



The Role of Modern Method of Construction Management with respect to Time, Cost and Improved Quality in Residential Buildings Addis Ababa, Ethiopia

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Abstract

The Construction sector in Ethiopia usually encounters Project overruns, inability to meet project quality, ineffective procurement methods. . The research aims to explore the effectiveness of Modern Methods of construction in terms of cost, time and improved quality. It is descriptive and qualitative in kind. Qualitative approach was Chosen because, there are fewer projects that have used MMC, MMC is new to Ethiopian building sector and to explore the experiences of MMC in-depth. Interview was used as an instrument of data collection. The research analysis shows how effective a MMC is on the project time, cost, quality, and customer satisfaction parameters of construction projects of selected residential buildings. Qualitative analysis is used to describe the benefits of implementing MMC, and its effectiveness on time, cost, and improved quality parameters of the contractors' projects. The finding of the research elaborates that MMC is more effective on internal factors time, cost, and quality of the contractors' construction projects.

Keywords: Modern Method of Construction Management; Respect of time; cost and Improved Quality

1. Introduction

Modern methods of construction (MMC) are those that enable effective product management to deliver more items of higher quality in a shorter amount of time. The goal of quality management is to ensure that activities are well-organized and planned in order to achieve the desired degree of quality for the product or service. Although it plays a significant role, the Construction sector in Ethiopia, has difficulties such as, Project overruns, poor quality, ineffective procurement methods, an inability to meet project criteria, and a resistance to adopting best practices are a few of these difficulties. Clients, contractors, consultants, and other stakeholders involved in the project view completion of the project within the budgeted amount as a key indicator of project success (Torbaghan et al., 2017).

In today's fast-paced environment, the time aspect is crucial. Lagers have no place in a business environment where speed and accuracy are required to work simultaneously. The establishment of suitable building standards, including the acceptability quality while in use, can provide several challenges to decision-makers (Keller and Mukudi, 2017).

It is obviously desirable to establish user safe and reliable standards that will offer the user a suitable degree of quality. When resources are insufficient or the setting in which the building or facility must operate poses threats of uncertain quantity and timing, these ideal measures may frequently be affected. One may argue that the majority of the solutions to construction-related issues are still being provided by technical advancements. In most cases, the poor and the governments that represent them lack the resources to offer expensive remedies in underdeveloped areas, nor can the government practically impose such solutions on such regions. Therefore, economic factors (cost) have been and will continue to be a constraint on the planning, design, construction, maintenance, and operational criteria for infrastructure/building provisions in all developmental projects (Keller and Mukudi, 2017).

Engineers have made decisions regarding the interpretation of a wide range of requirements, some based on client instructions, others on rules or standards, and still others on the most recent technical information (Neyestani & Juanzon, 2016).. The final choices made will set out to best meet the financial restrictions and will provide structures that function quite close to expectations. In this setting, engineers are typically asked to find difficulties with construction projects that may exist now or in the future for individuals in certain regions. Funding restrictions, a lack of optimal knowledge, irrational design criteria, and the necessity to establish standards for a certain circumstance are always factors that influence the solutions. This demands serious thought and challenging decision-making. Therefore, it is not surprising that built infrastructure may occasionally fail to provide the intended service.

2. Research Objective

The aim of this research is to explore the effectiveness of Modern Methods of construction in connection to on time delivery of residential buildings, Cost effective construction process and improved construction quality (three key components of construction projects (construction quality, project duration, and project cost).

3. Research Questions

1. What is the role of MMC implementation in terms of the time of project delivery in residential building projects?
2. What is the role of MMC implementation in terms of project cost overruns delivery in residential building projects?
3. What is the role of MMC implementation in terms of the desired construction quality of residential construction projects in Addis Ababa?

4. Literature Reviews

Ho et al. 2017 underline the requirement for successful MMC business models that can more effectively convey the benefits and Saad et al. 2023 highlight the necessity for MMC companies to innovate

their business strategies in order to improve consumer confidence. Similarly, Darlow et al. 2022 explain how business models may influence and persuade the market at large to utilize MMC as a construction substitute, aligning with Goulding et al. 2015, who believe that the methods used by MMC businesses to demonstrate value are directly associated with adoption rates.

A key idea in organizational management is contingency theory, which places business competency at the heart of an organization's performance. The theory offers a paradigm in which the amount of variables a person uses in their business procedures, but rather by using the right ones (Miles, 2012). (Tijani et al. 2021) discusses how well the theory explains the propensity of construction firms to satisfy external demand. In addition, the idea contends that there is no single best way to gain a competitive edge. . The theory, moreover, suggests that a single optimum strategy to achieve a competitive advantage does not exist (Nnaji and Awolusi, 2021). In contrast, it demonstrates how diverse business environments necessitate various business methods and how better business performance depends on how well the various contingency elements are matched (Donaldson, 2001; Cigolini et al., 2022). Despite this, the theory is highlighted as the essential theoretical pillar for these kinds of arguments (Liu et al., 2023), it is yet underdeveloped in the realm of construction management research (Alkilani and Loosemore, 2022). As a result, it is vital to define the business environment in terms of the researched contingencies and respond to any criticism related to the use of this theory.

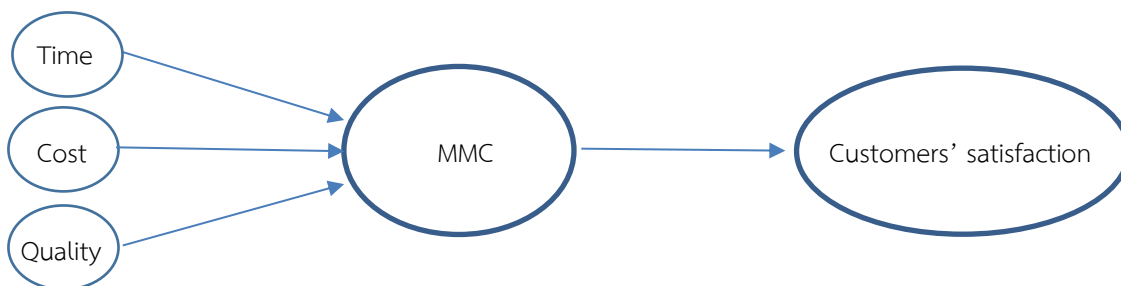
Time, cost, and quality have been identified as the key performance indicators in the construction sector. However, other alternative theories have emerged from various researchers. A project's efficacy is thought to be improved through studying critical success factors (CSFs) and project success (Ramlee, Tammy & Noor, 2015).

MMC has several advantages for the construction sector, but there was little acceptance at the time, according to Rahman's study on the obstacles to its implementation. He further found that a number of other problems, such as high initial capital costs and contractual blockages brought on by traditional procurement methods, were also major implementation hindrances (Rahman MM, 2014).

The Business Model Canvas (BMC) According to (Massa et al. 2017), the Business Model Canvas (BMC) classification is one of the most frequently used to describe the essential elements involved in outlining a business model. Beyond the realm of popular phrases, the use of BMC is regarded as an efficient and trustworthy unit of analysis to gauge an organization's business performance and competency (Zott et al., 2011). The exact definitions of quality differed slightly from person to person, but they remained in two basic categories: conformance to requirements; and customer satisfaction (James L. Burati Jr., Member, ASCE, Michael F. Matthews, and Satyanarayana N. Kalidindi, 2018).

By enhancing stakeholder engagement and communication, modern methods of construction (MMC) are assisting the construction industry in completing projects on time and within budget. Clients, contractors, consultants, and other stakeholders involved in the project view completion of the project within the budgeted amount as a key indicator of project success (Torbaghan et al., 2017)

5. Conceptual Framework



Conceptual Framework- Adopted from Alaeddin Ghadamsi (2016). Criteria For Selection of Design and Build Procurement Method.

6. Methodology

This research, narrative analysis is used for the semi-structured interview data. The collected data from the interview questions by the selected contractors are gathered and analyzed by comparing and contrasting the interview stories. Then the connection between the answers and the previous studies are narrowed to easily present the findings. Since it is a qualitative study, all data retrieved through interview may vary in content, but the categorization will help to generalize the findings. Therefore, contractors that are in the highest time overrun, cost overrun, quality problems, and customer complaints were analyzed respectively. Then, a summary of each data is organized from the data collected and presented that show the analysis of the MMC practices implemented by the contractors to have maximum effectiveness on their construction projects are developed. Qualitative modes of data analysis provide ways of discerning, examining, comparing and contrasting, and interpreting meaningful patterns or themes. Meaningfulness is determined by the particular goals and objectives of the project at hand: the same data can be analyzed and synthesized from multiple angles depending on the particular research or evaluation questions being addressed (Qualitative data analysis methods and techniques, n.d).

This study employed a qualitative methodology. The researcher collected in-depth interview from six construction firm owners. This strategy was chosen in order to thoroughly examine MMC's experiences and because there aren't as many projects that have employed it in Addis Ababa. Additionally, it aided in the investigation of the contractors' current methods and past experiences with MMC implementation on their building projects. In addition, Small sample units are described and analyzed more effectively with qualitative research.

The geographic location and level of awareness are the primary focus of this study work. The project managers that are based in Addis Ababa are the group of experts for this research. Although there are many different contractor classifications and grades, the chosen residential building project managers who have used MMC are the research's intended Samples.

Method of Data collection

Studying the different type of qualitative approaches the researcher chose to use phenomenological type approach and Interviewed Six Project Managers. Data was gathered by asking the chosen project managers In-depth interview questions. The decision to conduct an interview was made in order to thoroughly examine MMC's experiences as there are fewer projects that have used it and MMC is new to Ethiopia's building industry. Additionally, the respondents won't have any biases while answering inquiries on the success of business projects. Additionally, by using this strategy, the interview session yielded deeper information about MMC implementation practices and a lower non-response rate. The type and depth of the questioning, the availability of funding, the required amount of time, and the level of precision all played a role in choosing the data collection method. The researcher first compiled a list of company owners and project managers with previous experience in Addis Ababa's MMC implementation. The researcher then scheduled a meeting with them after that. The researcher then did one-on-one interviews at convenient times and locations. The researcher used a voice recorder to capture the participants' voices while conducting the interview.

The researcher attentively listened to the voice recordings before transcribing them. The records then be thoroughly examined and condensed to arrive at the notion. The researcher then included a summary of the results after these procedures. The researcher went over and clarifies the implications of the research findings based on the summarizing.

7. Results

7.1 Effectiveness of MMC on critical factors of construction projects

Table 1 Effectiveness of MMC Summary

Company Profile	Company 1	Company 2	Company 3	Company 4	Company 5	Company 6
No. of projects in the last 5 years	24	17	12	9	8	8
Number of Time overrun	5	16	6	3	0	2
Number of Cost overrun	6	15	8	2	0	5
Number of Quality problems	1	9	7	0	1	3
Customer dissatisfaction / compliant(no.)	7	17	7	3	1	4

The effectiveness of MMC on critical factors of construction projects was assessed in which the results indicated of the six construction companies, five had encountered time overruns, five had seen cost overruns, and five had encountered quality issues. Company 2 is one of the contractors that showed the biggest time overruns. The business with the highest rate of project cost overruns of Company 2 and Company 3 are also being conducted. Company 2 and company 3 are the ones with the greatest amount of project quality flaws. Companies that suffered the highest levels of customer complaints (complaints) also experienced the highest levels of time overrun, cost overrun and quality overrun.

Interview subjects were asked if, and to what extent, they agreed or disagreed with the MMC effectiveness measuring items for time of projects that are generally accepted by various experts. The respondents found MMC to be effective on the majority of views from the list of items stated as effectiveness measures of the time parameter of project performance by MMC implementation developed from the literature review. The results of this analysis demonstrate the relationship between MMC implementation success on time and the contractors who had the largest percentage of delays. Contractors No. 2 and No. 3 are those that have encountered the largest project time overruns, as was previously reported. The majority of the project time effectiveness level metrics in regard to MMC implementation are unimportant to both contractor nos. 2 and 3. Even contractor number two disputes the idea that using MMC results in improved performance. These contractors claimed that despite MMC's implementation, they had not seen any real results because importing items into Ethiopia is a labor-intensive operation. Contractors No. 5 and No. 6 did not encounter any project time overruns, and they both concur that the challenges of implementing MMC in Ethiopia helped them reduce delays. As a result, contractors who implemented MMC in their projects saw significant reductions in project delays compared to those who did not.

Questions about the efficacy of MMC for project cost were posed to interviewees in a manner similar to the effectiveness measure from project time. As understood from the responses, The primary obstacles to employing Modern construction techniques are the costly initial investment, greater design, crane, and transportation costs. The substantial volume and ability to lower mould costs with repeated usage of the design can overcome the high initial outlay. The capacity to generate design layouts that are especially suitable for high rise buildings and high volume of housing design may reduce the expense of mould. Due to this, advanced technology is necessary in order to manufacture any sort of building and to make modular buildings that meet the highest standards. Two of the cost effectiveness metrics were as effective for the respondents as predicted, and few expressed uncertainty about them. These opinions contend that MMC reduces production costs by reducing the number of nonconforming goods, rework, rejection rates, and errors while successfully resolving issues with construction projects without altering the scope of the project. They had stated that whether or not MMC was implemented, if an issue had arisen, it would cost more to fix it. However, all of the respondents agreed that MMC lowers rectification costs by identifying defects earlier. They have clarified that while some errors cannot be prevented, their impact can be reduced by identifying them earlier before irreparable harm results, or can result in a loss for correction



for the organization. The majority of respondents stated that their budget includes a contingency plan for these kinds of problems. All six interviewees agreed that the availability of inexpensive labor, which counteracts the cost-savings of utilizing MMC, is a major factor in Addis Ababa's delayed adoption of MMC. All six interviewees shared the same opinion regarding the effectiveness of MMC on costs. Labor prices will remain low as long as it is simple for businesses to locate employees, and builders won't be enticed to switch to more straightforward options like MMC. Additionally, it is emphasized that hazards in the supply chain must be addressed if MMC is to be used more frequently. There are issues with the scope and standard. There are issues with suppliers' capacity, size, and ability to produce large volumes of product. Other challenges include the requirement for an early design reduction, shipping logistics, and the capacity to create custom interiors and designs while overcoming standardization's limitations.

A few metrics of effectiveness were derived from the literature study in order to analyse the role MMC plays on project quality and how effective it is for construction projects. Respondents were questioned whether each measure was effective or not and why. Numerous academics concur that improving quality was one of MMC's main advantages and a major factor in its spread to other nations. These performance indicators for a construction project's quality are: MMC's ability to match project scope to project proposal and fulfill contract requirements; improvement of quality awareness and understanding of the organization's quality objectives; improvement of product and service quality; and decrease in product defect rate. Increases effectiveness and efficiency in achieving the organization's quality objectives by enhancing quality awareness and understanding of the quality objectives within the organization, improving product and service quality, and contributing to the achievement of clearly defined quality objectives for construction projects. On the majority of points, the respondents concurred that MMC is effective in terms of the quality of their construction projects. The interviewees highlighted how putting MMC into practice helped their business increase quality.

The effectiveness of MMC in ensuring client satisfaction with their construction projects was inquired of the respondents. Similar to the other three parameters—time, cost, and quality—possible efficacy measurements for customer satisfaction can be found by reading through various academic publications. The success of MMC on customer satisfaction is indicated by the fact that it reduces client complaints and enhances customer relationships and communication.

Many scholars believe that MMC will fix a wide range of issues that can arise between contractors and clients because it enhances the primary sources of contention, such as quality and construction time. The respondent also concurred that late project delivery, cost increases after the contract, and quality issues are major contributors to problems in the construction business, which degrade the relationship between the client and the contractor.

8. Discussion

The following are the key discoveries made in this study of the implementation efficacy of modern construction methods on a sample of residential construction projects by contractors involved in the main Addis Ababa residential building construction projects.

The respondents concurred that one reason for Addis Ababa's sluggish adoption of MMC is the availability of inexpensive labor, which counteracts the cost-saving benefits of adopting it. In the measuring of MMC effectiveness in time parameter, it is discovered that respondents find it effective in a way that it reduces time spent on site mostly because the components are fabricated at a factory to use on-site quickly. According to Idoko (2008), a lot of projects in developing nations experience significant delays and overspending, fall short of their intended goals, or are completely abandoned before or after they are finished. Furthermore, compared to other industries in emerging countries and their counterparts in rich ones, the construction industry often advances far more slowly. According to Jekale's (2004) general conclusion, the building sector in emerging nations fell short of the expectations of governments, clients, and society at large. A project is considered successful when its goals are met in terms of timeliness, budget, and quality (scope) in order to satisfy the client's requirements (Kerzner, 2010).

According to Dires (2016), who conducted a study on condominium housing projects in Addis Ababa, the main causes of defects in the Ethiopian construction industry are known to be poor workmanship and low-quality materials, which contribute to the rapidly rising rate of major building defects. As a result, the rate of construction project completion is weak. It is also abundantly evident that building flaws are typically present in both privately owned and low-cost projects. Due to this experience, the project's overall success is compromised, and customer satisfaction is poorly rated. In the measuring of MMC effectiveness in Cost parameter, it is discovered that the availability of inexpensive and well trained work force is a major factor for the late adoption of MMC in Addis Ababa. There is also issue with supplier's capacity, size and ability to produce large volumes of construction materials.

In the measuring of MMC effectiveness in quality parameter, the respondents concurred that MMC is effective in terms of the quality of their construction projects. It is discovered from the respondents that concurred that quality and product consistency can be improved in a factory setting, they also recognized that these benefits come at the expense of installation and low supply chain capacity. The development of various MMC techniques and products has fundamentally altered the housing industry's historical behaviour. This is an incredible shift that will lead to even more advancements in the construction industry ("Modern Methods of Construction," n.d.). The quality of the products that building projects produce is significantly influenced by modern construction methods. After outlining the aforementioned concerns, this study evaluates how the implementation of MMC affects the performance of particular residential building contractors in Addis Ababa. Additionally, its efficacy with regard to the primary components of the chosen construction projects—cost, schedule, quality/scope, and customer satisfaction—as well as the project's overall success.

According to the respondents, putting MMC into practice results in higher-quality project deliverables, shorter construction times, and higher customer satisfaction. However, these contractors were not always in favor of the institution's increased industrial competitiveness. They have therefore not reaped the full benefits of MMC implementation. The contractors with the highest project quality problems are also the contractors with the highest time overrun and cost overrun.

The respondents say they have used MMC to some extent, but not to a sufficient level, due to supply chain issues, material shortages, and late letter of credit (LC) deliveries from banks, all of which are typically tied to a lack of foreign currency.

9. Conclusion

MMC implementation is a practical method for construction projects to decrease cost and schedule overruns and to improve quality. According to the report, Addis Ababa's MMC application is not at an adequate level. For residential building contractors in Addis Ababa as well as other contractors in other parts of the world, the implementation of MMC is effective for the performance of construction projects on the critical factors of a project, which was proven by many scholars as pointed out in the literature review.

According to this research, the key benefits of employing MMC in their projects, according to the project managers who were contacted, are better building quality and lower levels of snagging, lower site labor costs, faster builds, better programming, and more overall construction efficiency. The cost of utilizing MMC was higher than the traditional building technique, and there was a shortage of professional skills. All of the respondents believed that the availability of inexpensive labor, which counteracted the cost-savings of using MMC, was the main reason for the slow acceptance in Addis Ababa.

In conclusion, this research paper is a preliminary study and a component of ongoing research that will attempt to improve successful MMC implementation practices in the long run while also introducing collaborative technologies to the construction sector, specifically in the MMC project delivery in Addis Ababa residential buildings. In order to promote the Ethiopian construction industry, it is also intended that the main research's findings will contribute to and serve as the foundation for significant management among project stakeholders and the MMC construction supply chain.

10. Recommendation/Suggestions

From the findings of the research; the government play the main role for the growth and use of MMC should consider generating skilled man power on MMC production and assembly and needs to support through policy and funding, the up skilling of the existing workforce to meet the needs of MMC.

This research recommends the construction industry to find ways to capture and disseminate technologies, lesson learned, and best practices from successful countries and companies to accelerate our learning curve on MMC and to guide the way forward.

The labor needs to upgrade their skills to be involved in MMC. This would add more value by providing a more expert labor force which would ultimately improve the competitive advantage of the industry in facing the issue of adoption from traditional to the MMC. They must be equipped in design, installation and project management skills which are important to MMC.

The researcher thinks that further study should be made on barriers of implementing MMC in Ethiopia.

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