GUIDELINE TO APPLY HEDGING TO MITIGATE THE RISK OF CONSTRUCTION MATERIALS PRICE ESCALATION

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Abstract: Accurately forecasting cost is vital to the success of any construction project. Cost estimation encompasses uncertainty, since construction projects are exposed to many forms and degrees of risk. Materials price volatility and shocks constitute one aspect. Most current approaches for material risk assessment are deterministic and do not take into consideration material price fluctuation. The application of hedging, to mitigate the risk of construction material price fluctuations, is proposed in this research. Although it is known that using hedging as a risk management tool adds value to a financial firm, limited knowledge has been established about using hedging for construction material price risk mitigation. Hedging has also been a practice applied in the airline industry for a long time, and substantive research has been completed in the field of airline fuel hedging. The objective of this research is to identify best practices in the area of airline fuel hedging to provide an outline for implementation in the construction industry, and to develop a step-by-step guideline to applying materials hedging in the construction industry. This is considered to be the first attempt to match construction material hedging with the airline fuel hedging application. The guideline presented herein helps construction companies to apply hedging to mitigate the risk of construction material price fluctuations. This guideline improves construction companies’ ability to submit a very competitive bid on a specific project.

1 INTRODUCTION

Cost estimation is considered to be one of the most important tasks in the development of a construction project budget. However, due to the possibility of material price fluctuation, cost estimation is usually uncertain. Construction materials may encompass 50-60% of the total cost of a project if combined with other services such as equipment (Spillane 2011). When left unmanaged, materials may have a greater significant impact on total project cost fluctuation. Materials price uncertainties are extensive throughout the project lifecycle, occurring at project initiation and continuing until termination. Fluctuations of materials’ prices, which are volatile, are a driver of project costs. The engineering and construction (E&C) industry has tried to address materials risk through numerous approaches. Most current approaches for material risk assessment are deterministic, which means that they treat variables such as price as if they were fixed. However, in reality, material prices fluctuate up and down (EUFRAM 2014). Indemnification and insurance provisions are the primary risk mitigation devices in any construction contract. These provisions obligate the party with less bargaining power to insure the other against certain risks. These provisions could help the two parties allocate materials risk and other risks contractually (Thomas 2014). However, they cannot address unforeseen circumstances that can affect materials pricing (i.e., the 1973 oil embargo). Current approaches for material risk assessment do not reflect price volatility issues. The construction industry has been slow to realize the potential benefits of new methods in risk management.
Although it is known that using hedging as a risk management tool adds value to a financial firm (Marsden and Prevost 2005), limited knowledge has been established about using hedging for construction material price risk mitigation. Macdonald (2013) first suggested using hedging as a tool to mitigate material price risk. In her research, Macdonald provided an overview of the construction industry need, and introduced the problem of materials price risk mitigation in construction projects. Hedging has been the practice in the airline industry for a long time, and substantive research has been found in the field of airline fuel hedging. Identifying best practices in the area of airline fuel hedging, then applying it in the construction industry, could save time and eliminate trial and error process improvements. The objective of this research is to develop a step-by-step guideline to apply hedging to mitigate the risk of materials price in construction projects.

2 METHODOLOGY

The first step of this research was conducting a literature review to reveal what is already known in the body of knowledge about hedging practice in the airline industry and the construction industry. The literature search revealed that there is a gap in the body of knowledge about using materials hedging in the construction industry. This research is an attempt to fill this gap. The second step of this research was collecting and identifying the best hedging techniques in the airlines industry. A best practice refers to a way that has constantly shown results superior to those achieved with other means, and that is used as a benchmark (Stevenson 1996). This research considered qualitative and quantitative criteria to identify best practices in the area of airline fuel hedging. The quantitative criteria looked for the hedging practice that consistently showed the pursued results. This means that the practice has been used for a long time, and each time the practice has been used, it gave the same result. The qualitative criteria looked for the practices that had a direct or immediate effect on the results. This means that the practice had a direct relationship with the result. For example, if a company uses only swaps as a hedging technique, and the hedging was successful, then the swaps technique has a direct relationship with the result. The hedging practice should meet both criteria to consider it as a best practice. Figure 1 shows the process to identify best practices using the quantitative and qualitative criteria.

![Figure 1: Criteria to identify best practices in the area of airline fuel hedging](image)

Eight primary research articles has been identified to meet the quantitative aspect, and one research article has been identified to meet the qualitative aspect. The third step was investigating the possibility of applying the knowledge collected from step two to create a guidance to help construction companies apply material hedging successfully. The researcher utilized the traditional risk analysis process to develop the guideline presented in this research. The final step was drawing conclusion and providing recommendation for future research direction.

3 NATURE OF FINANCIAL HEDGING

A hedge is an investment position projected to offset potential losses that may be incurred by a companion investment (Mattus 2005). Derivatives are financial instruments used in the hedging process.
They are contracts whose value is derived from one or more variables called underlying assets (i.e., fuel). Forward, future, option and swap are examples of derivatives contracts. Both forward and future contracts are an arrangement to buy or sell something at a future date at a fix price. Contrasting with forward contracts, futures contracts trade on central exchanges, called future markets (Morrell and Swan 2006). Another type of derivative is called an option. Options are of two types: calls and puts. Options give the buyer the right, but not the obligation, to buy or sell a certain quantity of the underlying asset, at an agreed price on or before a certain future date (Morrell and Swan 2006). The last type of derivative is called a swap. Swaps are private arrangements to exchange cash flows in the future according to an agreed formula (Morrell and Swan 2006). Hedging derivatives and their integration make up the major part of an oil company's operations in the worldwide oil market (Mattus 2005).

4 FUEL HEDGING IN THE AIRLINE INDUSTRY

Based on a survey of the relevant literature, eight primary research articles provided the level of detail to indicate best practices in airlines industry. Mercatus Energy Advisors (an independent energy trading, marketing and risk management advisory firm) conducted a survey of executives at 24 global airlines. Participants in the Mercatus (2014) survey stated that they are currently and/or have previously utilized various hedging instruments and structures. However, the majority of these airlines are utilizing fixed price swaps, call options, and collar options, which tend to be the favored hedging instruments of the industry. According to Mercatus (2014), only 3% of the companies use futures while 39% use swaps. Also, 29% of the companies use call option and 26% use collar option while 3% use forwards. Carter, Rogers, and Simkins (2006) conducted a similar study on the airline industry and they arrived at the same result as Mercatus (2014). Carter, Rogers, and Simkins (2006) stated that the call option is used primarily by airlines, since it protects them from any fuel price increase.

Options are more flexible than futures, giving the holders the ability to protect themselves against undesired price movements, while at the same time giving them the chance to participate in favorable movements. However, in order to hedge their exposure to fuel prices, airlines have more recently moved to use blends of a call and a put option called a collar (Carter et al. 2006). The call option protects the holder from price rising higher than its strike price (the price at which the contract can be exercised). The holder of this call option also writes a put option to limit any possible gain if the price decreases below its strike price (Carter et al. 2006). The total cost of taking the two options is the difference between the call option premium paid and the put option premium received. This is popular with airlines because it fixes the price for fuel between two identified values.

Carter, Rogers, and Simkins (2006) stated that a swap is often considered the "most favorite" hedging strategy for airlines. The airline would buy a swap for a period of one year at a fixed strike price for a stated amount of jet fuel per month. The average price for that month is then compared with the strike price. If the average price is larger than the strike price, the counter-party (which is a bank) would pay the airline an amount equal to the difference between the average price and the strike price times the amount of fuel (Carter et al. 2006). However, if the average price were lower than the strike price, then the airline would pay the difference. A third study is done by Gerner and Ronn (2013). They backed up the results of both Mercatus (2014) and Carter, Rogers, and Simkins (2006). Gerner and Ronn (2013) stated that most airline companies use call options to provide insurance against sudden upward price shocks. Also, buying a jet fuel swap allows airlines to hedge their exposure to jet fuel prices fluctuation. If the price of fuel goes up, the gain on the fuel swap offsets the increase in fuel cost (Gerner and Ronn 2013). On the other hand, if the price of fuel declines, the loss on the fuel swap offsets the decrease in fuel cost. Either way, once the swap is executed, the airline has locked in their fuel cost (Gerner and Ronn 2013).

According to Scott Topping, Director of Corporate Finance for Southwest Airlines, “the majority of airlines depend on plain vanilla instruments to hedge their fuel costs, including swaps, call options and collars” (Carter et al. 2004). This is consistent with the argument of the first three articles above. Cobbs and Wolf (2014) state that “the most frequently used hedging contracts by airlines are: swap contracts (including plain vanilla, differential, and basis swaps), call options (including caps), collars (including zero-cost and premium collars)”. Further, Lim and Hong (2014) state that futures are used by some airlines, but most airlines today use primarily swaps and call options to hedge their jet fuel price risk. Westbrooks (2005)
supports this argument and he state that most airlines use hedges to some extent to limit their fuel risk. This has been done mostly by utilizing swaps, call options, and collar options.

Carter, Rogers, and Simkins conducted an earlier study in (2002) investigating the fuel hedging performance of 27 firms in the U.S. airline industry during 1994-2001. They found a positive relation between using call options and swaps as hedging tools and value increases in capital investment (Carter et al. 2002). These eight articles identified call options, collar options, and swaps as the best practice for fuel hedging application in the airlines industry. One of these articles found a positive relation between using these hedging tools and capital value increases. As a result, call options, collar options, and swaps meet this research’s quantitative and qualitative criteria for best practice since they are the primary derivatives that are used by airlines and they have a positive relation with airlines companies value increase. The fuel hedging process includes nine steps as shown in Figure 2. First, the airline industry identifies all energy-related risks including market, credit and regulatory risks. These risks can be investigated using quantitative or qualitative analysis. Next, an energy risk management policy can then be established to formalize the goals, objectives and risk tolerance, and to determine who executes the hedging policy. A hedging committee is the preferred choice for the airline industry to make hedging decision (Mercatus 2014). The responsible party should determine three main values:

- The strike value, or the value of the jet-fuel at which the contract starts to pay out.
- The tick value, or the payout amount for $ increment change in a gallon of jet fuel price beyond the strike value.
- The maximum financial payout of the contract that need to be purchase.

![Figure 2: The airline hedging process](https://example.com/figure2.png)
preferred types of contract are options and swaps. These contracts are traded Over-The-Counter (OTC). OTC derivatives are traded directly between the airlines and banks, and as such have counter-party risk that must be taking into consideration (Gerner and Ronn 2013). Hedges should be constantly examined to determine if they fit within the company’s goals and management policy. The positions should be enhanced when possible. As the company’s risk exposure changes, there should be an efficient process for reporting and determining if the hedging policies need to be modified or if the existing policy and strategies are correct. A call option protects the airline company from fuel price increase. As suggested by Gerner and Ronn (2013), an example of a call option for an airline is shown in Table 1.

Table 1: Call option for an airline company

<table>
<thead>
<tr>
<th>Terms</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coverage Period</td>
<td>from Jan 1 to June 30</td>
</tr>
<tr>
<td>Fuel Type</td>
<td>Jet Fuel</td>
</tr>
<tr>
<td>Strike Value</td>
<td>$5 per gallon</td>
</tr>
<tr>
<td>Tick Value</td>
<td>$1,000,000 per 10 cent increase per gallon</td>
</tr>
<tr>
<td>Maximum Payment</td>
<td>$5,000,000</td>
</tr>
</tbody>
</table>

In this example, the option seller would pay the airline company $1,000,000 per 10 cent in excess of $5 per gallon of jet fuel, up to a maximum payment of $5,000,000. Figure 1 shows the airline hedging process steps.

5 CONSTRUCTION MATERIALS HEDGING PROCESS

Based upon investigation of airlines fuel hedging practices, this research provides construction companies with a step-by-step guidance to apply material price hedging successfully. These steps are based on the knowledge collected from the fuel hedging application in the airline industry. As shown in Figure 3, these steps are: identify and analyze risks; determine tolerance for risk; develop hedging management policy; develop hedging execution strategies; implementation, monitoring, analyzing and reporting risk; and, finally repeat the process.

Figure 3: The seven step guideline for construction material hedging application
5.1 Identify and Analyze Risks

The fuel hedging process start with identifying all risks related to hedging. The construction company can apply this step during the bid process. Before bidding, the construction company estimates the cost of material needed using a cost index. That leads to an understanding of the impact of the material price fluctuation on the company profit by projecting cash flow requirements in the event that material prices significantly exceed norms. During this step, the exact type of materials that affects the company should be identified and looked at in monetary terms (i.e., price fluctuation of one ton of steel).

5.2 Determine Tolerance for Risk

The fuel hedging process mentioned determining tolerance as an important step in hedging process. Once relevant material variables have been identified, analysis of the price volatility of this material should be done to decide at what point price volatility become unacceptable for the company. Consideration of any schedule penalties (i.e., late delivery of the project), as identified in the project contract, will be incorporated into this step.

5.3 Develop Hedging Management Policy

Hedging management policy should be developed to clearly describe the decision-making process and define who (individuals and/or committees) executes the hedging and related activities. The fuel hedging process mentioned clearly the importance of determine who is responsible for hedging decisions. Based on the knowledge collected from airline fuel hedging, creating a dedicated hedging committee is the best choice for making the hedging decisions for the construction industry.

5.4 Develop Hedging Execution Strategies

Execution strategies are the process for implementing the hedging strategies, and complying with hedging management policy. For example, the execution strategies determine which hedging and trading instruments should be used to meet the targeted hedge objectives. Based on the fuel hedging application in the airline industry, the best trading instruments are swaps and options (i.e., call, put, or collar options).

5.5 Implementation

The airline fuel hedging application shows that the primary market trade for derivatives is Over-The-Counter. OTC securities are unlisted so there is no central exchange for the market. The first step a construction company must make before they can trade in OTC securities is to open a hedging account with a broker. After the company places the market order with the broker, the broker must now contact the material supplier. The material supplier then will quote the broker the ask price that the material supplier is willing to sell the security at. If the construction company accept the price quoted, the broker will transfer the necessary funds to the material supplier’s account and is then credited with the respective securities. It is important to address the following four points during the implementation process:

- At what point do material price volatility become intolerable (the strike value or the value of the construction materials at which the contract starts to pay out);
- What is the incremental cost to your company for each $ increase per ton/lb of the material (this is the tick value);
- What is the worst possible case (the maximum financial payout of the contract);
- What is the duration of the hedging instrument that fits the company need (short-term, mid-term or long-term)?

A hypothetical example of a call option for a construction company is shown in Table 2.
Table 2: Call option for a construction company

<table>
<thead>
<tr>
<th>Terms</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coverage Period</td>
<td>The life of the project (or a phase of the project)</td>
</tr>
<tr>
<td>Index</td>
<td>Average price of 1 ton of steel</td>
</tr>
<tr>
<td>Strike Value</td>
<td>$800 per ton of steel</td>
</tr>
<tr>
<td>Tick Size</td>
<td>$100 /Ton</td>
</tr>
<tr>
<td>Limit</td>
<td>$500,000 (for 5,000 ton of steel)</td>
</tr>
<tr>
<td>Premium</td>
<td>$50,000</td>
</tr>
</tbody>
</table>

When the steel price hits $800 per ton, the hedging contract begins to pay off $100 per ton, up to a maximum value of $500,000. The strike value, tick value, and maximum payment can all be changed to meet the company's preferred risk coverage. Companies should take into consideration that the price of a material risk hedging contract to protect against financial loss depends on the likelihood of a contract payout. If the probability of certain material price volatility is low, so will the cost of the contract.

5.1 5.6 Monitoring, Analyzing and Reporting Risk

Reporting and deciding if the hedging policies or strategies need to change is one of the process steps to apply fuel hedging. Similarly, materials risks should be continuously monitored, measured and reported. As the company's risk exposure changes, there should be a methodical process for reporting and determining if the existing policy and strategies are correct. Also, hedges should be modified when market conditions change, as noted in the next section.

5.2 5.7 Feedback Loop

Continuous revision to the entire process of material hedging is necessary, because the material price could be affected easily by a variety of factors (i.e., regulatory change, world political and economical stability). Changes in material price may then have a subsequent effect on the initial steps of the process. Further, these derivatives may be initiated for varying short-term, mid-term and long-term durations throughout the project.

6 RESULT

This research identified best practices in the area of airline fuel hedging, and discussed how these best practices can be applied to the construction industry. The identification of fuel hedging best practices provided a general outline for material hedging application. This research used the analysis of the fuel hedging process in the airline industry to develop a seven step guideline for the construction material hedging application. These steps are: identify and analyze risks; determine tolerance for risk; develop hedging management policy; develop hedging execution strategies; implementation, monitoring, analyzing and reporting risk; and, finally repeat the process.

The research concludes that applying material hedging in the construction industry could be very useful and should not be overlooked by construction companies. The guideline presented by this research helps construction companies to apply hedging to mitigate the risk of construction materials price fluctuations. This guideline could improve the ability of construction companies to submit a low price bid on a specific project.

Future work in this area could include the investigation of material hedging cost to determine if the hedging application is feasible. This is very important and could be added to the tolerance phase of this guideline to help the company decide if material hedging is economical for them. Further research could be done to investigate the best way to settle the hedging contract. This could be done by simulating different scenarios of hedging situation. Different scenarios could generate different settlement options such as moving out from the hedge early or keep the hedge contract until its due date.
References


