

Material Cost Fluctuations: Analyzing the Effects of Market Volatility on Civil Project Budgets

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Abstract: *Building materials cost has climbed to the top of the list of buying considerations when making construction purchases for many contractors increasingly, as material cost fluctuations are becoming a huge consideration that can potentially add to budgetary increases, delayed deadlines and a loss in profitability. Prices for raw inputs like steel and cement and other building items can be volatile due to a host of global and local economic factors, as supply chain disruptions, global tension, inflation, changes in demand. This paper aims for analysis of the effect of market volatility on civil project budget; the causes of material cost fluctuations; effects on construction projects and risk mitigation approaches. A detailed study of recent data illustrates how the presence of monetary unpredictability in the costs of materials is clearly related to such things as the budget planning and the completion of projects; this is done both from case studies of projects in various parts of the world. Results reinforce the impact of adaptive cost management strategies in enhancing predictability of steady financial conditions and their mitigating consequences to the civil projects.*

Keywords: Material cost fluctuations, market volatility, construction budgets, supply chain disruptions, cost management strategies

1. Introduction

The construction industry has always been sensitive to changes in material costs due to large processing of resources and the need of a fair quantity of resources for civil projects. Project success and ensuing material price changes can ruin controlled budgeting and costing. Indeed, until recently, these fluctuations were relatively moderate for largely macroeconomic and geopolitical reasons. But these are compounded by broader world events, including the COVID pandemic, requiring workers to be quarantined, lockdown and supply chain bottlenecks, as well as higher inflation for workers to pay for rising prices in steel, copper, aluminum and cement.

More importantly, these volatilities complicate the procurement process and result in projects in significant project delay, re negotiation, and even in project termination. Uncertainty around material costs is a major problem for civil project budgeting that is usually associated with overruns, and subsequent disputes between contractors and project owners. Such a conflicts could arise from disagreements in pricing that can lead to the destruction of the project, or lack of ability to meet hurried revisions of the budget.

With these challenges in mind it is crucial to understand material cost volatility drivers and the implications thereof for budgeting. The sudden material price increase is not the only concern to project stakeholders as global demand fluctuations, geopolitical tension, change in trade policies, and other natural disasters can lead the material price to increase unexpectedly and stake holders are unlikely to predict.

This paper investigates these main causes of material cost volatility and the area in which it impacts budgeting of construction projects. It also analyzes three case studies of projects whose material cost variation was particularly high to understand how these projects dealt with such challenges. In this paper the strategies employed by these projects to manage the financial risks of material cost variation are

examined and applied to the paper to provide some practical recommendations as to how construction professionals with similar constraints in other projects might manage the financial risks of material cost variation. This paper takes a further step towards understanding material cost volatility and how it affects the construction industry, which then will help to better budget and risk manage in times of uncertainty.

2. Material Cost Fluctuations in the Construction Industry

Several interconnected factors, such as supply demand dynamics, global economic conditions, and ... exhibit effects on material cost fluctuations. In recent years, prices in the sector have been extremely volatile — as materials such as steel have seen price increases of over 50% for some markets in 2021 to 2022 [1]. And there are several primary factors which drive these fluctuations significantly affecting project budgets and timelines.

2.1 Supply Chain Disruptions

The main contributors to the fluctuation of material cost are supply chain disruptions, heavily multiplied by the effect of the COVID - 19 pandemic. Manufacturing and transportation were limited in the pandemic, which fed into large supply shortages and supply and demand mismatch. Because the construction industry likes to keep marginal storage as minimal as possible through just in time delivery systems, allowing for the materials to be delivered as they're needed, the construction industry is particularly susceptible to disruptions of this type. Exact materials specialists say when demand surged post - pandemic, their dwindling supplies led to steep price increases for the kinds of items that are now deemed essential [2].

Moreover, material delay has adversely impacted project execution schedules and intensification of cost. Additionally, contractors often found themselves obliged to arrange alternative supply arrangements — arrangements which not only cost more but also complicated matters by introducing

additional logistical hurdles [3]. This unpredictability in material availability gives rise to cascading effects through the project lifecycle, causing interruptions and teams pulling in and out of the project repeatedly having to reevaluate their timelines and their budgets.

2.2 Geopolitical Instability

Construction material prices, it is also worth noting, have also been affected by geopolitical events. One instance includes how the Russia Ukrainian conflict has disrupted the construction materials' supply chain globally. The conflict has disrupted supply chains of the various steel and various

raw materials that Russia supplies and resulted in sharp price increases in markets around the world [4].

The ripple effect does not end at these imedate regions in conflict. For example, when the supply of Russian steel narrowed, countries that were dependent on this import faced short supplies and began purchasing materials in other Russian imports, from different and more expensive sources. Not only, does this dynamic influence the cost of materials, but it also brings in uncertainty in project budgeting and planning because prices vary depending on the geopolitical climate [5].

How will construction costs increase in the world in 2024?

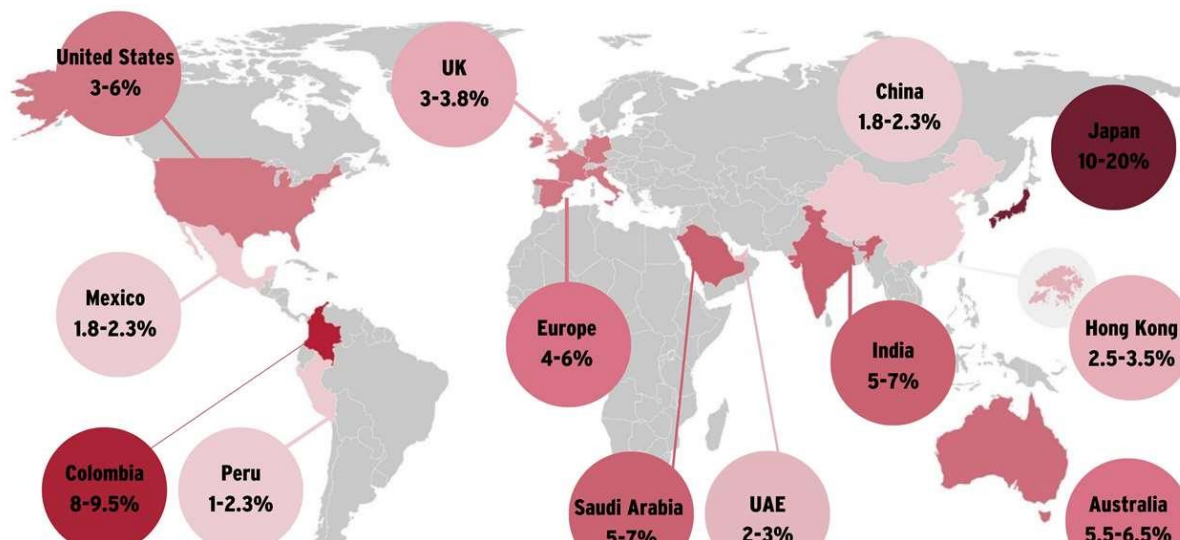


Figure 1: Projected Construction Cost Increases by Country in 2024: A global map showing the estimated percentage rise in construction costs across various countries, with Japan experiencing the highest increase

2.3 Inflation and the Money

Unsurprisingly, it is becoming another critical factor driving material costs up: inflation. The pandemic was largely over when economies picked up, yet inflation spurted globally throughout the world, as the costs for both materials and labor

rose [6]. Central banks' inflation fighting monetary policies add an extra twist making this an inflationary environment. Interest rate hikes can frustrate construction companies in two ways: increasing the costs of borrowing that might tighten, their budgets, or diminish cash flow to spend on the materials [7].

Price changes for construction and selected materials

June 2020- June 2021

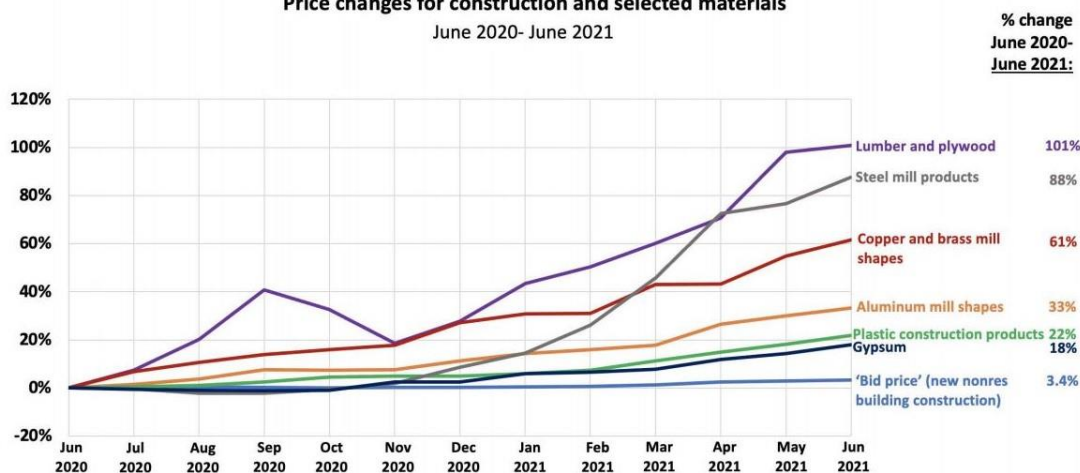


Figure 2: Price Changes for Construction and Selected Materials (June 2020 - June 2021): A line graph showing the significant increase in prices for materials like lumber, steel, and copper, with percentage changes over the year

Now construction firms need to balance the demands and maintain profitability as all economic pressures coalesce.

Adoption of higher material costs coupled with an increase in interest rates that force the engineer to make difficult

decisions as to whether a project is feasible or can be funded. Therefore, construction firms have to take this into consideration so as to handle its financial health and project success at the same time.

3. A Study of the Impact of Material Cost Fluctuations on Civil Project Budgets

A direct and profound impact on the civil project financial planning arises from material cost fluctuations. Material price increases that were not planned can damage the project with significant cost overruns, and the contractors may be forced to renegotiate terms, or absorb the losses, in order to stay viable. These fluctuations of course, have an impact not just on the immediate procurement of materials — but also the long - term feasibility and profitability of civil projects.

3.1 Budget overruns, and contractual disputes

Material price volatility is one of the most immediate affects on project cost as it often results in budget overruns. Construction industry is one where fixed price contracts are frequently used and such contracts do not take into account sudden rise in the prices of materials. Consequently, for example, contractors may be exposed to financial losses if unexpected price increases occur [8]. This scenario often makes disputes between project owners and contractors most with the former not willing to pay more whereas the latter have a higher chance of becoming bankrupt or its financial state will be severely affected.

This can result in project delays, lead to litigation or cancellation, which would unfortunately affect all stakeholders [9]. So many construction firms are adding escalation clauses to their contracts to mitigate this risk. By allowing for price adjustment in these clauses, they offer a way for contractors to, in some measure, transfer some of the financial risks of material price volatility [10]. By establishing these clauses in advance, both sides can provide protection to themselves, as well as work towards a more congenial partnership of execution.

3.2 Rescheduling and 2 Project Delays

Other than budget overruns, material shortages due to price fluctuations can add significantly to project time. An example of this is a delay in steel delivery resulting from price hikes or ongoing supply chain issues that would cause the shut down of construction activities and cascade into overall project timelines [11]. These delays, while they do not affect solely the immediate and up front costs of labor and supplies do also cost penalties for missing project deadlines that only compound financial strain [12].

The reallocation of resources to deal with delays will disrupt the project workflow, will increase the tension among the subcontractors and could even lead to a non quality work due to rushed timelines. However, the result of combined increased costs and extended schedule is a decreased net profitability of the project from start to finish and a decreased client satisfaction from project to project.

3.3 Risk Mitigation Strategies

Construction companies are moving toward various risk mitigation strategies to combat the financial uncertainty that comes with material cost volatility. In relation to proactive measures, advanced procurement techniques, diversified sourcing, and alternative materials are being used [13].

Through advanced procurement options, firms lock in prices during a period before market fluctuations can happen, thus providing a more predictable budgeting and a decreased cost overrun risk. For example, a contractor might purchase a bulk supply of a critical material that isn't needed right away even if the prices are good, or even if the materials aren't ultimately needed at that rate.

The risk mitigating aspect of diversified sourcing cannot be undermined. Construction firms can help ensure they are not over reliant on a single market or vendor by sourcing their materials from several suppliers. This provides much flexibility and helps make contractors more powerful when they negotiate price [14].

Additionally, the use of alternative materials, including engineered timber in lieu of traditional steel, is becoming an increasingly used method to manage risky material costs [15]. Where possible, these alternative materials can often be sourced locally, saving on transportation and project lead times, and be aligned with environmentally sustainable project owners.

4. Case Studies

4.1 Case Study 1: Steel Price Volatility that is Part of a Bridge Construction Project (2021)

Last year in the United States, a significant bridge construction project struggled as steel prices spiked an unprecedented 60%. Originally, this project was budgeted at \$50 million, however the project exceeded budget by \$15 million as global steel prices skyrocketed due to supply chain problems and more demand due to post pandemic recovery efforts. As a result this financial stress compelled the project owner and contractor to go to renegotiating terms, and as a consequence delay the completion of the project by three months [16].

For these unforeseen costs, the project team engaged in risk sharing agreements, including a price escalation clause. This clause provided for adjusting the contract price on the basis of steel prices fluctuations, thus sharing the financial risk between the contractor and the of ownership project. This worked to some extent but the project timeline and cost overruns exemplified the absolute necessity for employing effective risk management approaches against the threat of material price volatility.

4.2 Case Study 2: Cement Shortages in a Middle Eastern High Rise (2022)

In 2022, a construction high rise project in Dubai experienced a sudden cement shortage, where the project was delayed by long haul. The \$200 million project was attributed to global

shipping disruptions and local manufacturing limitations as it sourced \$200 million in material costs, 10 percent more than normal, [17]. Because cement became increasingly scarce, and budget overruns and delays of up to six months threatened the project's timeline and financial stability, the project team found itself struggling to manage the ever escalating costs.

To these challenges, the project team adopted an alternative procurement strategy including the purchase of cement from neighboring countries as an insurance against delay [18]. Not only was the forced involvement of multiple suppliers in the short term vital to solving the problem, but it also highlighted the importance of flexibility and flexibility in acquisition. Diversifying their supply sources, the team was able to maintain progress and less the drain of cement on the overall project timeline.

4.3 Case Study 3: Alternative Material Use in a European Residential Project (2023)

Driven by inflation and market instability, steel and concrete are becoming increasingly more expensive in Germany and are raising the costs of a residential construction project there in 2023. The contractor responded to these challenges and abated costs by choosing to adopt engineered timber as the primary building product. It led to a significant 15% reduction of material costs [19].

While the design of the project had to adapt to the transition to engineered timber, the project was able to stay on budget and on schedule because of it. In summary this case demonstrates how alternative materials can play a role in mitigating the effect of market forces of volatility [20]. In addition to tapping into innovation in material sourcing, the success showed the value of being flexible in planning and executing a project. Construction teams can take advantage of alternative materials in order to be responsive to the market swings and achieve successful projects.

5. Conclusion

There has been a rise in consideration of material cost fluctuations as a critical challenge to the construction industry especially to civil projects where material costs represent a considerable percentage of the total budget. This paper presented analysis that shows that supply chain disruptions, geopolitical instability and inflation are the main factors that drive material price volatility. Not only they cause budget overruns, but these fluctuations also cause project delays, contractual disputes, and have therefore acute need for efficient risk mitigation strategies.

Construction firms need to take proactive means like using advanced procurement techniques, diversified sourcing of material and use of alternative material in innovative manner. These strategies will stabilize costs to reduce exposure to market uncertainties before the development is started. The case studies examined show in how construction projects in different regions have reacted to the consequences of material cost volatility by using different strategies to varying degrees of success.

The global economy's volatility continues and now it's more important than ever for construction companies to be able to

be agile and proactive with managing material costs. Such monitoring of market trends includes strong supplier relationships and investing in training and development programs for developing teams with the adaptability for changes in conditions. To help construction firms better ensure the financial viability of their projects in an unpredictable market landscape, robust strategies to manage material cost fluctuations can be implemented by construction firms.

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