. The motive behind the partnership was to improve the profit margin and performance of the work delivered and to develop the needed skills and good relational interactions (Jelodar et al., 2016). The synergy of such a partnership was short-lived as soon as the project ended. As for last, a consolidated supply chain through partnering were two elements that improved innovation (Bygballe & Ingemansson, 2014). The whole idea behind this theory of diffusion of innovations was to advance the success of innovation in

the traditional construction industry practices. The theory resembled the current challenges in the construction industry to introduce the required change to counteract construction material cost overruns.

Transition

Section 1 included the need for researching the material cost overrun problem that most large construction projects experienced. Section 1 includes the prospectus that covered the (a) problem statement, (b) purpose statement, (c) nature of the Study, (d) research question, (e) interview questions, (f) conceptual framework, and the (g) significance of the study. Section 1 also contains the review of the professional and academic literature that presents the theory used to explore the phenomenon in its past, current, and probable future state. The literature discusses topics such as why material cost overrun materializes, why counteracting was important, how waste occurred, what current managerial strategies counter material waste, and how certifications influence companies to adhere to principles to counteract material cost overruns.

Section 2, was the proposal of this study that describes my role as the researcher and its responsibilities, including the strategies that managerial leaders used to counteract material cost overruns during construction projects. Section 2 rehearsed the prospectus' purpose statement and continued with several other parts needed to fulfill the requirements of doctoral research. These are the (a) role of the researcher, (b) participants, (c) the research method and (d) design, (e) the population and sampling, (f)

ethical research, (g) data collection instruments, and (h) techniques, (i) data organization techniques, (j) data analysis, and (k) the reliability and validity of this research.

Section 2: The Project

Purpose Statement

The purpose of this qualitative single case study was to explore strategies successful construction managerial leaders used to counteract material cost overruns. The targeted population consisted of six managerial leaders from a single construction company in northwest England, whose company exceeded industry profitability standards. The implication for positive social change includes the potential to conserve valuable natural land reserves from ending up as landfill. To prevent construction material from ending up in landfill implies more biodiversity through the consumption of fewer mineral resources. Mitigating the exposure of dangerous and toxic substances on landfill will create a safer and healthier environment for both society and wildlife. Counteracting the material cost overrun problem successfully might also increase the firm's profit and contribute to communities by making their essential need for buildings more accessible.

Role of the Researcher

I must complete several tasks such as forming questions, recruiting, and interviewing respondents as the researcher of this study. During the data collection phase, the researcher's role is to collect and to make sense of the abstract information (Moon, 2015). As the researcher, I must also deliver valid and reliable results (Bengtsson, 2016). I was involved in finding the right sample of participants from the population to deliver meaningful and in-depth information using a semistructured interview technique that

promoted dialogue (Yin, 2017). The interaction and collaboration with participants increased the accuracy of discovering and understanding the hidden perspectives and motives, which is common during the data collection (Fusch & Ness, 2015). The chosen qualitative method allowed me to capture the perspectives and experiences of crucial subjects involved in the study phenomenon (Kornhaber, de Jong, & McLean, 2015). These tasks helped make the outcome of this research holistic and robust in addition to completing the research on time and with less effort.

An important responsibility during the data collection process was to keep both the subjects and collected data confidential. The most important responsibility was to protect the involved participants including the company from harm. Before starting the inquiry, the institutional review board (IRB) approved and controlled the ethical procedures to guide me as the researcher in safeguarding the participants and their confidential data (Sutton & Austin, 2015). Before the interview started, I asked the participants to mention any concern or doubt they may have, and if they understood their rights to waiver whenever their safety came into jeopardy (Adams, 2010). When the interviewee withheld conclusive information during the intake, I worked toward mitigating any unforeseen risks to increase the accuracy of the collected data. The data collection of this study followed the procedures, standards, and protocol of the 1979 Belmont ethical codes of conduct and guidelines whenever human subjects were involved, and maintaining their safety was a priority. I included the ethical standards of the participants' region. The U.K. Research Integrity Office contained ethical instructions

for researchers on intellectual property, collecting and keeping data, and conflict of interests. To guarantee the safety of the interviewees was essential and a priority according to leading ethical codes.

Though the qualitative method's subjectivity helped in interpreting feelings and behaviors from the interviewees that were complex to understand, a subjective approach must maintain a scientific approach to lessen the negative effects of research bias and support the research (Kornhaber et al., 2015). Any prior knowledge or experience I as the researcher had with the study posed a risk to the goal and the integrity of the study (Alase, 2017). I do not have any experience researching in the construction industry, but I do have some experience researching financial topics on cost overruns that covered examining public and private investments using economic instruments. These economic evaluation instruments measured the probability of an investment with the help of indicators such as cash flow, operational costs, initial investments, time, and rate. Understanding cash flows, costs, and probability aided in examining material cost overruns. The interview participants from a large construction firm who were successful in keeping material cost overruns from surging were not related to my social or professional network.

I also took steps to mitigate bias such as using multiple coding, which can also increase the credibility and objectivity of a study (Kornhaber et al., 2015). To articulate existing research bias with the interviewee before the intake started was done to lessen the negative effects of bias, though subjectivity was inevitable (Ibrahim & Edgley, 2015).

Subjectivity in qualitative research was impossible to remove as the interviewer and interviewees are individuals. The effort to counter subjectivity increased the objectivity of the collected data and benefited the research with increased robustness.

Participants

The interviewees were successful top-level executives, project leaders, project managers, and contractors from a single large construction firm in northwest England that have experience in large construction projects. These participants with managerial and leadership positions had to know how to counteract material cost overruns when their innovation or techniques did not diffuse with stakeholders involved in the project. Neutralizing material cost overrun should increase the firm's profit because the causes of material cost overrun were 96.88% related to project cost overruns (Ibrahim & Shakantu, 2016). To understand how sustainability innovation could reduce material cost overrun the managerial leaders must know to innovate successfully (Pulkka & Junnila, 2015). The construction firm under investigation had to equal or exceed industry profitability standards because construction projects that have rendered sustainable construction outcomes were successful (Kiron et al., 2013). The single large construction company needed an ISO-14001 or equivalent certification such as the Eco-Management and Audit Scheme because social change must be part of the managerial leaders' work and vision (Żemigała, 2015). Knowing who to select as an eligible participant for an interview was an important aspect when using a purposive sampling strategy.

Obtaining access to eligible participants through the human resources department of a company offered more advantages compared to soliciting directly. The human resources specialist is a suitable candidate as the community manager for this research, who was involved in distributing invitations to the eligible candidates. A human resource department conducts the performance evaluation and training for a company's workforce (Zhai, Liu, & Fellows, 2014), meaning the human resources specialist was aware of the rights, ethics, and professional capabilities of these eligible participants at the targeted construction firm. A purposive sample strategy was used to select participants based on specific characteristics and not at random. Another way to find eligible candidates were to search for firms listed in the best building awards and was my secondary strategy to obtain participants. Knowing where to find eligible participants was part of my role.

Getting to know more about the interviewees' interests and personal life before starting the interview helped build rapport (Jacka, 2016). Because the qualitative research method is a subjective approach, I was able to develop relationships and rapport with participants (Newton, 2017). Establishing a proper working relationship with the participants helped turn the interviews into a deeper conversation and developed an atmosphere of openness and camaraderie. The interview process with the participants was temporary and subjective, yet to develop working relationship was an acceptable ethical practice because the interview was voluntary. Good interviewing skills required my empathy, knowledge of the subject, listening skills, time management skills, and organizational skills with important principled aspects (Adams, 2010). Good interviewing

techniques helped gather the right information and gauge attitudes (Jacka, 2016). I used a variety of techniques such as listening carefully, managing silence, supporting a neutral and professional behavior, allowing the interviewee to guide the interview, and emotional control (Adams, 2010).

Besides interviewing techniques to collect information, I supported the research by including the right ethical procedures. Subjective interviewing may affect the research process because both the interviewer and the interviewee may unknowingly fulfill conflicting needs that are not common with each other during the intake (Newton, 2017). To decrease this effect during the interchange of information, both the interviewer and interviewee must stay transparent and express their feelings and objections during the whole dialogue. My part was to explain the aim of the research whenever needed following an ethical code of conduct (Ibrahim & Edgley, 2015). I was also prepared for unexpected events when researching because there is no perfect design study (Bengtsson, 2016). I explained the potential benefits that affected the social, economic, and environmental aspects of the study to the interviewees to increase the accuracy of the data collected. The recording materials and raw data gathered during the data collection phase will remain safely on an encrypted and password-protected external memory drive and a cloud drive for not longer than 5 years from the date of graduation. No sensitive or objectionable data were recorded or stored.

Research Method and Design

Research Method

The three common research methods in social research are quantitative, qualitative, and mixed methods (Zou, Sunindijo, & Dainty, 2014). The appropriate research method for this study was the qualitative method because I explored the experiences of the participants to obtain an in-depth understanding of the prevalent material cost overrun problem in the construction industry (Ibrahim & Edgley, 2015). The qualitative research method was also appropriate approach to explore the human nature aspect involved in the phenomenon under study because the interaction between human behavior, attitudes, values and beliefs, goals, and cultural perspectives influences the material cost overrun problem (Kornhaber et al., 2015). The subjective information gathered from the experienced participants allowed me to develop a deeper ideogram and complex understanding of the matters through interpreting and clarifying the meaning (Zou et al., 2014). Exploring a phenomenon required a a holistic and in-depth approach to analysis.

I selected the qualitative method over the quantitative method and the mixed method research method because each construction project that has experienced material cost overruns are unique and difficult to generalize (Lai et al., 2015). The mixed method approach was not selected because doing more than one thing may lower the quality of the research due to the time, space, or ability constraints (Gerring, 2017). Additionally, the quantitative method allows for generalizable and objective results from fact-based

data, but the qualitative method allowed for an in-depth understanding of the complexities surrounding phenomena (Kornhaber et al., 2015). The qualitative research offered me a thorough understanding of the phenomenon and the ability to interpret the human condition in its real-world context (Bengtsson, 2016). Qualitative research is also appropriate whenever multiple levels of the phenomenon exist (Patty, Mumford, Bower, & Watts, 2014). Relating universal commonalities about the material cost overrun phenomenon with projects in general, which were unique, was useful for understanding how the objective relationship with the subjective expertise relate (Maritotto et al., 2014). The selected research method helped gather the data needed for the research question.

Research Design

The four possible research designs were a case study, phenomenological, ethnography, and the narrative because these designs are the most common methods applied in qualitative inquiries (Zou et al., 2014). My worldview influenced the selection of this study's research design. The case study design informs a unique issue through investigation of the events or experiences from subjects (Watts et al., 2016). The case study design is also useful whenever the phenomenon is broad and complex (Dasgupta, 2015). The single case research was appropriate for my study as opposed to multiple cases because this approach offered a deeper understanding of issues surrounding a phenomenon with a more vivid projected outcome (Maritotto et al., 2014), and a common case can capture an understanding of a usual circumstance (Yin, 2017). The multiple cases approach was not the proper design for my study because construction projects are

unique and should exclude a shallow universal understanding of a phenomenon in its respective environment (Seneviratne et al., 2015). The multiple case study usually involves comparing or contrasting two or more cases in conditions with similar findings (Cope, 2015). The right research design made gathering and analyzing the data needed to answer the research question feasible.

The other three popular research designs were less useful for gathering information. The phenomenological approach is common in qualitative research and is concerned with collecting descriptive data or lived experiences from the interviewees and creating meaning of these experiences (Alase, 2017). The narrative approach is used to try to understand personal interactions because the design distinguishes lived experiences (Thurgill, 2017). Considering the time, space, and subjects needed for the narrative and phenomenological approach, the case study design was more appropriate. Additionally, ethnography involves learning from subjects and their lifeworld experiences (Henriksen, 2015), but the ethnographic design was not suitable to explore the phenomenon in this study thoroughly.

I reached data saturation to show that this qualitative research was of the highest quality (Reinecke, Arnold, & Palazzo, 2016). No universal data saturation technique exists to reach content validity, and there was no quantifiable way to measure the right sample (Fusch & Ness, 2015), but adhering to a study design ensured the best outcome. The reliability and validity concepts in qualitative research concern with the quality of the derived data that included capturing the perspectives and experiences of the

participants and not the quantity of the sample (Boddy, 2016; Kornhaber et al., 2015). The large sample size limits the depth of analysis whereas the smaller size obstructs generalizing a single case study (Boddy, 2016). I planned to include more interviewees during the data collection process if new information continued to surface from the participants until data saturation occurred. Categorizing and abstracting data helped to distinguish if data saturation occurred (Elo et al., 2014). This data collection strategy increased the chance that the coding process gathered the themes needed to conclude. Further, sharing my perspective and bias on the phenomenon before interviewing the interviewees increased the accuracy of the information gathered, as research bias may obstruct knowing when the data collected reaches saturation.

Population and Sampling

The population for this study was top-level construction managerial leaders from a single construction company found geographically in the northwest England that was successful in counteracting material cost overrun during large construction projects in its perspective business network. The sample consisted of six experts in the field of construction purposely selected from a large construction company in England. This nonprobability sampling strategy allowed me to select a sample of the population that matched the criteria needed to answer the research question (Palinkas et al., 2015). Purposive sampling was suitable for this qualitative study to obtain the best knowledge about the research topic from the informants (Elo et al., 2014). The goal of qualitative studies is to select participants with knowledge and experience who offered both detailed

and generalizable data concerning the phenomenon of interest (Palinkas et al., 2015). The sampling technique helped assemble the right interviewees to extract the primary source of empirical data to explore the ongoing material cost overrun problem thoroughly (Sackey & Akotia, 2017).

The number of participants needed in research depended on the context the research evolved (Boddy, 2016). The six sample of participators were construction managerial leaders who guided a single and large construction company and had extensive knowledge and experience in their field. Yin (2017) revealed that a single case study did not focus on the number of samples, the design rather depended on the quality of the collected data. Experts involved in the decision-making processes, direct and control most large construction projects. These experts who have managerial leadership include career positions such as the chief executive officer, chief operating officer, chief financial officer, chief innovation officer, and chief human resources officer. Other eligible experts were the contractors, project managers, contract-makers, and environment managers are eligible participators who would suffice for reaching data saturation. The single case study was perfect for investigating a problem that allowed personalization during the data collection process (Murale & Preetha, 2014). The result of the data gathered was about quality and not about the size of the sample used (Kornhaber et al., 2015). The selected sample could guarantee the completeness of the information on material cost overrun for a thorough examination (Palinkas et al., 2015). These participators must have extensive knowledge and experience with large construction

projects. Ethical research was part of a professional and academic research rigor and needed attention.

Ethical Research

Ethical research kept a standard that adhered to several codes such as getting consent from the participants and safeguarding them from harm. Whenever human subjects were involved in an inquiry, I must adhere to the ethical practices that guaranteed the privacy and safety of the participants (McClimans, Pressgrove, & Rhea, 2016). The participant must reaffirm to the consent form obtained before the interview process started. I will send each participant an email requesting their permission with the possibility to consent using an electronic signature. Before the interview started, I requested that each participant reaffirmed their voluntary participation. The interviewees must know the goals, benefits, requirements, and the possible risks associated when participating in the inquiry. The interviewees must acknowledge that they understand the purpose and full disclosure of the study, and their willingness to take part voluntarily (Stang, 2015). King (2015) wrote that learning how to safeguard human subjects and their welfare in research was continuous because uncertainty remained. I increased the trustworthiness of the qualitative inquiry by reviewing the basic ethical standards of researching with human subjects (Goodell, Stage, & Cooke, 2016). I will ask that the interviewees sign a mandatory informed consent form for voluntary participation in the research. The signed form included the interviewees' right to withdraw from the interview process whenever the participators found that their safety or welfare was in

jeopardy or violated. Whenever the interviewee decides to opt out of the interview, I will return or destroy the signed consent because that would cancel its legitimacy for use in this research (Øye, Sørensen, & Glasdam, 2015).

The participators of an interview usually obtain incentives as a fair reward for their efforts in partaking in the interview process. This interview did not offer incentives even though the higher the stimulus, the more efficient the measure was to increase the response rate (Meuleman, Langer, & Blom, 2017). This inquiry will not compensate the interviewees because of its academic nature. I will inform the interviewees on the social and educational implication of the study. If an interviewee decided to withdraw before or during the interview, the subject might do so at free will without any negative consequences, and I will inform this study of such occurrence (Bengtsson, 2016).

The ethical considerations of an inquiry assured that the interviewees were safe from harm (Øye et al., 2015). These measures included the inability to trace the participants including the company protection against negative publication or any form of defamation. This research will adhere to the highest ethical standards under the guidance of Walden University's IRB that secured the safety of the participants (King, 2015).

To support the integrity and consistency during the data collection phase of multiple subjects, I will issue a standard letter of invitation (see Appendix B) for each eligible participant and use a fixed interview protocol (see Appendix A) for each interviewee who took part in the interview process. These invitation letters included the IRB obtained approval number to increase the invitees' awareness that this interview

intake conformed to high-grade ethical research standards (King, 2015). I will destroy all hard copies that pertained to the company or interviewees on the date of graduation. To further protect the confidentiality of the participants, I will destroy the electronic copies of the interview such as the data, sound recordings, company documents, and transcripts within 5 years from the date of graduation. I will replace the names of the participants and their respective company with a code to increase privacy protection. Once Walden University's IRB approves ethical standards of this research, it will receive an IRB referral number. Any future access to the stored data must happen under my supervision and will adhere to the same IRB guidelines that protects individuals from harm (McClimans et al., 2016). The IRB's standard will protect the participants, support the integrity and consistency during the data collection phase, and complied with contemporary ethical standards.

Data Collection Instruments

The qualitative research that explored experiences, values, knowledge, or beliefs from the participants used open-ended data collection instruments to promote dialogue (Ibrahim & Edgley, 2015). The data collection phase used the semistructured technique that offered the respondents the freedom to express their opinion with the result that the gathered information was meaningful, insightful, and in-depth (Adams, 2010). In this qualitative inquiry, I was the primary instrument during the data collection phase (Sarma, 2015).

A researcher must understand and make meaning of the collected data during the interviews (Castillo-Montoya, 2016). I have the arduous task to hear and understand the perspectives of the interviewees because of the existing research bias that influenced the quality of the data analysis (Fusch & Ness, 2015). I will adhere to a fixed open-ended semistructured interview instrument with the involved participants (see Appendix A). During each interview intake, I will set a nonjudgmental attitude to support the interviewee and to help guide the interview as a conversation (Adams, 2010). The interview process must adhere to the ethical approval policies set by the Walden IRB in a private and quiet space (Crowe, Inder, & Porter, 2015).

The subjective aspect of the qualitative approach relied on important characteristics such as reliability and validation techniques in the data collection phase to increase the rigor of its scientific work (Sarma, 2015). A qualitative inquiry gained credibility if the collected data reflected the experiences and ideas of the informants and not of the interviewer (Sarma, 2015). The first technique to achieve qualitative research rigor and credibility was member checking. Member checking lowered the possibility of researcher bias and increased the trustworthiness of qualitative results by actively involving the interviewees into checking and confirming the results (Birt, Scott, Cavers, Campbell, & Walter, 2016). I will return the interview transcripts to the interviewees for member checking and make an additional meeting if the need to change arises. For confirmation purposes, I will request the interviewee for follow-up questions to increase the trustworthiness of the interview process and value (Birt et al., 2016). The role of the

interviewer was to have the right attitude and not evoke biased responses that dishearten the interviewees to respond subjectively and stimulate their personal preferences in answering the questions (Goodell et al., 2016). I will take on the role of a servant and allow each interviewee to guide the interview as this increased the robustness needed to finish professionally.

Data Collection Technique

This single case study's purpose was to explore the material cost overrun problem that affected most construction projects. I will collect data from the respondents using interview questions that help answer the central research question that explored strategies construction managerial leaders used to counteract material cost overruns. I conducted a semistructured interview either face-to-face or with an Internet videophone technology, such as Skype, as the primary means to collect data. The interviewer captured and gave meaning to the in-depth experiences, feelings, and thoughts of the research participants through Skype or face-to-face interviewing (Adams, 2010; Hanna, 2012). I used a voice recorder application on an Apple device that transcribed the voice recording into text. A backup application on a laptop computer ran in the background for increased safety. After the interviews, I controlled the transcribed text for completeness using the voice recordings. This open-ended technique offered the flexibility to extract the right information from the participants during the interview while I tried to access the thoughts and feelings of the interviewees (Sutton & Austin, 2015). The semistructured interviews sufficed to collect the needed information that answered the central research question

(Dasgupta, 2015). I explored and analyzed the phenomenon closer using the document analysis technique (e.g., company documents, research data, or archival records) as a secondary source for data (Fusch & Ness, 2015). I offered the interviewees the opportunity to present documents that supported any claim during the interviews. Yin (2017) stated that the support of document analysis during the interviews aided data saturation because the responses are subject to the communal problem of bias, poor recall, or inaccurate articulation. The gathered documents helped secure that the interviewees were factual and on par with the interviewees' responses. The interview protocol aided in refining and preparing for the data collection phase.

The semistructured interview technique offered me the opportunity to use open-ended questions. The open-ended approach permitted interpreting the meaning of the interviewees' hidden meaning with greater accuracy through observation while keeping an active dialogue. The semistructured interview technique qualified to explore these in-depth subjective experiences of the research participants and their meaning with greater accuracy (Adams, 2010). The single sample used in a qualitative single case study could yield highly instructive information, according to Boddy (2016). Kornhaber et al. (2015) reaffirmed that the interview technique was dynamic enough to make meaning of the participants' experiences in more detail through the observation of the interactions and actions of the interviewees. The interview technique compared to other data collection instrument may deliver more descriptive and precise information (Abro et al., 2015). The weakness of interviewing was the presence of subjectivity from the interviewees that

worked counterproductive to the valid interpretation of the collected data (Abro et al., 2015). The interview technique was a flexible and practical instrument that allowed to redirect the conversation to focus on the issues that mattered most.

The semistructured technique allowed the conversation to revolve around the respondents' responses, which was a reflective way to uncover in-depth information (Goodell et al., 2016). The right sample of participants showed both detailed (depth) and a generalizable (breadth) account of the phenomenon under study resulting in data saturation (Palinkas et al., 2015). The use of document analysis during data collection was present in most case studies (Yin, 2017). Yin suggested that the strength of document analysis laid in its stability, unobtrusiveness with both specific and broad content. The challenge to conduct effective semistructured interviews laid in the amount of preparation needed to work with subjects. The interviewer guided the conversation with the interviewees emotionless, minimized research bias, and considered the ethical standards that protected human subjects (Adams, 2010). Yin (2017) illustrated that interview weakness laid in the way the poorly articulated questions led to bias. Yin continued that the respondents' reflexivity and the human error factor of reflexivity, which translated into giving what the interviewer wanted to hear, affected the answers. The weakness with relying on the document analysis approach laid in the ability for the interviewees to withhold information, and the selection bias equal to the interview questions (Yin, 2017).

After the interviews, I will perform a research activity, member checking, which lowered research bias. The dual role of a researcher as the collector and analyzer of the

data could instill the possibility of flawed data and biased results (Goodell et al., 2016). I applied member checking, which was a technique that confirmed that the captured meaning of the collected data reflected what the interviewees meant (Welch & Piekkari, 2017). I returned the interview transcript to the interviewees to assure its content. I conducted a member checking process by returning the interview transcripts for confirmation, modification, and verification where needed (Birt et al., 2016). I gave the involved participants 7 working days to submit their response. In the scenario that a participant required a transcript modification, the interviewee must submit this alteration by text and confirm the request with the community manager or me.

Data Organization Technique

Organizing how to capture a large amount of data was vital to stay effective. Data organization techniques helped prepare and manage the vast amount of incoming unstructured data that developed during the case studies. Organizing data during the data collection phase served to prevent the loss of data and kept confidential information concealed. The use of reflective journaling described the decision-making processes and the progress of the research, which increased the research rigor (Taylor & Thomas-Gregory, 2015). The reflective journal helped increase my awareness of the details that matter and organized the workload with better precision (Cathro, O'Kane, & Gilbertson, 2017). When the interaction of theory and the experience of the interviewees crossed each other, reflective journaling enhanced the learning and increased understanding through reflection (Cathro et al., 2017). I included the mind mapping technique to help

bring diverse opinions and thinking to a mutual understanding that stirred the discussion (Burgess-Allen & Owen-Smith, 2010). The self-reflection affected how I performed the qualitative work (Bengtsson, 2016). Cope (2015) argued that limiting research bias by keeping a journal that documented feelings and reactions were valuable. Reflective journaling served in the scenario when I needed to reuse the research data from this study for a different purpose and to help increase my understanding about the phenomenon through learnings, observations, and this research's metadata.

To stay organized, I used two folders to separate the type of information collected. The primary folder that held the raw interview data stored the invitation letters, audio recordings, transcripts, computerized qualitative data analysis software (CAQDAS) files, mind maps, and the reflective journaling notes. The second folder included the company documentation data collected during the preliminary search on the company that supported the aim of the study, and the documentation gathered from the respondents during the interview intakes. I labeled the digital archived files using a prefix that identified its category. For example, literature files used for analysis in the CAQDAS obtained the *lt_* prefix, and all the interviewing files obtained a fixed *intvw_* prefix.

I kept these two folders encrypted on the cloud storage of Office 365 student account for no more than 5 years as directed by the Walden University doctoral rubric guidelines manual. A reason for storing the data was to have the ability to reuse that gathered data for future further investigation, which was one of the core aims of a project that distinguished between active data management (Burgi, Blumer, & Makhlouf-Shabou,

2017). After 5 years, the concealed research data should not impose harm on the company involved because the collected data was not up-to-date information.

The cloud storage was more accessible and was a low-cost variant compared to the external hard drive that was stationary. The external memory drive used served as a backup to the archived data that was resident on the cloud storage. I stored the encrypted external memory drive in a safe place. The external memory drive protected with a password contained the two folders holding the raw research data. Only safe computers may access the research data from the cloud because public computers posed a risk. The research data was not linked to personal cloud storage account because that undermined the safety through exposure to public and unsecured networks found at wireless hotspots.

Data Analysis

The objective of this single case study was to explore strategies that managerial leaders in the construction industry used to counteract material cost overruns. Stake, a prominent research methodologist, presented four strategies to obtain data source triangulation in a case study design, and these are (a) investigator, (b) theory, (c) data source, and (d) methodological triangulation (Yazan, 2015). The methodological triangulation used multiple data sources such as semistructured interviews, document analysis, and the literature to increase the objectivity needed to ensure that the research was robust (Fusch & Ness, 2015). The document analysis assisted with the coding process and ensured that I obtained data triangulation (Dasgupta, 2015). Using techniques

and strategies to achieve data saturation and triangulation proved that the research was rigorous.

I used open-ended interview questions with a semistructured technique to promote dialogue with respondents and captured their feelings and experiences. The installed dual data collection method with member checking enhanced the understanding of a phenomenon that leads to robust and valid interpretations, which helped achieve triangulation of knowledge (Birt et al., 2016). Data analysis required critical thinking that involved streamlining the data in an iterative process to create valid themes and codes (Watkins, 2017). The proper data analysis techniques were analytical procedures that enhanced the validity and reliability of the research with steps that showed the objective truth about the phenomenon under study (Yazan, 2015).

Like the rigorous and accelerated data reduction (RADaR) technique described by Watkins (2017), as the researcher, I committed to the following five sequential and logical steps to help aid the data analysis process. I transcribed each of the interview sound recordings (a) verbatim into a structured document format followed by (b) adding each interview sequentially into a single matrix. In each record, I added attention to the similarities and contrast alike with the help of a (c) notes column. After the completion of the matrix, the sequence followed with a (d) CAQDAS like NVivo12 to advance the analysis process (Zamawe, 2015). Cope (2014) showed codifying the findings into themes. As for last (e), followed the interpretation of the codes and themes (Dasgupta, 2015). The four main identified stages were (a) decontextualization, the (b)

recontextualization, the (c) categorization, and the (d) compilation (Bengtsson, 2016). These four stages in action started with extracting the meaning of the text, then link the aim of the study to the purpose, followed by naming themes and categories, concluding the last step of analyzing to find the hidden meaning in the text and reporting these. This case study research was flexible for considering multiple sources of data from the participants, which answers the *how* and the *why* of material cost overrun problem during construction projects (Cope, 2015).

Three prominent CAQDAS software that analyzed qualitative methods were NVivo, ATLAS.ti, and MAXQDA. I selected the NVivo application over the ATLAS.ti software because its query tool was weak. I chose NVivo over the MAXQDA because Walden University supports NVivo. I discarded the RADaR technique because the CAQDAS can lower the researcher's bias and increase the objectivity surrounding the data (Welch & Piekkari, 2017). CAQDAS was a useful and practical way to analyze qualitative data that replaced the time-consuming manual tasks of analyzing data (Cope, 2014). Not all CAQDAS systems qualified to produce the analytical results for qualitative single case studies as research design and method (Cope, 2014). NVivo was a popular qualitative data management program that supported qualitative research in organizing and giving insights into unstructured data such as interviews, open-ended survey responses, company documentation, multimedia, articles, social media, and Web content (Ose, 2016). The presented CAQDAS packages were all proficient for this study's need. The most appropriate for this study was the NVivo software whose strength

lay in its flexibility and compatibility with existing research designs (Zamawe, 2015). Both the NVivo application and the case study research design allowed me to personalize and analyze the obtained data with creativity (Murale & Preetha, 2014; Zamawe, 2015). I needed to immerse in unstructured qualitative research data that needed rigorous, thorough, and efficient data analysis (Watkins, 2017). Mind mapping was a powerful tool used during the data gathering phase to aid me in getting feedback from the respondents (Burgess-Allen & Owen-Smith, 2010). The mind mapping technique helped guide and aid the dialogue with the respondents. Mind mapping may find the common themes and help ascertain if no new themes appeared and when data saturation occurred.

Qualitative research was about finding and understanding the subjective meanings and experiences of the interviewees (Crowe et al., 2015). The reason for committing to a single case study was to gain new insights and knowledge from complicated areas. Content analysis is a strategy that organizes and interprets the qualitative data, which were clusters of responses, through commonalities and differences from the interviewees' descriptions (Crowe et al., 2015). The content analysis procedures offered ways to capture the meanings hidden within the data (Crowe et al., 2015). The RADaR technique just as the content analysis strategy required to set up these categories and their frequencies (Crowe et al., 2015; Watkins, 2017). I committed to a latent analysis to uncover the underlying meaning of the text and not the manifest analysis that stayed close to what was said and did not interpret the meaning (Bengtsson, 2016). The inductive approach tried to find meaning subjects that answered the research questions (Bengtsson).

The content analysis presented realistic conclusions and did not prove the size of a unit of analysis criteria, the number of participants, or the size of the text (Bengtsson). The semistructured interview allowed me to collect both verbal and nonverbal communication, such as thoughts and feelings, from the respondents. I rehearsed the recordings for missing elements in mind maps to assure good reflection of the conversation (Burgess-Allen & Owen-Smith, 2010). I highlighted each concept of the diffusion of innovation theory during this stage to increase the meaning of the visual work and research analysis. The final analysis and write-up stage compared the results against the conceptual framework of the diffusion of innovations to find a closer meaning to the aim of the study.

Reliability and Validity

Qualitative studies need to prove that its work was scientific because the collected data was highly subjective. Primarily reliability and validity were rooted in the positivist worldview conception of research, which was a quantitative research method (Elo et al., 2014; Sarma, 2015). Qualitative studies need to prove that its approach to solving a problem was scientific because this research method was highly subjective (Sarma, 2015). The idea was to create trustworthiness of the content analysis that depended on well-saturated data (Elo et al., 2014). Giving a thorough and precise description of the participants and how their selection process took place increased the credibility of the data collected (Elo et al., 2014). Qualitative research must increase the trustworthiness of the received data to complement the credibility of the study (Elo et al., 2014).

Reliability

When a study replicated, and its outcome yielded the same results, I could safely assume that the collected data was reliable (Bengtsson, 2016). To get the same results when an inquiry replicated, a researcher took steps to stabilize the analysis process what in turn increased the trustworthiness of the outcome and the credibility of the study with valid inferences (Elo et al., 2014). Dependability referred to a consistency needed during the analyzes phase because changes in coding decisions occurred over time and that the application of these developments of recoding and relabeling must happen (Bengtsson, 2016). To obtain consistency in the results, I committed to member checking and a codes list. Member checking was a way to confirm that the results from the interviewees were complete and genuine (Birt et al., 2016). Multiple data collection instruments such as interviewing, document analysis, and member checking enabled triangulation of knowledge on a phenomenon with increased understanding as its result (Birt et al., 2016). When conducting member checking, I returned the interview transcript, and not its interpretation, to the interviewees as a confirmation that the collected data was complete and accurate. During the coding process, I increased the reliability of the outcome through the application of a codes list that described and explained the meaning of each code as to prevent cognitive change during the process of analysis (Bengtsson, 2016).

Validity

According to Bengtsson (2016), validity in a qualitative study meant that the results obtained were a genuine reflection of the phenomena under study. Bengtsson

(2016) explained that credibility corresponded to validity in the definition. The credibility of a qualitative work augments as the inquiry adhered to well defined and accepted procedures across the community of researchers (Sarma, 2015). A qualitative study that collected the right data from the right participants obtained credibility to answer the research question (Birt et al., 2016). Member checking increased the accuracy and completeness of the data collected as the participants acknowledge the validity of the content through objectivism and constructivism (Birt et al., 2016).

Transferability, according to Bengtsson (2016), was the ability to compare the results of research with other studies in different settings. Qualitative studies do not solely aim to generalize their work because the findings pertain to a small, nonrandom sample of the population from a unique setting (Sarma, 2015). Taylor and Thomas-Gregory (2015) confirmed that the case study was not about generalizing its findings, rather its interests laid in describing the details, which were transferable to a different context. To help the reader with generalizing this study's outcome in their context, I exposed the data collection and analysis procedures used.

Confirmability, the fourth criteria to obtain trustworthiness in qualitative data, regards the participants' extent of influence on the research findings excluding the research bias (Sutton & Austin, 2015). According to Sarma (2015), confirmability, was about presenting the findings in its original state and as objective as possible, without any subjectivity or deviating influence from its intended meaning from external sources such as a theory or research bias. Hott, Limberg, Ohrt, and Schmit (2015) claimed that

accurate reporting was an important ethical task. Confirmability of the findings portrayed the collected data in line with the research question in place (Elo et al., 2014). Confirmability occurred through member checking and during the dialogue with the respondents where the interviewer summarized what was said or in the form of a confirmation to the meaning of the respondent's message. The use of a reflective journal during the data collection phase sustained the research rigor because the notes presented facts, feelings, the point of views, and other essential data experienced during the data collection process that support the analysis processes (Taylor & Thomas-Gregory, 2015). Confirmability was important because the readers could draw their conclusions regarding the trustworthiness of the results (Elo et al., 2014). Editors, readers, practitioners, and researchers could critically value qualitative study findings and synthesize qualitative finding results and implement when the reporting was best (O'Brien, Harris, Beckman, Reed, & Cook, 2014).

Before starting the data collection phase, I must prepare thoroughly to prevent problems from happening. Before the actual interview took place, I reviewed the professional and ethical procedures such as dress code and cultural etiquette to help end unsolicited problems such as misunderstandings (Collins, & Cooper, 2014). I prepared for each participant considering their gender, role, and their position and influence with the organization's politics (Collins, & Cooper, 2014). After I obtained the IRB's approval to conduct the interviews, I handed the participants the interview questions a day before so that they had ample time to consider any preconception or bias regarding the material

cost overrun problem phenomenon. Qualitative research should concentrate on the quality of the gathered data and not the quantity because the amount was not a precursor to data saturation or research robustness. I allowed the participants to discuss the topic freely while I made meaning of their life experiences (Adams, 2010). The interviewees have the freedom to present their findings they deem important. I must procure that the interviewees discuss only relevant and important subjects (Crowe et al., 2015). The interviewer must discuss the same material with all the participants so that the process would elicit an in-depth description of the object of inquiry (Crowe et al., 2015). Staying consistent during the interviews with all participants would increase the reliability of the collected data.

Transition and Summary

Section 2 showed the rationale for this qualitative single case study that explored strategies some managerial leaders in the construction industry used to counteract material cost overruns. The project described each research element that directed the researcher's effort in collecting the required data to answer the central research question. I justified my preference for using a qualitative method and a case study design. This section also included the ethical description of my roles and responsibilities as a researcher, and towards the selected target population. I described how I would achieve methodological triangulation using the data collection techniques of semistructured interview and document analysis to collect in-depth information. Successively, I

explained how I would conduct each research activity and presented the findings so that the readers could draw their conclusions about the trustworthiness of the results.

Section 3 is where I commit to the research activities as described in the project phase. Furthermore, I describe the application to professional practice, the implication for social change, recommendation for action and further research, and a reflection of my experience with the research process, and as for last the summary and conclusion.

Section 3: Application to Professional Practice and Implications for Change

Introduction

The purpose of this qualitative single case study was to explore strategies successful construction managerial leaders used to counteract material cost overruns. To investigate the phenomenon, I used semistructured interviews to gather in-depth and relevant information from six managerial leaders working for a large construction company in northwest England. I conducted an open-ended question interview protocol for all interviewees taking part in the interviews. To process the qualitative data obtained from the managerial leaders into categories (themes), I used the NVivo qualitative data analysis software package. I used multiple data sources, like the semistructured interviews, company documentation, and the literature to help obtain an increased comprehension of the phenomenon. The findings, four emergent themes, showed several methods that the managerial leaders used to counteract material cost overruns successfully.

The focus of this study was to examine how a successful construction company commits to strategies that successfully counteracts project cost overruns incurred through the loss of material. In Section 3, I provide (a) the presentation of the research findings, (b) application to professional practice, (c) social change implications, (d) recommendations for action, (e) recommendations for further research, (f) reflections, and a (g) summary and the conclusion.

Presentation of the Findings

The main research question that this study answered was what strategies successful construction managerial leaders use to counteract material cost overruns. The community manager from the construction firm under study used a purposeful sampling strategy that selected the most qualified personnel. The central research question of this study influenced the purposive approach that determined the selection criteria of the interview participants (Crowe et al., 2015). I continued with the data collection process until no new information about the topic surfaced, and when I obtained enough data to answer the research question. To help decide if my study obtained data saturation, I categorized the interviewees' information into clusters of information because the background and the position of the interviewees varied. New themes stop emerging when the data collection process stops obtaining new information about the phenomenon under study (Fusch & Ness, 2015). Having rich and thick data helped obtain meaningful information that answered the central research question.

To obtain insight into the unstructured interview data, I used NVivo for the coding process. The four constructs of the diffusion of innovations theory were present during the coding process. These four constructs reflected the interviewees' responses of why the complexities found in the construction industry make counteracting material cost overruns difficult. These four constructs were also important components of strategies that prevented material cost overruns. To strengthen the validity of the obtained data, I adhered to methodological triangulation principle and used several sources of data (Fusch

& Ness, 2015). I also took notes during the interviews to increase my understanding and recognize themes during the dialogue with the interviewees (Goodell et al., 2016). I used company documents and reports to help remove research bias and help strengthen the analysis process (Joslin & Müller, 2016). I used member checking to ensure the reliability of the transcripts and the interpreted data (Birt et al., 2016). The first step in the coding process required searching the transcripts' text and labeling grouped text into codes according to its description. The codes discovered in the interview text were audit, budget, certification, collaboration, social system, innovation, time, communication channel, interface management, logistics, material cost overrun, planning process, pollution, procurement, production process, project cost overrun, standardization, training, knowledge management, material management, push management, supply chain, waste management, and project management. The second procedure was grouping the codes with similar meaning and relationship with other codes into a new one using a different label or the same description as the parent-code. In the last step, I created categories from group codes that reflected descriptions from the literature or its relation to the subject of counteracting material cost overruns (see Table 1).

Table 1

Emergent Themes and Codes

#	Emergent Themes	Codes
1	Material management and planning	Time, cost of transportation, material cost overruns, planning process, inventory.
2	Onsite production process	Time, knowledge management, logistics, procurement, safety.
3	Site meetings and inspection	Time, budget, certification, innovation, procurement.
4	Supply chain and logistics	Time, collaboration and partnership, communication channel, logistics.

During the coding process, I discovered that some interviewees presented a different perspective of a parent-code that led to subcodes. These subcodes have a relationship with the parent codes and are unique to the interviewee who introduced it. The parent-code together with the meaning of the subcodes helped discern how to label the theme's activity such as *control* or *inspection*. The company documents and the constructs of the conceptual framework confirmed that the codes that identified the categories were appropriate.

During the interview intake, I discovered that the participants' profession influenced the responses because of the different responsibilities. The roles these

interviewees performed were the site manager, contract manager, project manager, compliance manager, operations manager, health and safety director, and the human resources director. Despite the variation, its interpretation displayed a similar pattern in contrast to the concerning theme. Each theme reflected the meaning of the relationships between the codes, work procedures, activities, responsibilities, and standards performed by the concerning interviewee. I categorized one theme, material management, based on a term used in the literature. Some themes contained the description of the location where the process took place (construct), and others reflected the managerial activities conducted at the construction site. The content analysis approach used to code the labels into categories is a widely used qualitative research technique (Parry et al., 2014). I gathered the transcripts and the themes for interpretative purposes and gained a better understanding of the meaning behind the text (Crowe et al., 2015). This inductive approach with the interviewees' subjective experiences found in the transcriptions helped the process of coding the labels into categories (Crowe et al., 2015). Analyzing the emergent themes presented evidence necessary to answer the overarching research question of this study.

Emergent Theme 1: Material Management and Planning

After analyzing the interviewees' experiences about the overordering of materials, logistical cost, inventory, and the planning process problems at the construction sites, I concluded that the problem related to the material management approach (see Table 2). A content analysis of the interviewees' responses to Interview Questions 1, 2, and 3 showed

that the activities about material management were present. The presented topics from the interviewees covered areas such as delay in material delivery, inappropriate handling of supplies at the construction site, low quality of material, and poor procurement programming of stocks. Planning, organizing, control of the supplies, and the distribution of materials and equipment from purchase to the construction site are activities that concern material management (Patare & Minde, 2016).

Table 2

Material Management and Planning

Excerpts from Transcripts	Codes / Interpretation and analysis
So, what happens as you get towards the end of the project, you may actually find orders catching themselves up in the system because, you're based upon counting your stock on site. Not fully knowing, or not fully accounting for potentially either what is still in transit, or still in the order system. So, unless you've got very, very good, either site manager or yourself, kind of, on site physically, knowing, "Right, I know that I've ordered X. Y has been delivered and that's plus or minus, I need to factor that in to what we're ordering again." It becomes very complicated at that point in time.	Code: Planning process and Inventory. It is difficult for the site manager to know how much materials to order when it is unclear how much is left in the warehouse and how much is still on the way. The time factor of ordering is essential.
Now, the problem what we have, or the problem what we've experienced in the past with the materials, it's either A, the guys can waste them, and so obviously they need to order more material, so obviously that's going to be more quantities, or B, they're a little bit lazy and leave the materials lying about and they get stolen.	Code: Material Cost Overrun. Having the right amount of materials at the construction site, is as important as proper storing of the materials.
What sometimes happens is that you will get the purchasing team purchasing in the most cost-effective way from a delivery perspective, but then actually over-ordering materials.	Code: Cost of Transportation. Material cost overrun is difficult to measure against fixed cost of logistics. The cost of transportation is important.

The presented topics from the interviewees covered areas such as delay in material delivery, inappropriate handling of supplies at the construction site, low quality of material, and poor procurement programming of stocks. Proper planning is essential to

prevent material cost overruns. Table 3 shows the percentage of the participants that acknowledge the code in their responses and the number of times each code appears in the transcripts as a topic.

Table 3

Frequency of Emergent Theme: Material Management and Planning

Codes	*N*	% of participants
Planning Process	12	83.25
Cost of Transportation	7	83.25
Material Cost Overrun	7	83.25
Inventory	7	83.25

The planning process has a direct relationship with this study's conceptual framework's construct of time. The time aspect is not analyzed independently from other codes during the analysis. The time factor is a dependent variable for each process encountered for each emergent theme presented in this section. The planning process is an offsite activity responsible for equipping the workforce with the right materials and paying attention to client demands (e.g., selection of supplies). The strategy is to register all materials requirements with the purpose of creating a realistic budget that meets the client's expectations. Interviewee #1 stated:

> Now we, on site, when we do this um we have a few things in place to um help us counteract the material overruns. Um. Firstly we've got something called a

> CVIRFI register, and that is basically, it's just a manual form that they fill in when the client, who we're fitting it for, says they want this black um downpipe instead of the white downpipe that's there, because it may cost extra money um to put that black that black pipe on. Or that black nail, or whatever it is. to the building. Um. It may cost extra money to do that, so they have to fill in a CVIRFI. CVI stands for Confirmation of Verbal Instructions from the client, and RFI is Request for Information. um. Basically, what happens is they fill it in, the site manager then sends it back to our commercial department, who will then get purchasing to price it up because it may cost extra money, and we may not have budgeted for that in the initial um tender or pricing. So that's ah one area. Uhm.. (Personal Communication, 9/6/2018)

As part of the planning process, doing the surveys right is part of the strategy to prevent circumstances that increase the chances of material wastage. The site manager has an important role to fulfill at the construction site, as Interviewee #3 stated:

> Okay, so what we'll do is, eh obviously you've got a material overrun. That could be a number of things. It could be either, you know, obviously, once you do a survey, if you've not done a survey right, then obviously you're not ordering enough materials. So, we need to make sure that the surveys are done right on each property in the first place. Then what happens then is when we've got the materials come into our yard, obviously we have a storeman who who who who checks the materials against the delivery and also when the guys come in and

> collect the materials, he'll put them out per property. To make sure that obviously the right amount of materials goes out to the right right properties. (Personal Communication, 9/4/2018)

Not updating the forms may cause insufficiencies at the end of a project because the supplier that monitors site requirements against stock volumes is not up-to-date. In total 83.25% of all the interviewees presented information about the planning process and up to 12 times during the whole interview.

Interpreting the transcripts of the participating interviewees, the cost of transportation also significantly influences the decision-making process for the managerial leaders. The managerial leaders need to consider the cost factor and time factor when it comes to ordering construction materials because at the end of a project the surplus of supplies will incur material cost overruns. Interviewee #2 said:

> Because you can see as you get towards the end of a program, um if if you're doing 100 houses and you need 100 doors at the beginning, you can order 20 doors on the first lorry, and that becomes the most, you know, cost-effective way of doing it. When you get down to the last 10, you only want 10 and it might cost you as much to deliver 20 as it does 10. But obviously you don't want 10 spare doors at the end. (Personal Communication, 9/5/2018)

The interviewees also presented topics having to do with specific transportation requirements for materials and issues on the overordering of materials because of logistical cost. Most participants agreed that the cost of transportation influences the

possibility of material cost overruns. Five of the six interviewees presented the cost of transportation code throughout the transcripts. These respondents explained their point of view in Interview Questions 2, 3, 4, and 5.

The material cost overruns code represents the direct result of material wastage through design requirements and employee negligence. Employee indifference caused through laziness leads to impairment, embezzlement, or misplacement of supplies. Interviewee #4 found that “there might be just negligent negligent wastage, where people leave stuff out and it gets damaged by the rain. Or, as you say, ‘Oh I don't want that, I'll just chuck it in the skip’" (Personal Communication, 9/6/2018). Interviewee #2 added to the same with “And that's where your waste comes from, because what happens then, is those originals will either get lost, broken, left outside, damaged, and you start to re-order” (Personal Communication, 9/5/2018). The factors during both the design and operational phases are important to consider because it affects the project’s success rate.

The inventory code or storage as the interviewees called it was a part of the material management system that required stock management. The inventory level was difficult to keep an exact overview, as Interviewee #2 stated:

> And, also really, if you like, stock-control systems. Uhm so, we have, or you can have uhm again, going back to my 1,000 square meter example, I know I need 1,000 square meters um and I know that a lorry will deliver, say, 350 square meters. So, we order a lorry and there X I know that that's coming to site. From the logistical point of view, the supplier may not actually send 350. He may send

> 300 and say, "I'm going to send you another 50 to follow." And it then gets kind of very complicated, when you start to get split orders, to track what's arrived, what's not arrived, particularly if you're then trying to place another order. (Personal Communication, 9/5/2018)

The inventory aspect focused on how material ended up in the surplus and what managerial leaders did to counteract material cost overruns at the end of a project, as Interviewee #1 stated:

> Well ah I think, for that one, when we have site closures, any excess stock is returned to a central location. It's then redistributed out to other sites. Uhm I'd like to see us stop ordering so much stock towards the end of the site. I think we don't get it right, and I think we should get it right. I think we can do it … I'm from a logistic background. I'm ex-army and from … we used to have a thing called just-in-time logistics, where you order just enough to get the job done. I think that's something that we don't do it quite right, here. That doesn't say we don't get it right all the time, I just think, you know, some of the sites, we the site managers are not abhorrent to the ordering process. They over order. So, yeah. (Personal Communication, 9/6/2018)

The last thing a site manager wants is its onsite storehouse to be full of unneeded materials. The site manager (Interviewee #1) expressed difficulty obtaining the right amount of material at the right time with the help of innovation. Interviewee #5 explained that the company's software helps the surveyor control the work by saying, "Hopefully

within the next six months we should we should have a system that hopefully work and that we'll see where it goes from there really" (Personal Communication, 9/10/2018).

Emergent Theme 2: Onsite Production Process

The category of onsite production process presents the factors and onsite activities to counteract material cost overruns effectively. The interviewees introduced essential production concepts, such as Just in Time, Total Quality Management, and Lean Management philosophies. Interviewee #4 explained, "I mean, we don't do all of our materials just in time because some of them got longer lead times, but certain components ah we do Just in Time" (Personal Communication, 9/6/2018). These and other managerial elements reflected the need to create the theme onsite production process because of its relation to managerial activities at the construction site (see Table 4).

Table 4

Onsite Production Process

Excerpts from Transcripts	Interpretation and analysis
And then finally we also do a uhm review of the costs as the project continues. Because we we soon identify that if the project, is uhm the margin is lower, or the costs are higher, or skips, or or more products, then something has gone wrong with our ah our procurement and management system.	Code: Procurement Procurement is a factor closely monitored and managed to keep unwanted material from the warehouses. Preventing material in surplus is key to keep material cost overruns down.
And I may, because of site kind of logistics and sites um size um, not have sufficient space to store everything in one area.	Code: Logistics Managing logistics is key to lean management or just in time concepts to keep material costs down.
We regularly got have training for site managers because obviously we do have site managers that leave, and site managers that come in, midway through the project, so we need um we need to conduct training with them, um you know. That that is they sit with another site manager on a different site for a week or two, then they'll come in and see me, and I'll take them through this filing system.	Code: Knowledge Management Training helps individuals develop their careers and help them become more effective with work.
We also have stuff like um Health and Safety qualifications and accreditations, so we've got Safe Contractor.	Code: Safety Important consideration to keep employees

Note. The excerpts from the transcripts in Table 4 shows how the codes influenced the onsite managerial activities and decisions to counteract material cost overruns.

Table 5 displays the codes about the emergent theme and its frequency among the respondents of the interview.

Table 5

Frequency of Emergent Theme: Onsite Production Process

Codes	*N*	% of participants
Procurement	20	100
Logistics	13	83.25
Knowledge Management	8	66.65
Safety	7	33.33

Procurement concerned itself with providing construction sites with the required materials. The procurement team was responsible for selecting and providing the right materials because wrong items or changes required at the construction site incurred cost overruns. The company under study has a strategic alliance with the suppliers that kept stock levels of the required materials in check. Interviewee #1 disclosed:

> We have the system supplier who's providing us with the system, part of the accreditation that we have, they have to do a percentage check of the properties. So that helps us. If they identify any issues that's flagged up to us. And we have the client. The client is the is the best person of all to be there, because they're either always on site and they have a vested interest in making sure what we put

> on the wall is right. So, we constantly talk with them. We constantly do audits. And that's it really, I think. I can't think of much else. Is that helpful? (Personal Communication, 9/6/2018)

The contract managers use software to do stock takes and calculate if stock levels are balanced as the work progresses. Interviewee #4 affirmed, “So So come to the end of the job then, we shouldn't be we shouldn't be in a position where our stores on site are full of unwanted materials” (Personal Communication, 9/6/2018). Not having your onsite inventory stocked with the right materials proves to increase material cost overruns. Managerial leaders had the ability to temporarily stop site managers from overordering, as Interviewee #4 added:

> Then part of our regime for our site managers is that they do weekly stock takes, and send them in. If they don't do the stock take, we prevent them from ordering any more materials until their stock takes come in. So that they're fully aware of what stocks of materials and all they've got on site anyway. (Personal Communication, 9/6/2018)

Interviewee #6 stated stating the following:

> We have tried to recently implement more stock-takes without the procurement team having a weekly stock-take check from the site manager that they cannot order anymore product from our suppliers. Which we've employed that over the last eight weeks because of a few sites had too much material left over. And that seems to have really worked to ensure that we police the stock checks better so

> that uhm we have a somebody who's reviewing the stock takes. (Personal Communication, 9/11/2018)

The ordering system was a significant concern for each interviewee because any deviance reported during the audits incurred material cost overruns.

The second code logistics concerned with ordering material on time to keep production uninterrupted. This phase is not involved with the optimal logistical plan that relates time and price. Interviewee #6 found the following:

> We usually know if the project margin is lower than what we anticipated it to be, that there has either been issues with labor, there's issues with the products, there has been too many ordered or not enough ordered, meaning there's a higher cost for transport, or even we'll be able to review how many skips we've actually used and how many we anticipated at the beginning of the project. (Personal Communication, 9/11/2018)

The code logistics concerned with ensuring that the required materials were present at the construction sites. The firm under study outsources the activity of disposing cost to a logistic container company that registers each element of waste in a record. Interviewee #6 stated:

> We also we also have a uhm skip company, the companies that take our skips away. They actually measure the materials that are recyclable that we put into the skips. So as part of our ah monthly uhm management meeting we now review how much items have gone into the skips. And we're able to even say what them

> items are, and how much have been able to be recycled. (Personal Communication, 9/11/2018)

The managerial leaders consider the factor logistics because it influences when to equip the storehouses at the construction sites with construction supplies.

The third factor, knowledge management, is a code that encapsulates the learning and experience the employees build up performing their duties at the construction site. The ability to recognize problems and address these is vital to foster learning. Interviewee #1 stated:

> Whereas, I'd like to see us go to the proactive and it's difficult. I don't know how they're going to do it, or how we do it, to be fair. I am just a, I just think that sometimes being proactive will work for us better. I don't know. I'm not a fan of always reacting to the nearest crocodile in the canoe, if you like. I just think that we perhaps should get it right first time, as opposed to keep making mistakes and then getting it right. If you like. I don't know. I'm not perfect myself. I mean, there's things I make mistakes on, as everybody do. It's human nature isn't it? (Personal Communication, 9/6/2018)

When an employee commits a human error, the employee must make the most of this experience and contribute to knowledge management because experience adds to better ways of doing things. Interviewee #5 said:

> Deviancies from there, ah we pick up and we ah we then put that on the system ah for future, well I call it learning because, sometimes you ah pick up something that's been missed that shouldn't have been missed. Ah so, we learn the lessons as we go, also, you know. So, it literally closes out any unforeseen eventually. (Personal Communication, 9/10/2018)

The experiences registered in this system will help the managerial leaders understand their employees better and can guide the processes with more accuracy, Interviewee #1 presented the following:

> And then and then the last bit is the site manager's ability, that we have we have sort of have we have in the past thrown a site manager in, who really isn't a site manager. He's the site supervisor who's acting up because he wants to be a site manager. So, we're testing him to see if he can do it. And he just he just can't cope with the amount of work that he has has to do. So, it's all, sort of, learning and human error, really. (Personal Communication, 9/6/2018)

Managerial leaders make maximum profit from their knowledge management system and develop their employees' skills and at the same time lower employee turnover.

Safety is an important issue to the onsite production process category because the failure to install environmentally safe materials may end up in fines, judicial proceedings, loss of certification licenses, and material cost overruns. The company under study takes safety conscientiously adhering to five types of quality certifications such as the Contractors Health and Safety Assessment Scheme, Safe Contractor from Safety

Schemes in Procurement, ISO-9001, ISO-14001, and ISO-18001. Interviewee #1 found the following:

> We've also just recently implemented a firing a site firing system um which, it kind of gives the site manager, instead of him going off on all tangents trying to figure out where he's going to next, it gives him a sort of structure, ahh, and process, and documentations to complete throughout his work. So, he doesn't forget stuff. He doesn't so, it's all there in place and he doesn't forget anything. Um. Because obviously if the site manager forgets to do something that could incur a future cost because he's forgot to do something. And then he needs to revisit and go back, and we've already budgeted for that, and he's gone on to the next place or something like that. (Personal Communication, 9/6/2018)

The company under study issued checklist forms that presented the contractor a step-by-step guide to keep the workplace safer, as Interviewee #1 clarified:

> And it's all about managing expectations from from our side, so our Health and Safety, our, um well myself and quality and environmental, we have to manage the expectations. So we have ..., it's all about good ahhh relationships with site managers. So, you're not there to beat them … There is a stick … There is a carrot, but we don't go there to beat them or we don't go there to to to write them down and say they're not getting a bonus or anything like that. We try and work with them, to bring them up to our standards. Sometimes that isn't easy because they are um stuck in their ways, hahaha. (Personal Communication, 9/6/2018)

The site and safety management schedule is a complexed spreadsheet with several periodical safety requirements and checks during the production process from project start-up till project closure. Safety and cost are two related components that affect cost overruns.

Emergent Theme 3: Site Meetings and Inspection

The site meetings and inspection theme primarily involve the audit topic to counteract material cost overruns. The managerial leaders perform audits regularly at the construction sites. Depending on the type of review, the stakeholders join the meetings to discuss various topics on progress, budget, procurement, and costings. Some examinations require the presence of the client and others the supplier. The type of inspections that takes place at the construction site includes quality checks based on the ISO and builders' certifications of the company under study. The third emergent theme was chosen based on company documents obtained by the interviewees, which indicated that by the interviewees, which indicated that there are daily, weekly, six monthly, and yearly safety inspections on site. The contracts managers are responsible for reporting the progress of the projects to the directors on a timely basis, and the inspections include quality of the work includes certification checks of all types. Each code has a relationship with the conceptual framework element of time. Processes and activities do not exist without the element of time, and time cannot act independently (Rogers, 1962).

Table 6 presents the codes that created the third emergent theme Site Meetings and Inspection. Each code listed in Table 6 has a relationship with the conceptual

framework element of *time*. Processes and activities do not exist without the element of time, and time cannot act independently (Rogers, 1962).

Table 6

Frequency of Emergent Theme: Site Meetings and Inspection

Codes	*N*	% of participants
Innovation	13	66.65
Budget	10	83.25
Procurement	12	66.65
Certification	8	66.65

Innovation is the first element of the diffusion of innovation theory and concerns itself with the ability to improve processes with the exception that the social system adopts the change (Rogers, 1962). The managerial leaders at the construction site employ various methods to improve their operations and communicate changes with stakeholders that need the information to take decisive actions. Innovation helps with reporting the actual inventory levels with the supplier and avoid paying employees for standing time. Interviewee #5 revealed the following:

> So our so our developers ah who actually work for a ah sister company of ours, uhm doing the Proquote and Progression. They're they're in the moment … they're in a more accurate and user ah user user-friendly is. It's something you have to sit at a desktop to do it, instead of being ah able to do it live site, which is what it's

> designed work at. So basically, you're surveying a property, you punch in the measurement measurement and then this software actually tells you everything that you need, in in in quantity as well as volume, you know? So, ah it's it's a little way off but I'm sure it'll get there. (Personal Communication, 9/10/2018)

Innovation at the construction site is not about the use of technology alone. Doing things better requires a workforce that is open to change. The construction industry employees, according to Interviewee #1, were laggards when it comes to adopting innovation:

> Don't know if you've ever worked with builders, um but they are fickle breed.
>
> Interviewer interrupts: ‘a fickle breed?’.
>
> What I mean by that is, they don't like change. They've done it they have done it a certain way for years, and then when you bring something new, it takes them a long time to react to the fact that it's new. Um. (Personal Communication, 9/6/2018)

Innovation is an important topic for this study because the ability to adapt to change keeps the workforce effective in preventing material cost overruns.

The managerial leaders compare the budget unit to measure project progress during most audits. The budget code represents all the financial aspects of a project during audits. The managerial leaders during these audits, the contract manager congregates primarily with the site manager and at times with the supplier. Most of the audits highly regard the presence of the client because their participation helps with the

decision-making process. The issues discussed in the audits keep them up-to-date with the progress of the project. Interviewee #1 responded with the following:

> Costing reviews, each managers' meeting that we have, we'll have a run through of the budget for that site, and the site manager, the contract's world well, the contracts manager definitely will have a view of where he's at. So, he'll know how much he's ordered, how much has cost so far, then it goes down to not just the system that we're putting on the wall. It'll go down to manpower, it'll go down to vehicles, it'll go down to … I don't think it goes to expenses, but we do cover that. And and when I say vehicles, it'll be fuel etc., and any work we've had to carry out on it. Because we try and allocate that ah costings in to that project, if you like. So that's another thing. (Personal Communication, 9/6/2018)

The contract manager compares the current amount of materials ordered against the initial total cost of the project. The difference exposes the cost overruns on materials (Niazi & Painting, 2017). The meeting develops its discussion on cost because the managerial leaders discuss the workforce and the logistical cost of the project. The contracts manager discusses any difference in balance encountered during these meetings and investigates the cause further using the S-curve technique. Interviewee #5 presented:

> But but we we follow what's called an "S" curve. Which is, the commercial department produce a chart a chart, basically, that data goes into. So what you get is productivity against a and cash coming in, etc. Ah And what I'll print is a bit of a graph and the S curve should always run relatively level. Peaks up and peaks

> down would only marginally, with a big dip, ahm the graph doesn't like basically. So we're able to look at the graph and think, okay, we got a big dip last month. What's the issue? And then we can drill down into the ah the actual details around that with the CVR, ah the stock, the particular project itself or ah the program, where it is. Because the other thing that sometimes pops its little head in there, is on em a particular project that's set, we sometimes have what we call bolt-ons. They may add certain works on that are not always factored in soon enough in that initial month uhm, ah they obviously have an impact on the material and the productivity. So, ahm it's how quickly that gets generated into the graph before that graph recovers then, ahm so that we're able to … It's quite a transparent system basically, where ah it's almost like a red flag. You see you see a dip in that wave bar.
>
> Interviewer: Okay.
>
> and what that what that, literally, ah that alerts all of us senior managers then into realizing there's an issue on that project and we we then drill down into the details of what created that curve, as it's called, an S curve. (Personal Communication, 9/10/2018)

The site managers are responsible for the stock takes at the construction site. Maintaining the stock levels of the inventory recent helps avoid overstocking, which eventually leads to waste materials. At times, the construction site stakeholders are accountable for the actions and the results.

The third label, procurement, entails making sure that the workers use the right materials for the project. During the tender stage, managerial leaders need to inspect, that all materials required are accounted for in the budget and scheduled to the construction site, as Interviewee #5 stated:

> Right. On the ahm with the material, our our considerations upfront usually done with ah We have an ordering system, the ah probus software where everything is ah scheduled off from the tender stage, ah and that material then is put into a schedule that literally give us, not down to the the the nail, but gives a list of the ah material that we should use on that project. Right? (Personal Communication, 9/10/2018)

The managerial leaders visit the construction sites and inspect if all the stocks are registered onto their technology system and control the cost of each construction site against the initial procurement. Interviewee #6 detailed the following:

> We also have our ISO 9001, 140001, which is the environmental management system. That is checked on a yearly basis by an external auditor. Uhm. We do spot visits as a strategic management team. So myself and other directors will go out onto site to check how many of the houses have been done, how many are left, how many properties have been implemented onto progression, how many stock takes have been completed, how much the cost of procurement for that job is. So as a management team we do our own reviews. (Personal Communication, 9/11/2018)

The right choice considers purchasing price, quality, waste cost, and complying to certification standards the company adheres. Changes admitted to the construction work usually added to cost overruns and were recorded in a memorandum, as Interviewee #1 stated:

> We also have uhm regular meetings on site with the client and the system manufacturer to ensure, A, we're putting the equipment on the the wall properly and um, B, if there are any changes, they're minuted and then we can then react to those minutes. That's again fed back into commercial and then obviously fed back to purchasing for them to um go out and look for the cheapest alternative. Or, um if we've got an alternative that will do the job, we'll go back to the client, the system supplier and say, "Well, can we use this? Is this acceptable?" uhm. But again, it may uhm affect costings. So, that's what that's another recording. So, we obviously have regular meetings. (Personal Communication, 9/6/2018)

The surveys are an important instrument during the inspection process. Managerial leaders keep the survey forms recent to help keep storehouse stock level supplied with the right amount and materials. Installing the wrong materials would incur material cost overruns. Managerial leaders did a lot of surveying at the construction site, as Interviewee #1 continued:

> the lastly I was going to say, is implementing stock checks on our stock. So, that's fed back into purchasing so they know, at any one stage on that site, what stock is available. So, it's not so um important through life, or through operational life of

> the site. It's more pertinent and important when the site comes to close down. Because, they'll have all this excess stock that's probably budgeted in there, that, you know, they didn't need to budget in. So, what they'll do with that is they'll ship it across to another site that's using the same system. Or, they'll bring it back to a central point and they'll uhm keep it for when the next time we use that sort of system that we're going to fit. But it's already budgeted so um it's just a case of getting ahead of the game, I guess or sending it to another site for them to use. (Personal Communication, 9/6/2018)

The inspection of procurement during at the construction site is important to counteract material cost overruns. The use of technology is extensive during these procedures.

The certification label in this theme concerns standards that each construction project require to adhere. Waste Management program adhere to these specific standards that keep all processes sustainable that managerial leaders must consider during their inspection at the construction sites. Interviewee #1 stated:

> Um, also, we are also conducting regular training for our managers, um, which is quite important, and because obviously not every site manager is at the same standard and there's not uhm
>
> Interviewer: Yes
>
> They may have done different um companies, they've come to us from other companies that are not into external wall insulation, or uhm, so, we have to sort of try and do a training um system whereby we, um, make sure they do they relevant

> course for the system they're fitting. We also get them in and do um how to fill these documents in, why we need them filled in. When we do management meetings- Quality survey. over on the budget and stuff like that. (Personal Communication, 9/6/2018)

The construction site contains a filing system that helps the managers to comply with the ISOs standards, such as 9001, 14001, and 18001. The standards entail the environment, quality, health and safety, and installer certifications. The strategies used during work must meet or surpass the certification quality, or the auditor will request to append changes to the strategy. Interviewee #6 stated:

> We hold a different audit for different accreditation. So we have accreditation called past 20/30. It's the government's lead for the U.K. on what you need to need to implement on site when it's government funded projects. So our auditor checks that, and they have an external auditor called BBA. It's an association that checks that every building project in the U.K. is conforming to our past 20/30 framework. uhm We have that audit done every quarter. (Personal Communication, 9/11/
> 2018)

After each project finishes an association named, The British Board of Agrément, acts as an auditor that controls the completed construction site against the U.K. Government's past 20/30 accreditations. Yearly, an external auditor controls the ISO standards of the company under review.

Emergent Theme 4: Supply Chain and Logistics

The supply chain and logistics emergent theme is an important aspect to counteract material cost overruns. The managerial leaders must partner with their suppliers in the supply chain to prevent overstocking and project delay. The right material at the right time is critical to prevent unproductivity and help deliver excellent work. This emergent theme is closely related to the term material management because the supplier handles material delivery. The difference is that the supply chain is a separate entity from the contractors and a valuable stakeholder during construction projects. The codes collaboration and partnership, communication channels, and logistics in conjunction with the interviewees' meaning translated provided the description used for the current emergent theme. Table 7 shows the frequency of each code about the emergent theme Supply Chain and Logistics.

Table 7

Frequency of Emergent Theme: Supply Chain and Logistics

Codes	*N*	% of participants
Collaboration and Partnership	7	66.65
Communication Channels	12	83.25
Logistics	9	83.25

The first code, collaboration and partnership, is essential to discuss because good standing relationships with the supplier maintain the warehouse stocked with the right materials and on time. Communication, according to Rogers (1962), is the ability to reach a mutual understanding among stakeholders. Good standing relationships with stakeholders are important for managing Just in Time concepts effectively and keep costs down. Interviewee #4 affirmed:

> And if our program gets behind because of bad weather, so delaying the dates that we require these deliveries in, is actually keeping communications open with our suppliers to say that, you know, "This job is running three days behind. We don't want that material Monday now, we need it Thursday." So, it's keeping all communication channels open. If you don't keep them open, that becomes a major obstacle then. Yeah?
>
> Interviewer: Understood. Understood. Collaboration indeed is a very important um …
>
> I mean your suppliers are stakeholders as well. So, it's keeping them in the loop and everything. Not just your end your end project client who you're working for, but right down the chain to your suppliers feeding in. They're all stakeholders really. (Personal Communication, 9/6/2018)

Interviewee #4 continued:

> And then it's, obviously, before you start the contract it's having your discussions and meetings with your suppliers so that they know what the overall job

> requirement is. So that their stocking levels is sufficient to meet our site requirements based on our program. (Personal Communication, 9/6/2018)

Continual collaboration on the construction site with all stakeholders especially the suppliers during the audits prove to help obtain the desired outcome that all stakeholders desire.

The second code, communication channels, is also the second element in the diffusion of innovations theory. Managerial leaders that have the right systems in place that communicates actual information to relevant stakeholders is essential for project success. Reporting the material requirements with the stakeholders was a vital strategy to counteract material cost overruns, as Interviewee #6 stated:

> Uhm, we also use a in-house software product called Progression, which uh calculates the setting, the main settings, the measurements of each property to give us accurate ah measurement of each wall, uh taking out windows, taking out doors, so that the measurement is true to the building and ... That automatically sends off to our uh supply chain the products that we require and how many we need. Uhm. (Personal Communication, 9/11/2018)

The managerial leaders must discuss the overall job requirements with the suppliers. The interviewees admit that constant communication with clients helps achieve specific work effectively because collaboration helps with insight into abstract matters.

The logistics code from this emergent theme is different from the logistics code used at the onsite production process category. The managerial leaders considered

strategies that obtained the required materials efficiently for the storehouses while counteracting material cost overruns. Interviewee #6 stated:

> they've ordered extra product from say Belgium or Germany, uhm they've tried to utilize uhm the cost of a HGV, a heavy goods vehicle, from say Belgium. So they'll have a full load. Which will mean that they have too much product. We try to lower the chance of that going into landfill by us simply ordering, getting the material from one location to the other so that it can be used on our other sites. Uhm. (Personal Communication, 9/11/2018)

The interviewees admitted that weather and transportation time played a role in deciding when to order. Interviewee #2 said “You can then count it down and it becomes much more cost efficient at that point in time to say, "I'll I'll only have half a lorry of that, rather than having a full lorry" (Personal Communication, 9/5/2018).

Descriptive Analysis of Emergent Themes

This section is the final data analysis phase of the coding process. I analyzed the frequencies of the codes for each emergent theme and gained more insight into which activity and stakeholder were more involved with the process to counteract material cost overruns. The descriptive analysis used developed an objective overview of the relationships between the codes. The obtained objective overview helped lead to a reliable application to professional practice. Presenting the important processes, activities, and strategies to counteract material cost overruns was the focus of the application to professional practice section. The codes that made up each emergent theme

were presented each in a chart pie because figures are the easiest way to communicate the information without obscuring detail (American Psychological Association, 2010).

The code that appeared more frequent in the interview transcripts within the Material Management and Planning category was the *planning process* (see Figure 2). The planning process code appeared the most because its implementation influenced the outcome of the other codes within the emergent theme. The careful preparation of the planning process helped finish projects within budget and time. The outcome of the planning process affected all other codes present in Figure 2.

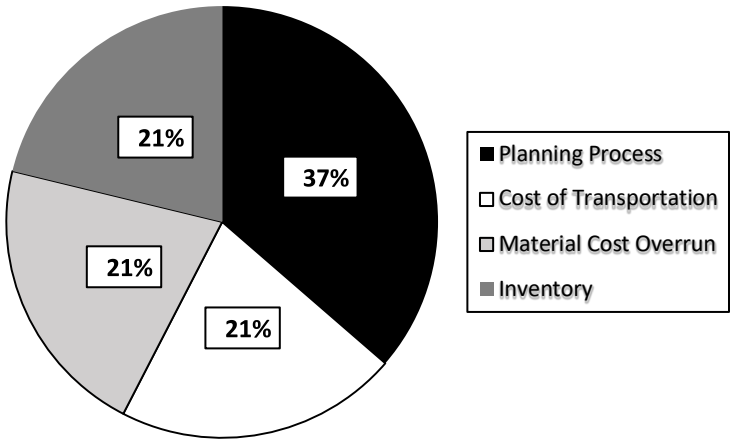

Figure 2. Code frequency analysis of category: Material management and planning.

The *onsite production process* emergent theme represents the activities that influence material cost overruns forming at the construction site. Each managerial leader of the company under study shared a perspective that regarded the code procurement (see Figure 3), and it appeared more frequent (45%) than the other codes in the emergent theme combined (see Table 5). All the interviewees acknowledged the topic of

procurement and had the highest number of frequencies throughout the interview transcriptions more than any other code. Having the right material, at the right time, and the place is the best way to prevent material cost overruns. For the company under study, having the materials in the right amount, location, and time was essential to counteract material cost overruns effectively. Any deviance of amount, place, and time will incur material cost overruns. Procurement and the second code logistics are related to each other because the amount, selection, and the over-ordering of the material depended highly on logistical cost. The codes procurement, logistics, and inventory closely resembled the activities occurring in the supply chain.

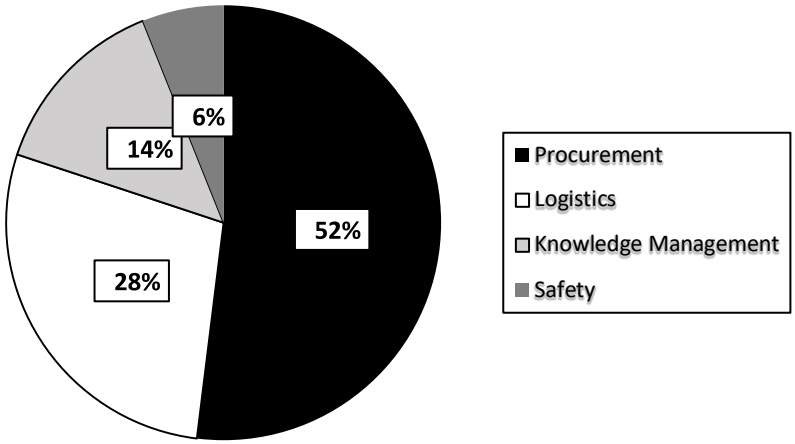

Figure 3. Code frequency analysis of category: Onsite production process.

The *site meetings and inspection* category with its codes budget, certification, innovation, and procurement are the most balanced compared to other categories (see Figure 4). The code innovation represents the use of technology to improve processes and the need to change from traditional construction to more innovative ways. The idea

behind implementing innovation is to achieve sustainable construction through the increase of operational efficiencies and a reduction of material waste. Budget and procurement are almost identical in value and meaning. The interviewees used the term budget especially during audits as a way that the contracts manager measures the cost overruns of the construction project. Managerial leaders calculate project cost overruns by reducing the final construction cost with the initial estimated cost (Niazi & Painting, 2017).

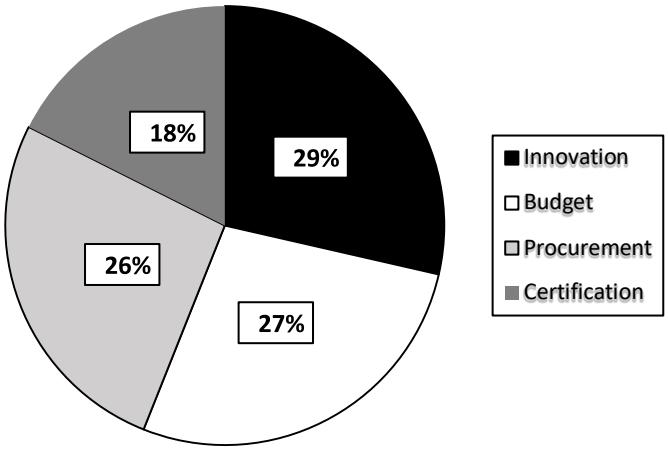

Figure 4. Code frequency analysis of category: Site meetings and inspection.

The last emergent theme *supply chain and logistics* contain the codes that resemble 80% of the codes found in the category onsite production process. The codes of the supply chain and logistics theme are the essential stakeholders and activities that influenced the strategies to counteract material cost overruns at the construction site. To engage offsite stakeholders, such as the suppliers, effectively with onsite activities required the continuous dissemination of information. The company under study relied on

innovative communication channels to enhance its collaboration and relationships with the offsite stakeholders. The effectiveness of these systems required continuous collaboration with the stakeholders. Figure 5 showed the critical codes that the supplier and construction site managers required to manage to counteract material cost overruns effectively.

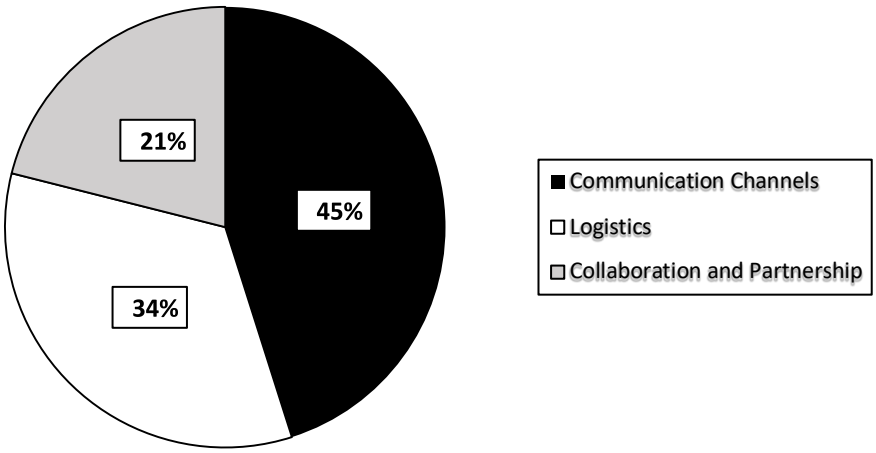

Figure 5. Code frequency analysis of category: Supply chain and logistics.

The most revealed codes of the combined themes were logistics, procurement, communication channels, planning process, innovation, budget, and the cost of transportation. The interview transcripts revealed that the systems, procedures, and planning activities met today's waste management standards. To effectively counteract material cost overruns, the builders need more skills than only craftsmanship. Critical determinants to project success were good standing relationships with the stakeholders, the ability to detect nonconformities for decision making and maintain continuous collaboration with stakeholders active.

This study identified the conceptual framework's construct *social system* in this study primarily as the construction site and the supplier. The codes encountered in the four themes that involved the suppliers are inventory, cost of transportation, procurement (2x), logistics (2x), budget, and communication channel. These eight codes of the total 15 codes covered 64% of the entire topic presented by the interviewees. These codes represented activities that involved the supplier within the social system (stakeholders). The second largest topic contained only two of the 15 codes and were the offsite activities of the planning process and knowledge management that covered 13% of the total topic discussed by the interviewees. The rest of the codes remaining codes that were five codes in total pertained to both the offsite activities and the supplier within the social system mentioned above with a total of 23% of the discussed material with the interviewees. Relevant information that answered the research question was knowing how to apply the analysis to the real world. The codes and emergent themes represented what the interviewees disclosed during interviews. These topics included strategies that were essential to counteract material cost overruns during construction projects in their perspective environment.

Application to Professional Practice

The interviewees disclosed evidence on the importance to coordinate and collaborate every activity and process during a construction project from the cradle to the grave. The ability to implement sound business practices will strengthen core values that help counteract material cost overruns effectively and support the company with business

continuity. The analysis of the transcripts revealed essential topics a single company used to counteract material cost overruns, such as engaging the supplier and the activity of auditing the delivered work against standards.

In the analysis section, the supplier's engagement in the construction project outweighed other topics in importance. The interviewees disclosed that having the right materials on time and at the right amount helped neutralize material cost overruns effectively. Conducting activities on material management effectively avoided the loss of materials by lowering the risk of exposure to factors that caused material waste. Managerial leaders planned carefully to coordinate and guide projects with greater accuracy over time. The use of software to distribute actual inventory levels to the suppliers helped to obtain the required construction material present at the construction sites. Innovation that supported onsite material management through the supplier helped obtain project success. Adequate collaboration between the stakeholders increased firm profitability and made the workforce more effective in executing the processes (Ajayi et al., 2016). Innovation helped the stakeholders collaborate more effectively and supported the mutual partnership.

Another vital strategy the interviewees discussed was how to counteract material cost overruns using periodic audits during the entire life cycle of the project. Managerial leaders held regular audits to control the processes and activities at the construction sites against numerous quality and environment standard checks that considered good business practices. Inspections that adhered to principles helped guide and coordinate activities of

a project with greater accuracy and improved the outcome of a plan to the desired result. Most of the measures that kept track of the progress during audits were the single code budget. The contract manager that controlled several sites kept track of development using the S-curve, which is a graphical project management tool used to plan, monitor, control, analyze, and forecast the status of a project. Contract managers measure the progress and performance of each construction site using the S-curve. In general, the audits managerial leaders held included controlling the outcome of the project against industry standards.

The study's findings entailed contemporary industry standards that managerial leaders used to control the project results against performance. Managerial leaders discovered problems on a timely basis and adjusted promptly. The construction workforce was a complexed social system that resisted change, according to Shibeika and Harty (2015). Each construction project was unique and required a different approach to circumvent the waste problem (Seneviratne et al., 2015). The ability of the managerial leader to forecast a project's status and taking the appropriate, timely action was critical to counteract material cost overruns. Managerial leaders, with the help of systems, examined how the activities of a project progressed over time comparing material needed against the number of materials used. In such a scenario, the managerial leaders and all stakeholders discuss the material imbalance together during the audits to take timely action.

Implications for Social Change

Nayak and Pandey (2016) stated that the minimization of material wastage during the phases of production was essential to prevent loss of profit. The implication for social change included the potential to increase employee retention through career advancement, an increase in firm profit, and less waste to landfill. Employee training and skills development increased the adoption of innovation rate in an industry that resists change (Sepasgozar et al., 2016). The benefits of employee training included an increase in employee retention and competency acquisition (Wong & Sixl-Daniell, 2015). The right strategies to counteract material cost overruns delivered sustainable results that made companies more profitable (Opoku, Cruickshank, & Ahmed, 2015). Decreasing waste to landfill was a significant cost overrun that would increase the social benefits to public health and the environment (Udawatta et al., 2015). The benefits to adhering these strategies were clear and practical to counter the problem of material cost overruns.

The implication for positive social change includes the potential for the construction industry to increase its contribution to economies around the world. Governments around the globe have trouble growing their economies without the adverse effects of the construction industry (Alwan et al., 2017). The findings from this study will help managerial leaders from construction companies understand the importance of directing resources to comply with quality standards and national values. Contracting companies who conformed to federal environmental standards were more likely to increase their chances to win lucrative government contracts.

Recommendations for Action

I encountered four main themes while analyzing the semistructured interviews and the company documents (see Table 1). Theme one and four deals primarily with the factors related to the supplier and emergent theme two and three focus on the contractors' side of counteracting material cost overruns. Imran and Yusoff (2015) stated that qualitative researchers could increase the rigor of their empirical evidence by employing a quantitative measuring tool during the content analysis approach. I measured the frequency of each code, during the content analysis, and concluded that a strategic partnership with the supplier and audits were the two prevalent topics discussed by the interviewees. Construction managerial leaders that desire to counteract material cost overruns and increase sustainable construction should consider the following recommendations.

The first recommendation to counteract material cost overruns is to use innovative systems that support the relationship between the suppliers and the managerial leaders, especially the site managers. The suppliers' engagement in the construction project outweighed in importance compared to the other partnerships to counteract material cost overruns, according to the analysis section. The interviewees disclosed that the site managers' behavior of overordering materials posed severe risks to material cost overruns. The site managers' behavior of overordering existed because they tried to prevent employee unproductivity that caused project delay. Interviewee #6 indicated the following:

> So we've had issues where site managers have been able to phone up the supply company uhm because they know the people who work there, and ask for more products, which is breaching the system of our progression to ensure that we have financial control, and control of the waste material. Rather than it going into buying too much, and it either going into uhm skips that will end up into landfill. (Personal Communication, 9/11/2018)

Interviewee #6, a director, reaffirmed:

> If they're not done then you're not allowed to order any new material. Well, for a site manager that could mean that there could be 50 to 70 people on site who are actually doing no work that day who need to be paid. So it has a real impact on uhm on the uhm job and on the margin of the job, which the site manager actually receives a bonus if they achieve it in time. uhm. (Personal Communication, 9/11/2018)

The discontinuation of one process affects the progress of other procedures and activities performed at the construction site. Innovative systems can significantly improve site managers in their decision-making processes for ordering supplies. The business constraints in innovative systems consider many factors required to decide when to purchase materials. Complexed procurement elements such as studying the number of materials needed, lead time, logistical cost, delivery time, product cost, production cost, and material waste cost inform when to resupply inventory levels. Sharing the responsibility of registering the project’s progress against the use of materials may give

the site managers more time to administer other processes that are important to the outcome of the project. The ability for auditors to take timely decisions can improve the outcome of a construction project.

The second recommendation for construction companies to consider is to perform periodic audits and at the end of each continuous project phase. Inspections are adequate managerial activities that improve the quality decision-making processes. Managerial leaders' inspections that control the work conducted by the construction workers against industry standards and certifications such as the British Publicly Available Specification 2030, ISO-9001, ISO-14001, and ISO-18001 can increase the probability of project success. These standards help managerial leaders control the quality, environment, and health and safety requirements of the project. Quality management limits poor quality results in construction projects and offers effective control over suppliers to meet client expectations while increasing profit (Shanmugapriya & Subramanian, 2015). The managerial leaders know after performing an audit which training each employee required. Collaboration during reviews helped create and raise awareness involving material waste with the construction workers (Udawatta et al., 2015). Auditing the work performed against standards increased consistency and delivered the same quality after each project. The project management tool used for auditing was the S-curve, which was a chart that displayed the progress of the project over time. The tool helped managerial leaders detect cost overrun problems during the audits, on a timely basis. The S-curve

approach revealed detailed information required to examine when and where to look for the problems.

The third recommendation is to use innovative software solutions that can measure a project's material needs. Senior managers can use software to measure a property's setting and calculate the exact quantity and volume of each required material, product, including the equipment. Sending these material requirements including the start date of the project to the suppliers on time can lower costs. Construction technologies have the potential to reduce the generation of waste (Udawatta et al., 2015). Ordering systems used by the company under study scheduled the whole process beginning from the tender stage. The software displayed the needed details of each material down to the nail size and type. Since wastage is unavoidable, the contract manager needs to measure the progress of the project against materials uses and take timely measures.

The fourth recommendation for managerial leaders is to promote a culture of learning and openness. The abrupt introduction of innovation in the construction industry creates difficulties because each stakeholder needs to adapt to the change (Bygballe & Ingemansson, 2014). Underdeveloped construction workers were likely to resist change compared to their trained counterparts (Sepasgozar et al., 2016). Construction workers, especially site managers, are quick to standardize operations because standardization usually improves consistency. The problem is that construction operations are highly interrelated with other processes, which makes controlling responsibilities challenging to manage. To increase innovation at the construction sites, managerial leaders collaborate

with the stakeholders continuously to improve adaptability to change. To make learning successful, it needs to support and not hamper interrelated processes or impede other activities and increase the flow of work. Learning capabilities increase the ability for employees to react and adapt to changes. Site managers have access to a filing system that reflects how to adjust standard procedures to new challenges. The last managerial solution is to offer the employees a quality assurance checklist that assists in delivering quality outcomes consistently through step-by-step instructions.

Construction managerial leaders should understand how the factors that cause material cost overruns can suppress the project success rate and profitability of their company. This study is relevant for the managers and leaders who are active at construction sites including the professionals who are responsible for offsite activities, such as the architects and senior managers. Applying the strategies to counteract material cost overruns could improve the company's profitability rate, win government contracts, and increase business continuity. Investing in these strategies to counteract material cost overruns.

As an agent of social change, it lays in my interest to disseminate the findings of this research with academic, professional, and industry related journals that contribute with the literature. The participants of the data collection phase will obtain the summary of the findings and any future research that relates to the phenomenon under study. Furthermore, I will publicize this doctoral study in the dissertation database of ProQuest/UMI and contribute to academia and theory development.

Recommendations for Further Research

The focus of this study examined successful strategies that managerial leaders used to counteract material cost overruns in the construction industry. The target population comprised of six managerial leaders from a single construction company located in the northwest region of England, whose company has experience with large construction projects, exceeded industry profitability, and adhered to industry certification standards. I used the methodological triangulation method to ensure that the data was rich and in-depth (Fusch & Ness, 2015). Despite the use of scientific methods to increase the reliability and the rigor of the research, each subjective interpretation suffers from researcher bias (Kornhaber et al., 2015). The first limitation was the small sample size of six managerial leaders of the targeted company that made statistical generalization impossible (Yin, 2017). The readers of this doctoral study willing to apply the findings must generalize the empirical evidence presented by comparing the similarities encountered in their environment with the company under review.

The problem encountered during the interviews was that the managerial leaders had to think deeply about the complexed factors that caused material cost overruns before answering the questions. I recommend that future studies further examine how construction companies can increase their contribution to recycling construction waste instead of outsourcing it to external companies. Research that explores strategies that make recycling construction material waste profitable for large construction companies

proves to be of value and could contribute to lasting positive social change for the larger community.

Reflections

The objective of this research was to explore strategies that managerial leaders used to counteract material cost overruns in the construction industry. I examined personal beliefs with the terms frequently found in the literature, such as innovation and sustainability, and realized that I had to append the construction industry's jargon, including the conceptual framework. The conceptual framework's theory and its constructs helped me during the coding process and understand the literature and the interview transcripts with greater accuracy. The ability to identify and classify research topics and outcomes against the conceptual framework's constructs helped remove preconceived ideas and remove personal bias. The meaning of the conceptual framework helped develop the literature review's content and understand the phenomenon under study with greater accuracy.

During the data collection phase, I soon understood that the participants were inclined to discuss the factors of what went wrong without presenting strategies. I subtly altered the discussion of the interviewees to talk about the successful strategies that solved the problem. Focusing on the strategies delivered more insight on how the managerial leaders counteracted material cost overruns. The interview data obtained from the interviewees was saturated because each code pertained to one or more categories and each interviewee discussed each code. I learned that innovative systems are essential

components to counteract material cost overruns successfully and cannot replace crucial manual labors such as audits that perform objective examinations of the construction site's progress.

Conclusion

The purpose of this qualitative single case study was to explore strategies successful construction managerial leaders used to counteract material cost overruns. The interview questions gathered useful and specific information to answer this study's central research question that was what strategies do successful construction managerial leaders use to counteract material cost overruns. I used interview transcripts from six managerial leaders, company documentation, and the literature to triangulate the data. The emerging themes were (a) material management and planning, (b) onsite production process, (c) site meetings and inspection, and (d) supply chain and logistics. The codes about these categories are 100% evident in the literature review. The company documents obtained from the interviewees pertained to the two major themes of site meetings and inspection and material management and planning. The conceptual framework's constructs innovation, communication channels, time, and the social system were the critical points encountered in the interview transcripts. These key points were essential to counteract material cost overruns. The relationship between the conceptual framework, the literature review, and the interview transcripts proves that the study obtained data triangulation. The two principal points induced through statistical inferences during the content analysis was that the use of innovation enhanced partnership with the supplier

and supported the auditing process as essential strategies to counteract material cost overruns.

The content analysis process used a holistic approach starting from the coding process, creation of themes, use of statistical inferences, and interpreting the results. These findings may help managerial leaders increase firm profitability and business continuity using the presented strategies with caution. Construction managerial leaders can assess and generalize this study's findings with their environment and the company's policies. Companies that adhere to strategies to counteract material cost overruns contribute to the environment. The business advantages for construction firms that comply with these study's findings include an increase in firm profitability, more business continuity, less project delay, and an increased employee retention rate.

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Appendix A: Interview Protocol

Interview process checklist	What to Say
• Introduce the interview and explain the purpose of the study to the respondent.	Thank you for your effort and time to show up for this interview. For one last time, please reconfirm that I have your approval to record our session and take notes as we go along.
• Ask if there are any questions and quickly clarify the purpose and content of the signed release form the interviewee must sign.	On [Date] at [Time] I have received your signed consent on the release form. As explained before, this interview is entirely voluntary and will not reimburse your efforts for compensation because of its academic attributes. If there are no more concerns, with your permission, I would like to start this interview.
• Briefly acknowledge the rights to confidentiality verbally and the intent of the interview. Assign a code to the release form.	My primary goal is to gather professional information from [preferred name] with the intention to inform my study, but whenever you feel that your safety is in jeopardy, you may opt out from this interview. The [preferred name] code for

	this interview is #@#@#. I am ready, are you?
• **Watch for non-verbal cues.** • **Paraphrase as needed.** • **Ask follow-up probing questions to get more in-depth.**	1) What strategies do you and your organization use to counteract material cost overruns during construction projects considering stakeholders who practice traditional construction? 2) What obstacles did you encounter when implementing the strategies? 3) Based on your experience, which strategy do you employ to mitigate material cost overruns when on site construction material waste is unavoidable or present? 4) How do you or your organization assess the effectiveness of these strategies over time? 5) What additional information about strategies would you like to share that

	we did not discuss during the interview?
• Wrap-up the interview, thanking participant.	Thank you, again, for your participation in this interview process.
• Schedule follow-up member checking interview	As for last, I would like to send you the interview transcripts and have you check and confirm that I have accurately captured all the answers you provided to the questions asked.

Appendix B: Letter of Invitation

Dear [*Eligible Employee Name*],

My name is Daniel van der Kuyp, and I committed to a research project at the Walden University for a Doctor of Business Administration degree in Technology Entrepreneurship. I am in search for candidates with managerial leadership positions that are aware of strategies to counteract material cost overruns. The [*Community Manager*] referred me to you as a potential candidate, and I have decided to invite you for an interview. This study involves research for academic purposes and cannot compensate anyone involved in this project for their effort. The social and business benefits of this research project include a cleaner and preserved natural environment and increased security for employees at the construction sites. If you opt to participate as a volunteer, the interview process will involve:

- Examining strategies to counteract material waste that affect large construction projects negatively.
- You may opt out of the interview intake at any given moment without any negative consequence to your professional career. A videoconference or videotelephony technology medium, such as Adobe Open or Skype, is used for the interview meeting.
- A time duration of about 30 to 45 minutes and will be audio recorded for accuracy and transcribing purposes only.
- The possibility of one follow-up meeting to discuss the accuracy of the transcribed data, if you find that it is necessary to do so.

If you decide to be a part of this important research, you may contact me for more information. You may also contact Walden's IRB directly at the email address irb@mail.waldenu.edu for any questions related to your rights or any content disclosed in this letter of invitation. You can also reach the IRB at 1-800-925-3368 ext. 312-1210 from within the USA, or +1-612-312-1210 from outside the USA. I highly appreciate your time, and highly encourage you to ask questions if you are hesitant about anything.

Yours sincerely,

[Researcher's Name]
[Contact details]

Appendix C: Community Manager's Letter of Cooperation

Community Research Partner Name
Contact Information

[Date]

Dear [Researcher's Name],

Based on my review of your research proposal, I permit you to conduct the study entitled Strategies to Counteract Construction Material Cost Overruns within the [**Partner Name**]. As part of this study, I authorize you to perform data collection, member-checking, and other data analysis activities needed to finish your research proposal ethically. Individuals' participation will be voluntary and at their discretion.

We understand that our organization's responsibilities include: A room with a Skype session that the partner will provide. We reserve the right to withdraw from the study at any time if our circumstances change.

I understand that the student will keep our organization entirely confidential in the doctoral project report published in ProQuest.

I confirm that I am authorized to approve research in this setting and that this plan complies with the organization's policies.

I understand that the data collected will remain entirely confidential and that no one outside of the student's supervising faculty/staff without permission from the Walden University IRB will receive a copy.

Sincerely,

Authorization Official
Contact Information