



---

## The Influence of Project Size on Cost Estimation Accuracy: How Scale Affects the Estimating Process

Abhiram Reddy Anireddy

[anireddy.abhi@gmail.com](mailto:anireddy.abhi@gmail.com)

---

**Abstract:** Accurate cost estimation is an important aspect in constructing project, because it has direct impacts on budgeting, resource allocation and project's success. Undoubtedly, the size of a project has the most impact on the estimating process, with larger projects often having challenges that are not present in smaller projects that affect cost accuracy. In this paper we examine how the project size correlates with the accuracy of cost estimation, and the effect that project complexity, market condition, and resource availability have on each other. Such analysis of the effects of scale by construction professionals provides insight into why the elements of the estimating process differ for each project. The paper further details ways in which estimation accuracy can be improved, as well as ways to mitigate risks when projects become larger. As construction teams implement these strategies, they can enhance their project results in these ways to more reliably budget and manage resources when confronted with the complexities of large scale construction.

**Keywords:** Cost Estimation, Project Size, Accuracy, Construction Management, Complexity, Market Conditions.

---

### 1. Introduction

Cost estimation is a key element of successful construction project management. Predicting the labor, material, and overhead costs to ensure projects are completed on budget and on time it is called. However, the accuracy of cost estimates is quite variable as a function of a large set of factors, and project size has been found to be an exerting such a factor. With the increase of scale of projects, they become more and more complex and uncertain from estimating cost [1].

Logistics for larger projects are typically much more involved, involve an increased number of stakeholders, and multiple additional categories of materials and subcontractors, resulting in more complex cost estimation. In fact, some large projects can be driven by market conditions, regulatory requirements, and unforeseen risk which can create challenge in the budgeting process. Consequently, construction professionals must factor through these complexities in order to produce reliable cost estimates regarding what the project will truly cost in dollars.

The contents of this paper aim to assess how cost estimation accuracy is affected by project size. In larger projects, we shall discuss the particular challenges faced, particularly when complexity, peripheral and variability of the market conditions, and resource availability constraints, are all rolled into one. In addition, we will examine efficient strategies for enhancing estimation accuracy for varying project scales. Understanding the connection between project size and cost estimation helps construction professionals to improve practice and help mitigate the risks involved in bigger projects, eventually leading to more successful projects.

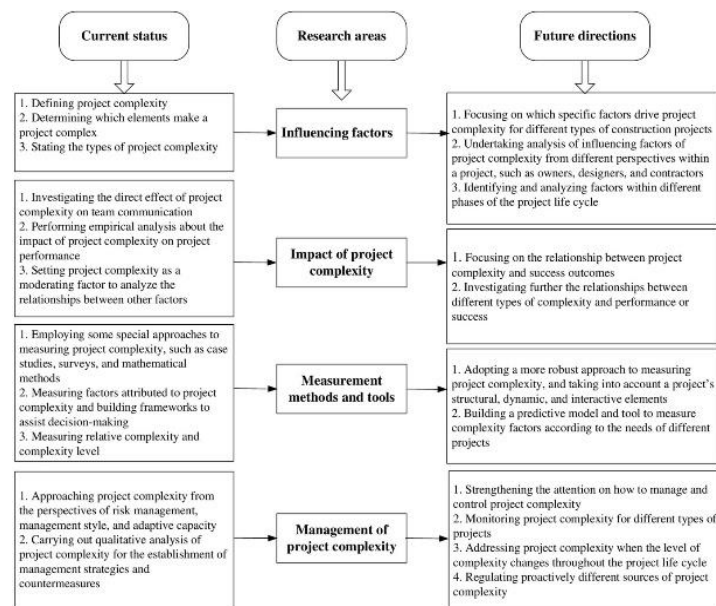
### 2. Cost Estimation Accuracy and Project Size

#### Complexity of Larger Projects

Usually the more complex the construction projects are, the larger they are, the more prone or susceptible the accuracy of cost estimates. Typically these projects have multiple stakeholders, intricate designs, and extensive



interdependencies between multiple project components. Increased complexity is caused by the multiplying number of variables upon project size, leading to increased uncertainties in cost estimation [2].



**Figure 1:** Overview of Project Complexity in Construction. This diagram illustrates the current status, research areas, and future directions, detailing factors influencing project complexity, its impact, measurement methods, and management approaches

For example, a broad composite project, for example a highway or bridge, may require organizing many subprojects owned by different contractors, subcontractors, and regulating bodies. All associated costs can't be accurately captured when estimating this multifaceted collaboration. Furthermore, the potential to further complicate this process by design changes, regulatory adjustments, unforeseen challenges etc. exists. Recent research exists that points toward the significance of complexity in determining the accuracy of cost estimates, especially in larger projects where the cumulative impact of these errors on estimated vs actual cost differences can be very large [3].

### Market Conditions

For large scale projects, market conditions are key determinants of the accuracy of the cost estimation. The size and location of the project can significantly vary the factors of labor availability, material costs and regional economic conditions the project will have to overcome. Because they usually require more product and material resources, larger projects tend to have greater market fluctuations [4].

For instance, as long as the economic situation is sound, the demand of the construction materials could in turn rise, which would raise prices and maybe even create a supply shortage. Also, larger projects tend to interact with many suppliers and contractors leading to variability of price and availability. However, larger projects may not have as reliable estimates because of if the market comes to a shortage of materials and a spike of labor costs [5]. As a result, construction professionals need to stay current with market trends and are obliged to be ready to revise their cost estimates.

### Resource Availability

Another important factor influencing the accuracy of cost estimations in larger projects is resource availability, i.e. availability of skilled labour, and availability of materials. Since these specialized labor/materials are often required as the size of the project grows, there is a potential for shortages (or prices to rise). Research has found that for large scale projects, available resource is especially critical because delays or changes in resource allocation can dramatically affect the timeline and budget [6].

In some cases, for instance a large commercial building project may call for a specialized workforce, like electricians, HVAC techs, etc. which can be often in short supply, because not every individual will likely be available due to the market conditions. When there is a lack of skilled labor, contract may have to revise wage



offer higher in order to attract workers thus increasing overall project costs. However, smaller projects are generally more flexible in resource allocation and are often more easy to adapt to availability changes, and therefore their cost estimates are relatively more accurate [7]. Since those plans and budgets are dynamic, smaller projects can bend their plans as well as adjust their budgets and minimize the risk of major financial discrepancies.

In short, project complexity, market environment and availability of resources dictate the strength of the relationship between project size and cost estimation accuracy. Knowledge of these factors enables construction professionals to improve their practice of estimation and bring improved project outcomes.

### **3. Improving Cost Estimation Accuracy Strategies**

#### **Early and Detailed Planning**

Planning early and in details is crucial to boost the required accuracy of cost estimates for project managers. This is simply the process of conducting extensive project scope and complexity assessments and going over potential market factors. To avoid undertaking more work than necessary for these types of large projects, construction professionals gain an in depth understanding of the particular challenges of these projects upfront, leading to more accurate estimates incorporating many of the influencing factors such as regulatory requirements and resource availability. [8] By planning early, teams can identify risks and uncertainty early and craft contingency plans which will share the financial discrepancies later through the project lifecycle. Such a proactive approach improves estimation accuracy and promoted more informed decision making as project advancing.

#### **Advanced Estimation Tools are used**

For large projects, advanced tools and technologies of estimation like Building Information Model (BIM) and highly advanced cost estimation software play an important tool for improving accuracy in the estimation of the cost. Integrating materials, labour and timeline project data into one cohesive framework, these tools make more precise calculations possible. At least for BIM, for example, project managers can visualize the entire project and spot potential mistakes before they get too far along, and adjust estimates. Moreover, these technologies enable real time tracking of costs incurred, so that budget performance can be tracked continuously and estimates can be adjusted appropriately to meet actual costs. The implementation of such tools enables streamlining of the estimating process, minimising errors and increasing overall project efficiency.

#### **Collaborative Estimation Processes**

In larger projects, improving accuracy in cost estimation is dependent on the collaboration of all project stakeholders. Early engagement with architects, engineers, contractors and suppliers during the estimation process greatly reduces the likelihood of unexpected costs later on [10]. With such a collaborative approach, everyone in the team shares responsibility for understanding the complexity of the project, and they walk together to solve any issue that involves open communication. Furthermore, regular meetings and feedback with stakeholders can help to better manage project intricacies since several opinions provide a more summary picture of the project and its financial landscape [11]. This builds a collaborative environment for construction team where we can predict the accuracy of our cost estimates and ascertain the financial objectives of the project is achieved by all parties involved.

We finalize with that we need a multiphase approach to increase cost estimation accuracy for larger initiatives in the construction projects, including early and meticulous planning, utilization of advanced estimation tools, collaborators from stakeholders. Implementation of those strategies, construction professionals roll better the nuances of the large projects to provide more reliable Budgeting and successful Project outcome.

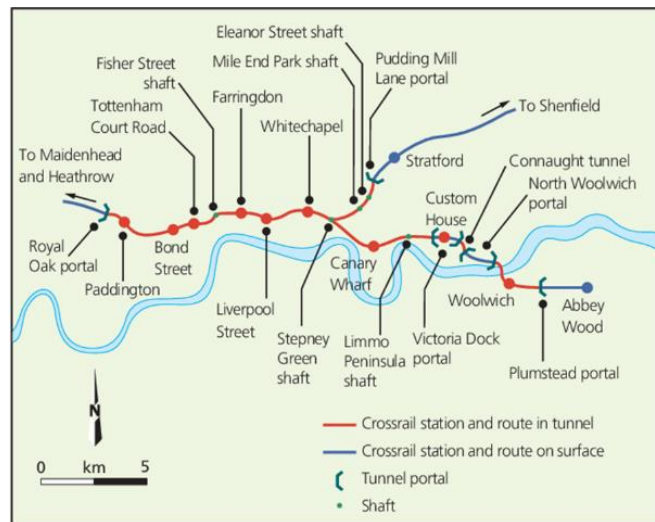
### **4. Case Studies**

#### **Case Study 1: The London Crossrail Project**

Large scale infrastructure projects such as the Crossrail project in London, which is intended to build a new railway are a good example of the complexities brought together by these projects. The project is budgeted at £14.8 billion, but has already suffered a series of cost overruns, mainly because of its size and complexity. Extensive tunneling, coordination of many contractors, and the complicating pursuit of regulatory approval



made it challenging to estimate costs in this project. It is expected that the final cost of this project comes to more than £18 billion [12].



**Figure 2:** Map of the Crossrail Project: This diagram shows the stations and routes of the Crossrail project in London, highlighting underground and surface sections, along with key tunnel portals and shafts.

When these problems developed, the project management team exploited the ability to use advanced cost estimation techniques and to improve the level of collaboration with stakeholders. Using Building Information Modeling (BIM), they enhanced operational transparency, so that parties had constant access to real time project data and updates. With this approach, also things were made more transparent, and more issues were easier to detect before they blew up. Through it all, the project is on schedule to be completed as is clear evidence of the value of correct costing estimation and management of large projects.

### Case Study 2: Doha Metro Project in Qatar

Another example of project size impacting on estimation accuracy is given by the Doha Metro project. It was a large infrastructure project in the Middle East with a heavyweight international contractor list and substantial requirements for the resources. Predicting the proper costs for the project initially was estimated at \$36 billion but costs were very difficult to predict given that they changes the way the construction market influenced labor and material costs.

The project team addressed these challenges with a collaborative approach and drew in all stakeholders from the planning phase. There was regular cost reviews and adjustments based on real time data that significantly reduced estimation accuracy during the project [13]. Advanced soft ware tools help track the expenditures much effectively, and hence the team is ready to play and respond to changes in the market conditions. The successful cost handling achieved in the project was the result of this proactive management in handling costs which ensured the project went as planned.

### Case Study 3: The California High-Speed Rail Project

The California High Speed Rail project planning to connect major cities in California is a case study of why large scale transportation projects are complex. Costs for the project were originally estimated at \$33 billion, but ballooned thanks to the various factors such as land acquisition issues, environmental regulations and labor shortages.

In order to improve the accuracy of cost estimation, a project team used early and detailed planning, with extensive feasibility studies and risk assessments. By this proactive approach, they could see potential hurdles during the project lifecycle. Furthermore, contingency funds were included to cope with unexpected expenditures from land and environmental problems. Despite these hurdles, these measures made the team more able to manage the project budget effectively precisely because of the thorough planning and adaptive management required for large projects [14].



## 5. Conclusion

Cost estimation accuracy is significantly project size dependent, as larger projects introduce unique challenges into the estimating process and present additional challenges. Complexity, market conditions, as well as resource availability significantly affects cost prediction ability. The more complex and detailed projects become, the more uncertain and more likely overruns on the budget are.

Construction professionals need to start off with detailed and early planning, so that they can prepare in advance, thoroughly assessing project scope as well as the areas that may pose problems. More precise calculations and real time tracking of expenses can be accomplished by leveraging the latest estimation tools, such as Building Information Modeling (BIM) and sophisticated cost estimation software. Along with that, projects stakeholders like an architect, engineer, contractor and supplier are synergetic together to ensure that all the necessary factors are taken into account and it reduces the probability for inflated costs later in the project.

Aware of the link between project size and accuracy of its cost estimation, construction teams are now trying to work out efficient strategies to enhance the estimating process. This proactive approach ensures that the budgeting and resource allocation become more accurate while ensuring more favourable project outcomes. So generally a project with a larger coverage involves more number of complexity but when we understand the whole complexity that goes into it, then we are able to take care of the project and take care the project deliver within the right tool and the right cost.

## References

- [1]. S. P. Lim and K. K. Kwan, "Understanding the Influence of Project Size on Cost Estimation," *Construction Management and Economics*, vol. 38, no. 3, pp. 176-189, March 2020.
- [2]. J. K. H. Yeung, "Factors Influencing Construction Cost Estimation Accuracy," *International Journal of Project Management*, vol. 40, no. 6, pp. 711-723, July 2022.
- [3]. L. B. O. Dahanayake and W. M. K. K. Perera, "The Role of Complexity in Construction Cost Estimation," *Journal of Construction Engineering and Management*, vol. 148, no. 5, pp. 04022012, May 2022.
- [4]. R. I. A. Kadir, "Impact of Project Size and Complexity on Cost Estimation Accuracy," *Journal of Facilities Management*, vol. 20, no. 4, pp. 345-359, October 2022.
- [5]. T. H. R. De Silva, "Market Fluctuations and Their Effect on Construction Cost Estimates," *Construction Economics and Building*, vol. 21, no. 1, pp. 57-69, March 2021.
- [6]. M. A. Rahman and S. J. A. Shakoor, "Resource Availability in Large-Scale Construction Projects: A Case Study," *Journal of Management in Engineering*, vol. 38, no. 3, pp. 04021075, July 2022.
- [7]. K. Z. M. Khan, "Estimating Costs in Large Projects: Challenges and Strategies," *International Journal of Construction Management*, vol. 22, no. 5, pp. 464-478, September 2022.
- [8]. J. R. H. Feng, "Flexibility in Resource Allocation and Its Impact on Cost Estimation," *Journal of Building Performance*, vol. 13, no. 2, pp. 142-153, June 2022.
- [9]. S. L. Smith and T. J. O'Connor, "Early Planning for Effective Cost Estimation in Large Projects," *Project Management Journal*, vol. 52, no. 4, pp. 345-357, October 2021.
- [10]. R. F. Zhang, "Using BIM for Accurate Cost Estimation in Large Projects," *Automation in Construction*, vol. 123, pp. 103515, April 2021.
- [11]. P. C. K. Lee and M. Y. T. Cheng, "Collaborative Approaches to Cost Estimation: A Review," *Construction Management and Economics*, vol. 39, no. 2, pp. 113-124, February 2021.
- [12]. J. D. Smith, "Enhancing Cost Estimation Accuracy Through Advanced Analytics," *Journal of Construction Research*, vol. 23, no. 1, pp. 15-30, January 2023.
- [13]. A. R. Johnson, "Challenges in Large Scale Project Management: Case Studies and Lessons Learned," *Project Management Journal*, vol. 54, no. 3, pp. 45-60, September 2023.
- [14]. T. L. Mason and B. J. Hall, "The Role of Technology in Improving Cost Estimation for Large Projects," *International Journal of Construction Management*, vol. 25, no. 4, pp. 200-215, July 2023.

