SIMIO WAREHOUSE
Fall 2023 Simio Case Study

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Abstract

This project aims to optimize the operations of a warehouse that supports an e-commerce platform for advanced application video cards. We used Simio simulations to determine the number of operators needed and to establish effective inventory policies for smooth warehouse operations. The main goals of the simulation are to boost operational efficiency, cut costs, and ensure customer satisfaction.

To develop this project, we analyzed provided data, modeled the warehouse in Simio, and designed scenarios to make informed decisions about warehouse management. The methodology is based on solid data and a precise simulation approach, ensuring the relevance and applicability of the results in the e-commerce environment for video cards.

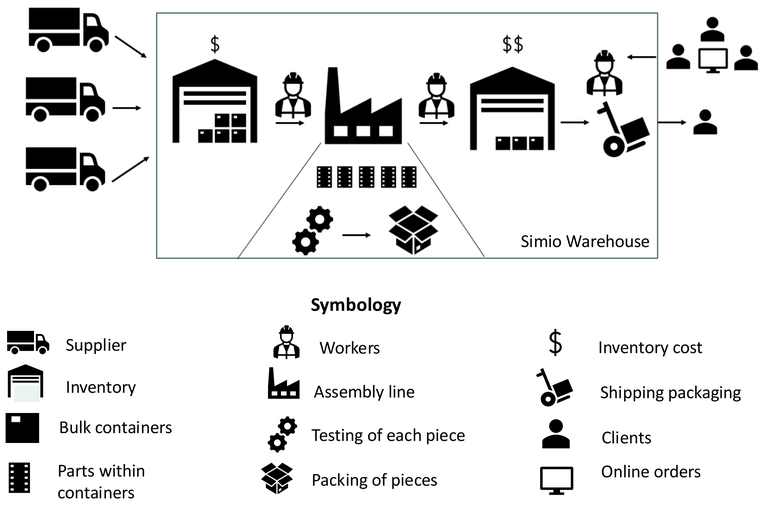
Introduction

This case study focuses on analyzing and optimizing the operations of Simio Warehouse, an e-commerce site for video cards used in advanced video applications, artificial intelligence, and cryptocurrency mining. The warehouse handles three types of cards (A, B, and C) and operates as follows:

- Cards arrive from suppliers unpackaged and are stored in bulk containers, each with a capacity of 60 cards (regardless of type).
- Customer orders specify full bulk containers and are processed 24/7.
- Before fulfilling orders, the cards must be tested and individually packaged, then reloaded into bulk containers.
- The testing and packaging machines are automated but can experience random failures. Additionally, there is a buffer of five cards between the testing and packaging machines, and when this buffer is full, the testing machine shuts down.

A simulation in Simio is desired to improve strategy and determine the number of operators. It also aims to identify the reorder points and reorder quantities for the inventories of unpackaged and packaged cards of types A, B, and C.

Figure 1. Problem scheme

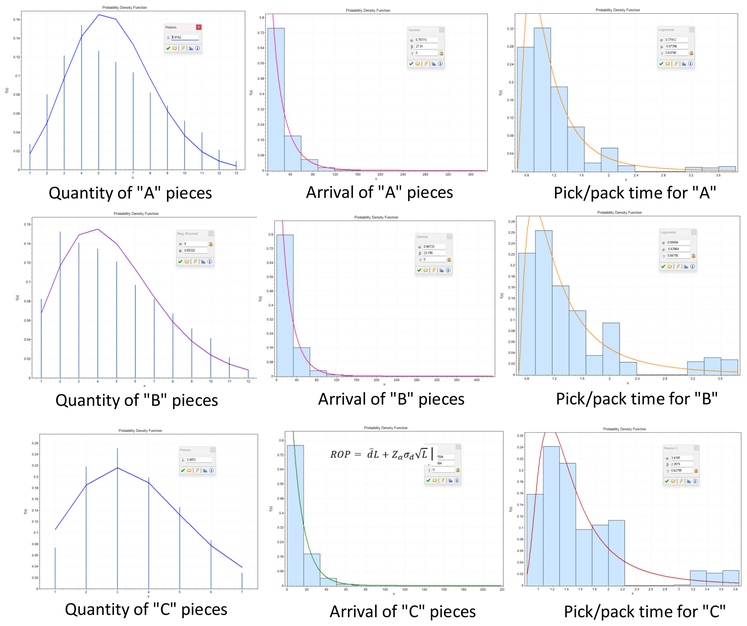


Methods

1. Data Collection and Preparation: We worked with a CSV file containing order information from Simio Warehouse from July 2022 to June 2023. A cleaning process was done using Excel to extract information on order quantities, inter-arrival times, and packaging times for pieces A, B, and C.

2. Obtaining Distributions: We used the EasyFit program with samples of 5,000 data points to determine the necessary distributions for the simulation.

Figure 2. Statistical distributions of the problem



3. Mathematical Calculations: The provided information was used to theoretically calculate the reorder points and quantities using the following formulas:

$$ROP = \bar{d}L + Z_\alpha \sigma_d \sqrt{L} \qquad EOQ = \sqrt{\frac{2 \times D \times S}{H}}$$

$$Q_{inv-pack} = \bar{d}\ x\ L$$

4. Modeling in Simio: We used elements such as Servers, Source, Separators, Combiners, state variables, events, and parameters.

Results

According to the theoretical calculations, the following reorder points and order quantities were determined for the inventories:

Table 1. Inventory data for unpacked items

Piece	Reorder point	Quantity to order
A	2,204	2,388
B	5,843	1,711
C	4,146	4,197

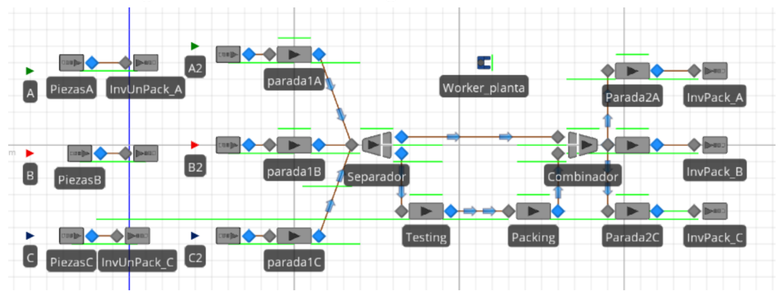
Table 2. Inventory data for unpacked items

Piece	Reorder point	Quantity to order
A	212	109
B	171	102
C	174	133

However, for the inventory of already packaged pieces, the theoretical data were not entirely functional as they were slightly low, leading to significant delays in demand. Therefore, within the Simio model, these parameters were adjusted to ensure the warehouse operated optimally, resulting in the following outcomes:

- Reorder point and order quantity for card A: 212 containers
- Reorder point and order quantity for card B: 261 containers
- Reorder point and order quantity for card C: 300 containers

Figure 3. Internal processing at *Simio Warehouse*



Finally, after adjusting the inventory policies and running the model, the following results were obtained:

- 3 workers are needed for the Pick and Pack area per shift, and with three shifts per day, this totals 9 workers.
- There are no delays in orders.
- To optimize costs, there is more inventory of unpackaged pieces than packaged pieces.
- Approximately 32,485 bulk containers of cards A, B, and C are sold monthly, totaling 1,949,100 pieces of all three types.
- Monthly costs amount to approximately $4,477,882.50, detailed as follows:

Table 3. Approximate financial results

Type	Costs	Type	Quantity	Monthly total
Order delay of more than 6 hrs	$ 120.00	per order	-	-
Worker Pick/Pack	$ 2,700.00	weekly	3	$ 32,400.00
To order "A" pieces	$ 4,000.00	per order	4	$ 16,000.00
To order "B" pieces	$ 3,000.00	per order	6	$ 18,000.00
To order "C" pieces	$ 6,500.00	per order	4	$ 26,000.00
Unpackaged inventory "A"	$ 15.00	per piece	71,640	$ 1,074,600.00
Unpackaged inventory "B"	$ 20.50	per piece	51,330	$ 1,052,265.00
Unpackaged inventory "C"	$ 9.75	per piece	125,910	$ 1,227,622.50
Packed inventory "A"	$ 45.00	per piece	6,360	$ 286,200.00
Packed inventory "B"	$ 61.50	per piece	7,830	$ 481,545.00
Packed inventory "C"	$ 29.25	per piece	9,000	$ 263,250.00

Conclusions

- Based on the simulation, it was found that 3 operators per shift are necessary to meet demand without unnecessary costs.
- Additionally, establishing reorder points and quantities has enabled the development of an inventory policy for Simio Warehouse that effectively meets order requirements.
- Simulation proves invaluable for gaining deeper insights into real-life scenarios and making well-informed decisions. Mastering programs like Simio provides a competitive edge in the workplace by optimizing processes and understanding new scenarios.

References

Flores, V. [Vinicio Flores] (2018, 28 de mayo) *Inventario Común - Simio Simulación - Experimentación* [Video] YouTube. https://www.youtube.com/watch?app=desktop&v=BnPdZ2XQtho