Journal of Information Systems Engineering and Management
2025, 10(50s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Design and Evaluation of Logistics Systems with FlexSim: Case Study and Continuous Improvement

Juan Carlos Valdivieso Sánchez[1], Luis Rodrigo Aroca Martínez[2], Ana Karina Maestre García[3], Jorge Alberto Acevedo Vergara[4], José Manuel Pulido Quintero[5]

[1] *Estudiante de doctorado en administración de organizaciones, Docente de Comercio Internacional, Universidad Popular del Cesar, juanvaldivieso@unicesar.edu.co, ORCID: https://orcid.org/0000-0002-1701-8915*

[2] *Mag. Gerencia Empresarial, Mag. Gerencia de Mercadeo, Docente Universidad Popular del Cesar, laroca@unicesar.edu.co, ORCID: https://orcid.org/0000-0002-1021-8527*

[3] *Especialización en gerencia en mercadeo, Docente de Comercio Internacional- Universidad Popular del Cesar, akmaestre@unicesar.edu.co, ORCID: https://orcid.org/0009-0008-9672-9627*

[4] *Magister En Educación para el Desarrollo Socio Cultural, Docente de Comercio Internacional, Universidad Popular del Cesar, jorgeacevedo@unicesar.edu.co, ORCID https://orcid.org/0009-0003-9229-2249*

[5] *Candidato a Master en Dirección de Marketing, Docente Universidad Popular del Cesar, josepulido@unicesar.edu.co*

ARTICLE INFO

Received: 30 Dec 2024
Revised: 05 Feb 2025
Accepted: 25 Feb 2025

ABSTRACT

The purpose of this article is the design and evaluation of logistics systems, validating the paradigm of discrete simulation. The basic concepts of efficient logistics systems are reviewed; Modules are added that standardize modeling and evaluation in simulations, increasing the reliability and speed in the execution of the process. This has led to the creation of a Supply Chain Management System, which has been developed with the clear objective of modeling an effective supply chain that allows for the optimal management of each and every one of the various processes involved in it. The main purpose of this approach is to reduce operating costs, obtain valuable information that facilitates crucial decision-making and the possibility of optimizing or simulating various alternatives that may arise in the logistics field.

Keywords: FlexSim, Discrete Event Simulation, Project Manager, Simulator, Design of Experiments, Implementation and Evaluation of Production Systems, Industry Pot, experience, systems, logistics, supply chain.

1. INTRODUCTION

The planning and optimization of the design of a logistics system are essential for the success of a company in its purpose of satisfying the demand of the end customer. To achieve this, it must not only have the right materials and products available, at the time and place and in the quantity required, but it must also be able to do so efficiently, making good use of resources such as inventory, transportation, personnel, and infrastructure assets (Arrieta Gamarra, 2021). For the instrumentation of this process, simulation tools offer the possibility of analyzing various scenarios and relevant design variables and operationalizing the distribution system before its implementation. This document presents the proposed methodology to carry out the design, evaluation and analysis of logistics systems, implementation through software, in a company in the fruit pulp industry. This methodology seeks to emulate the behavior of the logistics system under study in its real way of functioning, establishing the use of modeling tools that link the study of it in the most similar way possible (Rey Escobar & Valle Nieto, 2024). In order to help decision-making and minimize time or costs in the development process of the designed models. The research was carried out for a company dedicated to the fruit pulper business in the region, which is currently projecting a growth in its sales in the coming years, due to the difficulty of execution that arises due to the operation of the current logistics system.

2. SIMULATION FUNDAMENTALS

Simulation is presented as an important computational tool, capable of modeling in detail a simplified system of the reality and behavior of the variables in that environment, without the intervention and need to make changes in the real system, guaranteeing the safety of these processes. This tool allows knowledge of dynamic processes and is

Journal of Information Systems Engineering and Management
2025, 10(50s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

capable of showing the reaction of the system to the different policy or design alternatives that can be addressed, it is an excellent support for decision-making, although it does not eliminate existing uncertainties but it does serve to represent them. In the simulation of logistics systems, it is important to know the characteristics of the processes in order to obtain more realistic results (Mogollón et al., 2025).

The following shows a process of building a model for the production system with the help of software, the objective of this work. The simulation allows you to execute all the operations required by the system, for satisfied periods of time and capture the desired results, from these results you can obtain conclusions about the behavior of the system. As a consequence, there is a connection between execution and results for the different scenarios used that can be analyzed for the improvement of the system (Cruz et al., 2024). Within the characteristics of simulation such as hardware and software, you must choose from the numerous existing applications. Among them we chose the software due to its performance and ease of use, it is also easy to import and export due to its compatibility with existing software.

3. FLEXSIM: TOOLS AND FEATURES

FlexSim is a revolutionary tool in graphical modeling for the discrete simulation of complex systems, providing the ability to describe the shape and behavior of each of the components, thus allowing the modeler to spend as much time as needed creating the model and evaluating the results (VARGAS). In this chapter, the central fundamentals of the FlexSim are presented, along with the most important tools and functions for the modeling of logistics systems that will be used later in this work for the modeling, validation and evaluation of the logistics system, the logistics system model has the purpose of answering the questions raised in the research and presenting a model that evidences the rules that condition the expected behavior of the system suggested; in addition, basic concepts of 3D modeling will be presented to guide the reader in this process of creating the model in a third section (Castro Díaz & Toro Ramírez..., 2023).

FlexSim is an innovative tool, as it allows the modeler to fully see the behavior of the logistics system and have a model much closer to reality where any disturbance, obstacle or what in an offline model could not count will be presented in it and will allow to see how the system responds to these changes. Additionally, the time and costs that could be sacrificed in a change or in doing a series of tests in a system that was not online can be quite high both in money and time.

4. LOGISTICS SYSTEMS DESIGN METHODOLOGY

For the methodology of design of logistics systems, and in order to establish a work plan for the construction of the model and the performance of simulation experiments, the work and the corresponding stages were taken as a basis, which are divided into four parts with particular objectives, taking into account that everything comes to an end with the evaluation of alternatives (Huamán Arones, 2021). During the construction of the model, the performance measures must be defined, and with this it will be possible to evaluate whether the proposed solution is good enough. As a first stage, a scheme of logistics processes is proposed in a general and integrated way to transport, sales drops, product updates, changes in the store plan and purchase of goods, where the approximation of information, storage and distribution is evaluated; and a comparison system is established to evaluate the process to be applied with the future system. Therefore, this establishes what the problem to be worked on is established – and after this, it enters into what corresponds to defining the real objectives for the design of the logistics model (Barrera et al., 2022) (Cossio-Mercado and Fernández, 2023). A As a central objective, attention to new strategies such as SKUs or logistic sternalizations. After this, it seeks to understand the general behavior of the current system, where a simulation can be carried out in time with the information obtained in the field. With the above result, the optimal and feasible alternative to follow is analyzed unless of past errors, different solutions are evaluated and the most competitive one is chosen for the solution to be implemented.

5. CASE STUDY ANALYSIS

The last chapter of the work consists of an analysis of several specific case studies in the real field that present different logistics systems analyzed. A total of five current topics are presented that require a diagnosis to make

Journal of Information Systems Engineering and Management
2025, 10(50s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

optimization decisions in the operation of production series, logistics hostels, paper mills, package sorting facilities and Loading System Monitoring Software. (MAURITIUS, 2022)

The first case study consists of making a diagnosis of a production system with high lead time using visual stimuli in the implementation of the software to improve the user experience. In this case, a global design of the system is maintained in its project guide, the existing infrastructures, the organizational resources and the regulations requested by the client. In this line, work is done with the times of the elements shown in the assembly line, not modifying them on the current logic of operation, entering part of the elements into the assembly system by direct collection and others are made indirectly. (Rojas et al.2022)

The second case study studied the diagnosis and design of a logistics shelter system that seeks to forecast the performance of the existing temporary infrastructure. In this sense, the project is asked to predict the availability rates that undermine this service in real time. The increasingly extensive line of supermarket shipments has led companies to look for solutions to increase the capacity of bulk tanks and avoid moving to outsourced in a critical element such as consolidation. In this sense, it can help to know the available capacities. (Aguilar Laos & Urbano Villota..., 2021)

6. IMPLEMENTATION OF FLEXSIM IN LOGISTICS PROJECTS

Scheduling offers many advantages to solve various operational and/or logistical problems; however, innovation and development must be carried out by good analysts to achieve an adequate use of their knowledge. For this reason, FlexSim is proposed as an evaluation tool based on simulation that allows different operational analyses to be carried out using programming without advanced knowledge, and is also complemented with programs that simulate certain functions and operations of logistics. In line with these paragraphs, this chapter presents a concrete example of the use of FlexSim in the evaluation of a logistics function, taking as basic information the relationship of the warehouse with its environment, which can be a simple coating such as a metal bag or a vehicle. (Camacaro-Peña et al.2021)

7. CONTINUOUS IMPROVEMENT IN LOGISTICS SYSTEMS

Continuous improvement is a methodology that allows the organization to identify and look for opportunities for improvement once an adequate level of quality and time has been reached. This methodology is self-conducted by the same staff. Its principles have a great influence on the current culture of continuous improvement in production management systems. Beyond the improvement of one or more systems by application of one of the objectives of traditional improvement methods. Improving the system as a whole applies technical and operational reliability. (Meraz et al.2021)

These tools and instruments of control of analysis, monitoring, estimation, evaluation and programming of improvement, propose a permanent change of consciousness and the meaning of improvement with respect to the effects and actions carried out with it. Some of the lines are made up of the "Lean Six Sigma" methodology. When it is aligned with other classic face-to-face control systems. When an objective is assigned towards a specific goal, the database for the "KPI" is implicitly formed, this can be used by action of such action, it will transcend to each department as each variety of internal customer so desires.

It is discussed in terms of "metrics" and "moderation." Focused on the frequent "audit" of "Key Performance Indicators" ("KPIs"). In correspondence to crudely informed with the technical and periodic "CxI", different from the improvement cycle. In medium and long-term improvement, to explore new opportunities for improvement and measurable infrastructural replacements until special specialization characteristics in problem attention or see each lane. (López et al.2023)

8. SYSTEM PERFORMANCE EVALUATION

To start the evaluation of the performance of the systems, one of the most important aspects is to clearly define the variables involved in the project; for example, the figures involved in overcrowding, overloading, or in general, dimensional tracking. The calculation formulas can be analogue or symmetrical, and define both the periods and the type of variables in the programming obtained from the model, conditions and/or limits; the path or itineraries, if any; maintenance of system users and the availability of information on spare parts in reserve should not be ignored;

Journal of Information Systems Engineering and Management
2025, 10(50s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

the terrain of the breaks; the path block library; the rate of arrivals and departures; and the dimensioning that was enlarged when there were other intermediate references. (Tovar Lozada, 2024)

In certain cases one only perceives that the information flies through one's head with the anguish of following it without further pretensions; when in reality it is difficult to accept that the situation can be resolved in time or resolved successfully; Because the fact that mechanical handoffs work well does not necessarily mean that handoffs allow you to keep the promises made to customers. Frequently, the decisions with the highest impact on the sum of costs are taken by people outside the production management; even when from the functions of an insurance company it can clearly demonstrate that certain decisions are harmful to the company's income statement. Advice that I do not share in any way, because it is obvious that in order to carry out such advice it is necessary to have the necessary operating information.

9. RESOURCE OPTIMIZATION

The optimization process is extrinsic to the system to be simulated, specifically to the discrete simulation used. The definition and evaluation of the logistics system is our first step to proceed with its optimization, once built. It is the previous step to know the initial situation of the system before making any decision. (Cruz and Azpeitia2021)

Once the result of the simulations used in the evaluation of the system has been collected, we will obtain some initial indications that will help us to make decisions about intermediate or final resources to achieve the objectives of the system. The results can also be grouped by products or groups of products, to establish conclusions at intermediate levels such as products, customers. In the event that the result or objective of satisfying the client's need is unsatisfactory, it will be time to propose in the base model new actions or resources that facilitate, depending on the beginning, achieving the desired situation and/or more similar to the expected results. It is different to propose different alternatives to the base model or a single approach.

The actions to be carried out in the system that affect the final results may be several and they may be measured at various levels of intervention. The first contact with the model will always be obtained at the level of the global model with intermediate work. If the customer (or the service) has several products influencing its results (in most cases this will be the case), we must obtain the results for products or groups of products first, if the computer support allows it. (Tovar Lozada, 2024)

10. CASE STUDY: SUPPLY CHAIN MANAGEMENT

The case study presented in this section is based on a real project that is considered very interesting and, at the same time, extremely complex. This project has led to the creation of a Supply Chain Management System, which has been developed with the clear objective of modeling an effective supply chain that allows for the optimal management of each and every one of the various processes involved in it (Martínez, 2021). The main purpose of this approach is to reduce operating costs, obtain valuable information that facilitates crucial decision-making and the possibility of optimizing or simulating various alternatives that may arise in the logistics field. The supply chain has been specifically designed to obtain 4 different products for a varied group of customers in the country of Guatemala, paying special attention to the individual needs and demands of each of them. To carry out this purpose, there was a system that was responsible for inventory management in an extremely optimal way; However, this system, together with the methodology used in order management, lacked several key indicators that were essential to facilitate strategic decision-making. This lack of indicators meant that, at the time of placing an order, it was not possible to make adjustments to flexibly and efficiently decrease or increase the quantity of products ordered (Cevallos et al. 2023). This situation generated certain restrictions that could negatively influence customer satisfaction and, consequently, affect the profitability of the business in a significant way.

10.1. Project Description

The company that is going to be simulated belongs to the fruit pulp manufacturing sector. Once the possibilities of the simulation are addressed and the situations in each of the different rooms of the plant are raised, the company will invest in the development of a model where cycle times, WIP, time at loading and unloading docks, error levels, among others, will be simulated. The objective of this project is to estimate the performance of the proposed system as a result of a correct implementation of the SKU elements in the plant's rooms. The activity will focus on the

Journal of Information Systems Engineering and Management
2025, 10(50s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

investigation of the advantages of the supply chain from the use of simulation software. The plant is made up of the following areas: a warehouse for incoming materials, an intermediate warehouse within the month of production, a parcel for the dispatch of goods to customers, an area for the management of a FIFO system, and an area for tailor-made work. By improving the management of all these elements, it is possible to increase the overall performance of the logistics system flow and improve the quality of the service provided to customers (Ghiglione, 2021). An important aspect of flow management is to consider customer demographics, as they are the drivers of supply and demand for products in the supply chain. Hence, we are talking about the SIMULATION of a DEMAND-DRIVEN logistics congruent with the logistics application.

10.2. Results and Analysis

The evaluation of the performance of the supply chain was carried out by simulating the model for a period of three months, whose duration was established as a real scenario at the operational level. This extension was modeled in four stages corresponding to the number of weeks required to manufacture each batch of finished product. Once the five iterations of each scenario were carried out and obtained from each of the analyses variables proposed in the model, they were averaged, which will be used for the evaluation of the supply chain, and thus obtain the result promised in the introduction, the sum between the precious metals in stock in each batch of raw material and finished product that will serve to calculate the total investment per finished product of all precious metals.

In this section, the different performance indicators represented by a normal supply chain and with the proposed improvement will be evaluated and the introduction to multiple products was promised in subsequent research. What was shown represents the way in which the supply chain was approached, a minimum investment of $ 60,000,000.00 for the finished product and an additional batch with a variety of fruits, with a minimum investment of $ 60,000,000.00 for each of the precious pulps. In subsequent projections of the work, the relationship between how long each product is obtained, the amount of resources that the producer must have to produce a product using a three-part strategy of manufacturing by customer, and the actual level within the year of the industry with respect to the investment that dangerously manages at a standstill.

11. FLEXSIM COMPLEMENTARY TOOLS

The world of simulation, especially automation and logistics, has been constantly evolving. With the great growth of simulation, the market for this type of software for logistics processes has increased more and more, so its growth will exceed in the medium and long term as its continuous implementation in various companies takes place. This software is .NET software, which can be additionally programmed with Visual C#. This allows it to be modified and/or new functionalities added depending on each of the needs that the user demands. However, as it is a standard software and does not have a free programming version, not everything is possible to do. (Peña et al.2021)

Below, we will briefly show two types of software that complement FlexSim in order to add or modify some functionalities. In the section TWO SOFTWARES THAT COMPLEMENT FLEXSIM we will explain one software to perform AHP studies and another for function optimization. Both software can create input data or optimize results of work done in FlexSim. Hierarchical Analysis Computer System, AHP or ANP is a technique that allows assigning weights to recursive decision criteria in a hierarchical model, in addition to implementing the paired comparison technique by showing the decision-maker a general framework. This technique is made up of a set of formal steps.

12. FUTURE PERSPECTIVES IN LOGISTICS SYSTEMS

The optimization of the company is important at the managerial and organizational level, therefore the design and evaluation of a company's logistics systems is a basic tool, either for decision-making or for the analysis, redesign and optimization of production and logistics processes. It can be concluded that the success of a logistics system lies in three fundamental factors: the first of them is the depth and efficiency in terms of logistics activities; secondly, there is the ability to communicate and transmit information; and the third is the daily and constant maintenance of monitoring of all processes. The logistics system must move forward, despite all the problems and inconveniences that may arise. The positive economic results that can be obtained are directly associated with logistics management, generating income that allows the health required to be achieved to carry out the investments to be made within the future development plan.

Journal of Information Systems Engineering and Management
2025, 10(50s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

13. Conclusion

The design and evaluation of a logistics system represents a complex task due to the large number of variables that must be taken into account, such as products, warehouses, the form of transport and mainly the inventory policy. This realization is carried out through various methods, such as the reinforcement of experience, the use of specialized software or even experimental research, the management of software is the most common practice used today, among which an endless number of discrete event simulators stand out, the FlexSim software is one of the most used tools with the purpose of simulating logistics processes in a simple and clear way. Unlike the rest of the commercial discrete event simulation programs, the FlexSim software is clearly a program designed and created from the beginning for the analysis and simulation of logistics processes, which makes its use clearer and simpler, allowing the user to model relevant aspects that our products and logistics processes are used for. Organically, FlexSim is composed of a hugely diverse range of objects, each of which has been written and programmed to simulate its respective part of the real world. All objects added to storage can be from one or more sequential objects.

BIBLIOGRAPHIC REFERENCES

[1] Implementation of a distribution system model for the San Lorenzo biscuit plant, located in Uyumbicho, Rumiñahui canton. Through FlexSim.
[2] Inventory Management through Supplier Comparison for the Raw Material of the Disensa Company "Hermanos Chévez" of the City of Machala.
[3] Analysis and improvement of the life cycle of 15 motorized vehicles of La Distribuidora La Bodega Limitada.
[4] Modeling, simulation and optimization, using FlexSim, of a production line of health products.
[5] Simulation of a supply chain: Comparing inventory policies of a single supplier and multiple suppliers.
[6] A simulation approach to analyze and improve performance and cost of ambulances in Taiwan, using FlexSim.
[7] Guía básica de simulación con FlexSim. A simulation model of the digital order procurement process in distribution centers.
[8] Increasing Efficiency in the assembly line using AnaSpil Simulation.
[9] Implementation of a logistics campus as an alternative auditorium with the FlexSim program. Simulation Optimization in a Two-Stage Supply Chain: Real Application with a Robust Design.
[10] References:
[11] Arrieta Gamarra, C. A. (). Design of a reverse logistics system for waste management at the Liteyca company in the city of Sincelejo, Sucre. repository.unad.edu.co. unad.edu.co
[12] Rey Escobar, I. & Valle Nieto, J. E. (2024). Digital Transformation in International Logistics: Strategies and Challenges of Artificial Intelligence for Inventories and Supply Chain in Companies .... upb.edu.co
[13] Mogollón, J. M. G., Ortega, C. A. P., & Castillo, V. S. (2025). Optimizing the Supply Chain in Sugar Mills through Discrete Event Simulation and Petri Nets: An Approach to Operational Efficiency. @limentech, Food Science and Technology, 23(1), 43-68. unipamplona.edu.co
[14] Cruz, E. A. C., González, D. C., García, J. A. J., & González, S. H. (2024). FLEXSIM VS PROMODEL: QUALITATIVE AND QUANTITATIVE COMPARISON OF ITS SIMULATION CAPABILITIES. Educational Tracks, 46(148). tecnm.mx
[15] VARGAS, G. C. (). ... APPLICATION OF LEARNING RESOURCES IN THE ENVIRONMENT OF SIMULATION MODELS FOR THE SUBJECTS LEAN PROCESS AND DESIGN OF .... repository.ucatolica.edu.co. ucatolica.edu.co
[16] Castro Díaz, C. A., Toro Ramírez, M., & Tovar González, C. A. (2023). Definition of good practices for the management of logistics projects using project management institute methodology (Bachelor's thesis, Specialization in Project Management-Virtual). universidadean.edu.co
[17] Huamán Arones, J. M. (2021). The SCOR Model and its relationship with the improvement of productivity in the Logistics area of the San Bartolomé–Huacho Clinic, 2020. unjfsc.edu.pe
[18] Barrera García, A., Feitó Cespón, M., & Cespón Castro, R. (2022). Indices to evaluate risk-based metrological performance in companies in the energy sector. Vision of the Future, 26(1), 38-60. scielo.org.ar
[19] Cossio-Mercado, C., & Fernández, G. P. (2023). PRENDER: A didactic-pedagogical proposal for the teaching of Computer Science. Argentine Conference on Computer Science Didactics. researchgate.net

[20] MAURICIO, B. P. (2022). Logistical proposal to improve the transportation and distribution costs of the Don Pollo company. unad.edu.co
[21] Rojas Hernández, D., Espinosa Martínez, E. G., Pelegrín Mesa, A., & Menoya Zayas, S. (2022). Methodology for designing the photovoltaic panel value chain as a support in financial management. Costs and Management, (102), 13-44. scielo.org.ar
[22] Aguilar Laos, A. A., Urbano Villota, D. J., Ortega Hernández, R. A., & Cerón Rosas, M. P. (2021). A model for consulting service, technical assistance and maintenance of the occupational health and safety management system in the hotel sector. ces.edu.co
[23] Camacaro-Peña, M. A., Paredes-Rodríguez, A. M., Aulestia-Potes, C. D., & Henao-Guerrero, M. G. (2021). Value chain map as a tool for the improvement of harvest and post-harvest processes in a pineapple producing company. Entramado, 17(2), 226-242. scielo.org.co
[24] Meraz Rivera, L. A., Castiblanco Jiménez, I. A., Cruz González, J. P., & Mateo Díaz, N. F. (2021). Design of a guide tool based on continuous improvement methodologies applicable to SMEs in the dairy sector in Latin American and Caribbean countries. Engineering and Development, 39(1), 86-104. scielo.org.co
[25] López, M. J. C., Castillo, A. L., García, G. E. R., & de Oca Rojas, Y. M. (2023). Strategic Quality Management for Educational Improvement in Mexico. Revista Venezolana de Gerencia: RVG, 28(10), 1298-1312. unirioja.es
[26] Tovar Lozada, J. A. (2024). Evaluation of performance indicators in a communications network for a case study of a digital substation in the Colombian electricity sector. uniandes.edu.co
[27] Cruz, E., & Azpeitia, L. A. G. (2021). Vertical and horizontal evaluation: An integration between the Supply Chain Operations Reference and the Balanced Scordcard. Religación: Revista de Ciencias Sociales y Humanidades, 6(27), 177-195. unirioja.es
[28] Martínez, R. (2021). Production line control based on performance indicators in small and medium-sized enterprises. conacyt.gov.py
[29] Cevallos, R. A. M., Gualán, A. P. C., Llanos, A. M. T., Guevara, A. M. G., & Quiñónez, M. B. R. (2023). Integration of Artificial Intelligence in Education. Ciencia Latina Revista Científica Multidisciplinar, 7(6), 2032-2053. ciencialatina.org
[30] Ghiglione, F. A. (2021). The balanced scorecard as a tool for efficiency in business management. Administrative sciences. scielo.org.ar
[31] Peña Veitía, F. J., Bello, E. E., Bello, R., Ferreira Lorenzo, G. L., & García Pérez, A. M. (2021). Fuzzy inference model for calculating key performance indicators. Ingeniare. Chilean Journal of Engineering, 29(2), 276-284. scielo.cl