Construction materials flow investigation – delay evaluation in a sand supply chain with simulation

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INTRODUCTION

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- The increasing competition in today's market;
- Need for more significant investment in planning and control, leading to studies to find solutions that reduce waste and losses in the sector;
- The principles of Lean thinking meet the demands of the current context and have as their starting point the elimination of waste;
- Integration allows better synchronization between supply and demand, bringing material to the workplace.

INTRODUCTION

- The purpose of this study is to evaluate the effects of using a delay generation system on the construction order time and delivery interval in a sand supply chain, measuring the impacts from supplies chain model simulations.

RESEARCH METHOD

- In the model presented in this article, the sand flow was evaluated in a case study of the construction of a 300m² single-family residential building.
- The development of the simulation model of this study was based on the works of Ruiz, Fontanini and Corrêa (2019) and Ruiz and Fontanini (2014).
- The period between the first and last request for sand delivery was 300 days. Shipments were weekly, made in a 6m³ truck. The ordering interval for sand work was, on average, two days, and the delivery time was three days.

RESEARCH METHOD

- The model was developed in the Stella® software;
- Within the model was inserted a delay system, that influenced the order and delivery intervals and an accountant.
- The delays during the simulation varied randomly.
- As for the delay in the work order interval, a maximum tolerance of 1.5 days in a month was considered
- The delay in the restoration interval, the tolerance was two days late in one month, which resulted in a 0 to 6.66% variation

RESEARCH METHOD

- A total of 100 simulations were performed on the model. The generated data were evaluated for the mean, median, standard deviation, coefficient of variation, amplitude, maximum, and minimum values;

- Based on this assessment, the impact of delays was measured on both the expected total Lead Time and the costs relative to the waiting teams.

DELAY IMPACTS

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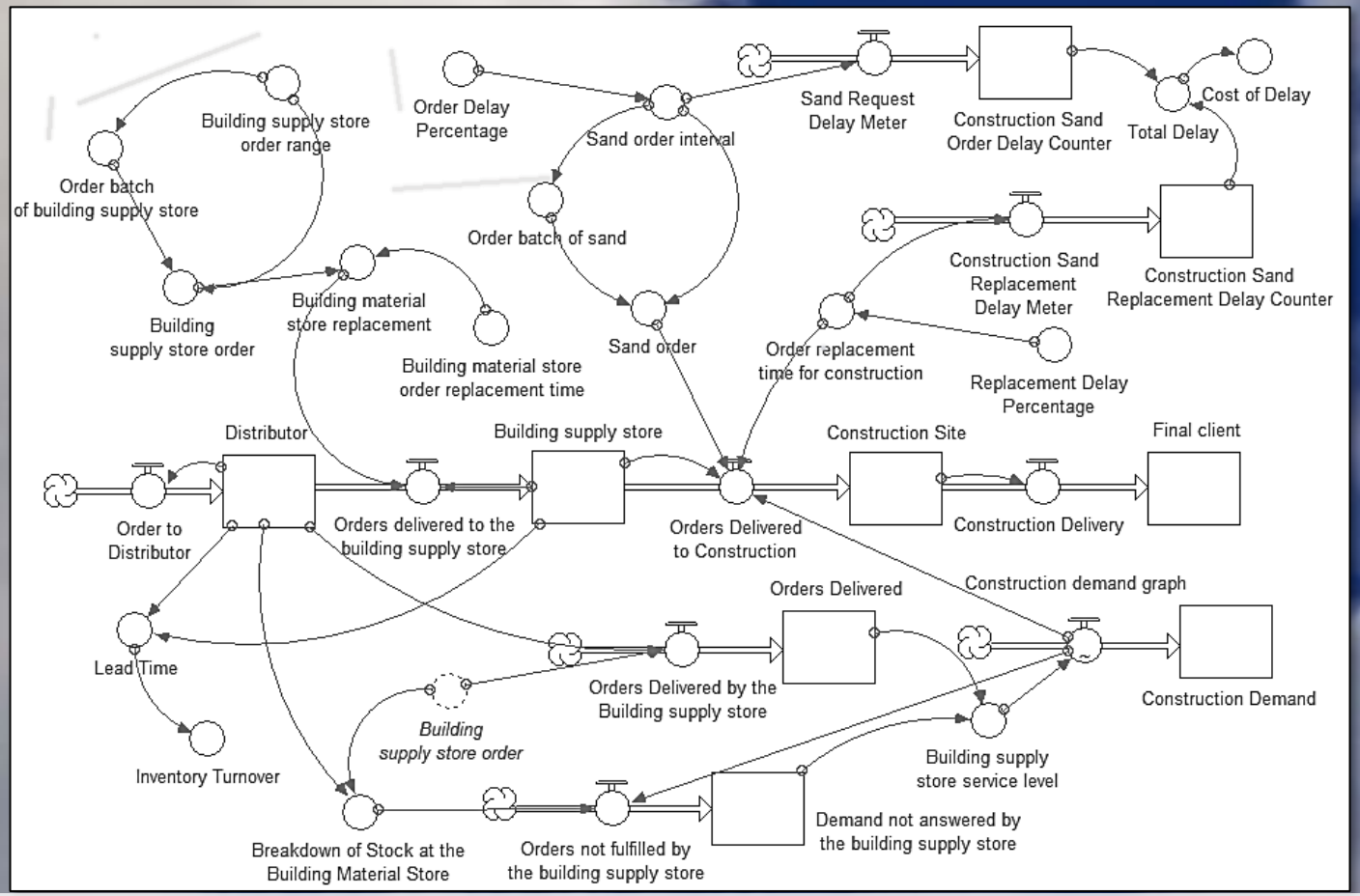

Figure 1: Macro Model of Sand Supply Chain Value Flow Map with a Delay and Loss Accounting System

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Average (μ)	Standard deviation (s)	Median	Coefficient of variation	Maximum	Minimum	Amplitude
US$	US$	US$	%	US$	US$	US$
1.993,78	51,08	1.994,06	2,5621	2.140,37	1.872,45	267,91

Table 1: Impact of cost delays (loss)

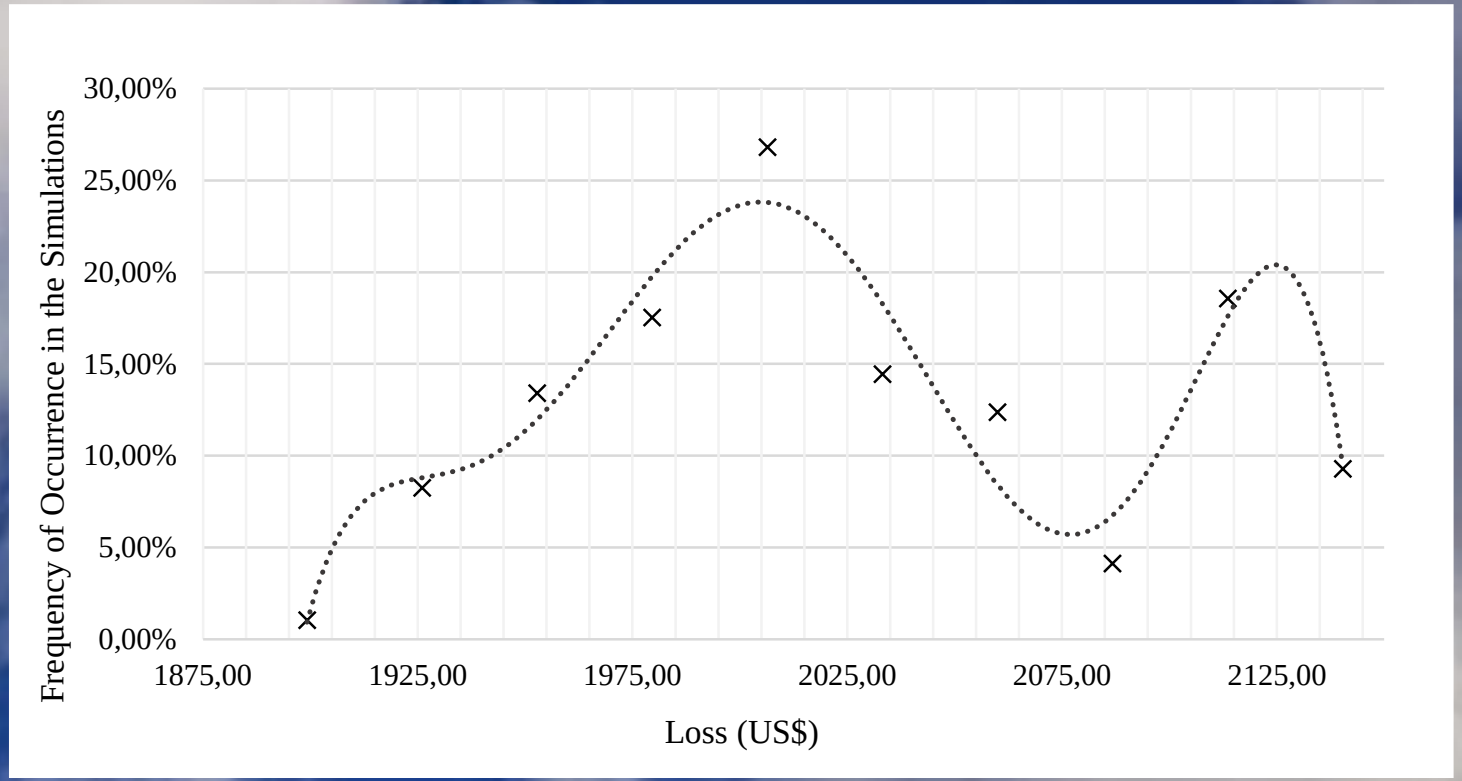

Figure 2: Loss frequency graph

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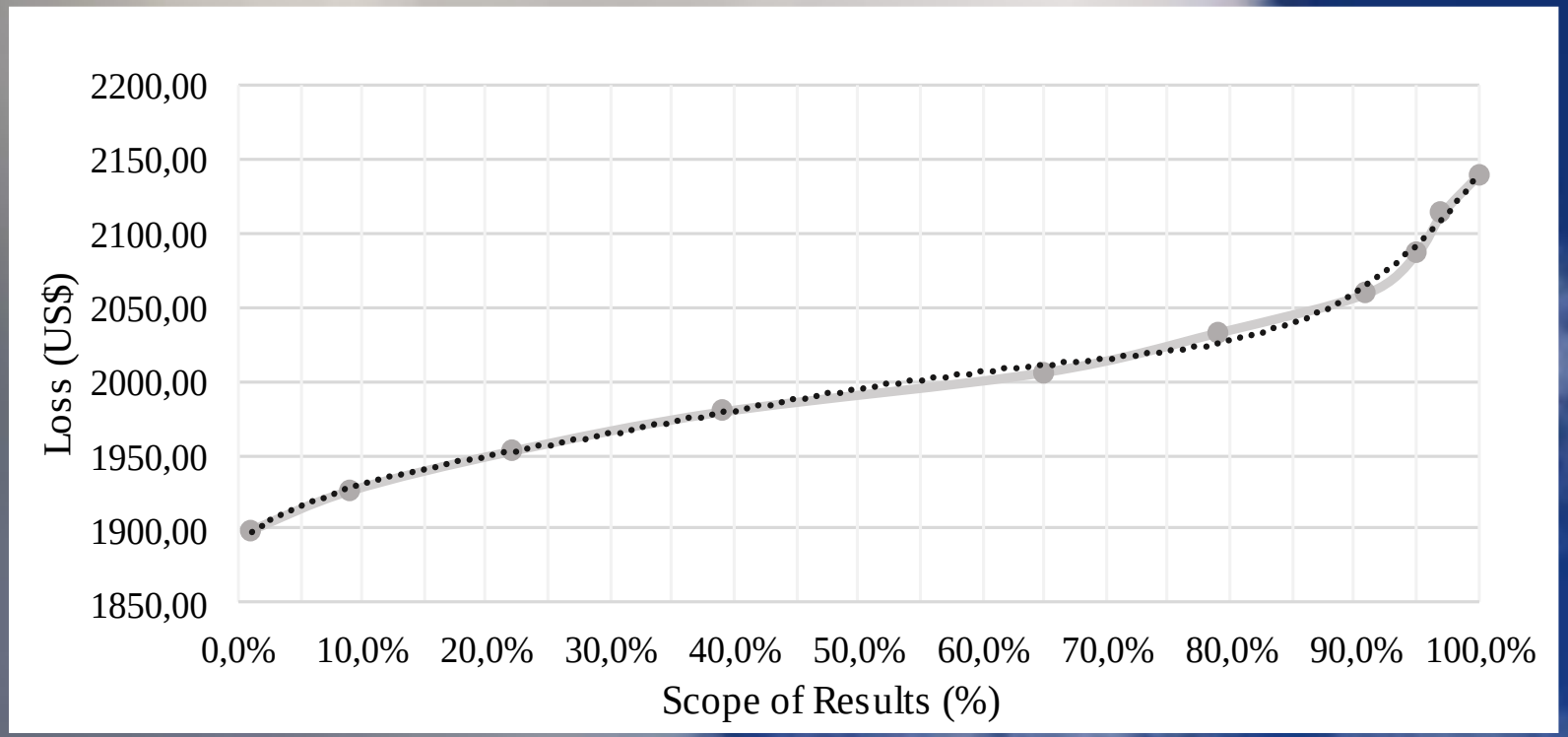

Figure 3: Graph of the scope of results for losses

CONCLUSION

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- Through the statistical analyses carried out in this study, it was possible to evaluate the effectiveness and precision of the model elaborated with a close approximation to reality;

- In the case study, the average loss generated by delays within the sand supply chain for the single-family residential project was R$ 6251.39 (US$ 1742.30). The model considered only the costs related to labor. The impact of material delays was not assessed in this study.

CONCLUSION

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- Due to the absence of a control system over orders and delays, it would be necessary to consider an additional cost in the work of approximately R$ 6543.00 (US$ 1823.58) in addition to the price initially foreseen, to cover 95 % of possible losses.

- Through the analyses performed, it was observed that the range of results regarding the loss at the end of the simulations was approximately R$ 840.00 (US$ 234.11), almost equivalent to hiring another mason's assistant

CONCLUSION

- The importance of having an inventory control system;
- Stay within the cost initially provided for in the project;
- With these delays, there will be a consequent decrease in the profit margins previously stipulated;
- The model structure used in this study has potential for implementation in other construction supply chains;
- A proposal for future studies would be to implement this model in other flows, assessing the impacts of delays in the monetary sphere.

ACKNOWLEDGMENTS

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Thank you!

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