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Online Logistics System (OLS) for the Copper Concentrate Mining Industry

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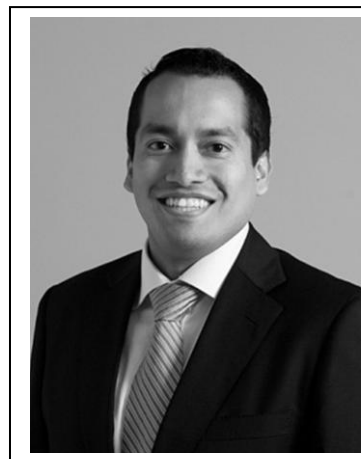
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Summary:

This thesis addresses the question of the value of the information that an Online Logistics System (OLS) can provide to the copper concentrate mining industry. In order to quantify the benefits generated by the system, a simulation model was developed and two scenarios were assessed, one with and the other without the OLS. The main benefits for the smelter companies were evaluated once the information flow was centralized and available in real-time.



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KEY INSIGHTS

1. Information provided by the OLS has the potential to reduce the frequency of purchases by smelting companies in the spot market.
2. Sharing real-time information reduces the uncertainty of the arrival of shipments; Smelter companies can improve their visibility and develop accurate and efficient operation schedules.

Introduction

The ultimate goal for the smelter companies is to have available supplies of copper concentrates, when required, at the lowest possible cost and at desired quantities. This is in order to have a constant and uninterrupted source of material for the smelting process.

The smelter companies have fixed annual capacities, and generally operate at full capacity. This means that every day of the year, the final output is the

same. However, the copper smelting industry is not highly profitable; on the contrary, optimizations of the operation and efficiencies throughout their processes have been key issues for them for many years.

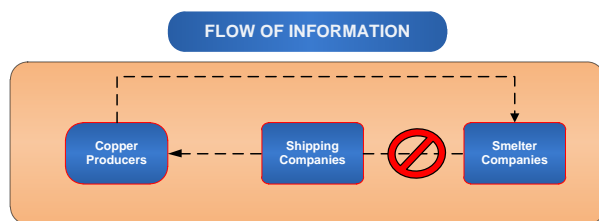
The distances between copper concentrate suppliers and customers are extremely long. Since approximately 50% of the total worldwide copper concentrates are exported by Chile and Peru, and 72% of the total worldwide demand is imported from countries located in the Far East, such as: China, Japan, Korea and India. Furthermore, transit times from Chile and Peru to the Far East are extremely long as well as highly variable. Shipments from Chile and Peru to the Far East could take from 31 to more than 70 days.

For these reasons, it is highly relevant for the smelter companies to have real time information of the location of their cargo on a daily basis. Currently, this lack of visibility affects the smelter's decision-making process regarding the appropriate number of times in which they should go to the spot market and buy parcels of copper concentrates at a premium price. Presently, without real-time information, smelter companies avoid taking risks related to the arrival times of the bulk carriers; as a result, they pay

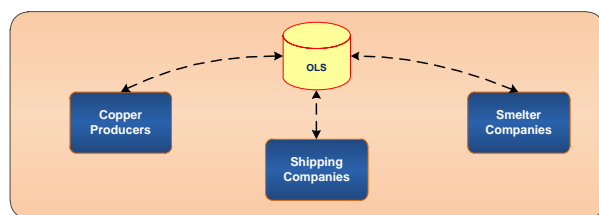
premium prices in the spot market. They make decisions without knowing the current location of the vessels. Therefore, smelters are increasing the frequency of purchases in the spot market and carry more inventory than is absolutely essential.

Problem Definition and Approach

Currently, the entire copper concentrate mining industry is facing a visibility problem in its supply chain due to the lack of a system that allows having a complete real-time overview of the ships' locations around the globe. The communication required for coordinating the logistics processes and the information flow among copper producers, shipping companies, and smelters is conducted via telephone and/or e-mail, and there is no connection between some of the players, as shown in the following figure. Usually, the process of obtaining the information of the location of vessels takes from one to two weeks.



This lack of real-time information throughout the whole industry negatively impacts the inventory-related decision making process at the smelter companies. This information would serve as the connection between the players in this supply chain, allowing them to coordinate and maximize the total profitability. The following figure shows the information flow solution proposed in this thesis.



Our approach was to develop a model that includes two scenarios: one with and the other without the system. These scenarios were proposed and evaluated. The simulation model measured in both scenarios the frequency in which smelter companies must buy at the spot market. The difference between these scenarios arises as the difference between the respective relevant cost functions. The expected benefits should come from the number of "unnecessary times" in which smelter companies go to the spot market.

Results

The results of the simulation for the proposed scenario with OLS show that the frequency of going to the spot market is 11 times a year. However, in the current scenario without OLS, the frequency is up to 24 times a year. Each purchase is equivalent to 10,000 DMT. Thus, the total quantity of copper that is not necessary to buy at the spot market is the frequency in the proposed scenario minus the frequency in the current scenario multiplied by the copper premium price at the spot market multiplied by the 30% copper content. This is the average value in a regular copper shipment.

The simulation shows that the smelter could decide not to buy on 13 occasions in a year, this represents 130,000 DMT. Moreover, this quantity represents 4,573,870 USD per year in savings due to avoiding paying the premium copper price. As a result, this represents 0.387% of the total amount spent from one smelter in copper concentrate in a year.

The average inventory on hand considering 99% of customer service level for the first scenario considering the OLS is 66,045 DMT. In contrast, the average inventory on hand with CSL of 99% for the second scenario without OLS is 66,018 DMT. The difference is only 27 DMT per day. In order to calculate the impact of this inventory level reduction a holding cost of 15% of the international copper price is assumed. The quantity of tons that the OLS saves has been multiplied by the holding cost and by the 30% of copper content of the inventory. This is equivalent to a difference of only 11,421 USD. It is not significant, because it represents 0.001% of the total amount spent from one smelter in copper concentrate in a year.

The ordering cost considers all the costs incurred while placing and receiving an order. It includes the costs of preparing the order or the invoice, salaries, telephone costs, etc. The average amount considered in an order is 10,000 DMT. A percentage of 0.01% is considered as the ordering for this simulation. The total quantity that the use of the OLS generates is 37,443 USD. It is not significant, because it represents 0.003% of the total amount spent from one smelter in copper concentrate in a year.

The total value of the Online Logistics System is 4,599,983 USD, representing a 0.389% of the total amount spent from one smelter in copper concentrate in a year. These results are shown in the following table:

Costs (USD)	Scenarios		Value of OLS
	Current	Proposed	
Inventory Holding Cost	\$ 28,172,852	\$ 28,184,273	-\$ 11,421
Order Cost	\$ 69,126	\$ 31,683	\$ 37,443
Spot Market Purchase Cost	\$ 8,548,236	\$ 3,974,365	\$ 4,573,871
Total Cost	\$ 36,790,214	\$ 32,190,321	\$ 4,599,893

The results show the potential benefits of the implementation of the Online Logistics System. Three sources are considered to obtain the values. However there is only one significant one and this is the Spot Market Purchase Cost.

Considering one smelter with a capacity of 450,000 DMT per year, the actual value of the information generated by the Online Logistics System is approximately 4.6 million USD per year.

Conclusions and Recommendations

In this project, we found that lead times of copper concentrates from Chile and Peru to the Far East will not change. The variability of these lead times will also stay the same. Nevertheless, due to the fact that the information flow in the industry is reduced on average 10 days, and this information flow is available on a daily basis, the main benefit generated by the Online Logistics System is related to the smelters companies going to purchase at the spot market.

Smelters will reduce the number of times in which they have to purchase copper concentrates in the spot market and will reduce the quantity of copper concentrate purchased at a premium price. For this reason the smelter companies will receive benefits due to:

- The value of the OLS in the Copper Concentrate Mining Industry is mainly located at the smelters level.
- The information flow uncertainty will be reduced by 10 days on average.
- As an average, the cost of raw materials per unit will be reduced. The reason for this is that with the use of the OLS the number of times going to the spot market will be decreased. Thus, the total amount spent paying premium prices will be reduced by 0.39%.
- The total inventory on hand will have insignificant changes.
- The ordering costs will have insignificant changes.
- The copper industry presents an excellent business opportunity, because at the moment, there are no

available information systems that provide value to the players in the industry. The further development of the Online Logistics System should consider the needs and recommendations of the copper producers, shipping companies and smelters.

By integrating the information flow, relationships among players would be stronger and cooperation between them will bring higher benefits than working separately.

The Online Logistics System could optimize the whole supply chain and would help the smelters' decision-making process by providing them information about the location and arrival dates of the copper to their inventories..

Further Research

The simulation model is focused on the value of the Online Logistics System considering one copper producer located in South America, one shipping company, and one smelter located in the Far East. In order to find future improvements to the OLS, there are several options to follow. We have three suggestions.

The first suggestion would be to consider the quality of the copper in the information inserted to the model. Copper quality means the right mix that a single smelter needs for their production plant. This quality information will allow the smelters to make other decisions concerning the source of the copper.

The second suggestion would be to simulate separately the variability of the loading ports -copper producers-, the variability during the transit lead times offshore, and finally the variability during the unloading ports –smelters-. This will provide more accuracy in the results calculated in this thesis and should permit enhancing the scope of the OLS to all the smelters.

The third one would be to evaluate the implementation of the OLS in similar industries with high profitability, such as Iron ore, Aluminum, Silver, etc. The biggest advantage for this suggestion is that the owners of the copper mines are the same owners of other mineral mines.

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