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Original Research Article

Application of Simulation in the Management of the Operational Warehouse, A Systematic Literature Review

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Abstract

A significant issue in the application of simulation tools in production processes is the difficulty in effectively integrating these tools into existing logistics systems, which often leads to underutilization and suboptimal performance. According to a study by McKinsey & Company (2017), only 17% of companies have successfully integrated advanced simulation tools into their logistics processes, resulting in considerable inefficiencies. Additionally, a report by Gartner (2020) highlighted that 55% of organizations face significant challenges in aligning simulation technologies with their operational workflows, often due to a lack of expertise and inadequate technological infrastructure. This document provides a qualitative analysis to present a current overview of the application areas and benefits of simulation tools in intralogistics processes through a systematic literature review of 108 articles published between 2011 and 2023. The primary focus to explore is about operational warehouses processes, examining applications by country, knowledge area, simulation tool type, practical or theoretical application and implementation challenges of simulation.

Keywords: Warehouse management, Simulation, Discrete event simulation, Intralogistics, Literature review.

1. INTRODUCTION

Nowadays, companies are increasingly immersed in deep competition where the main elements determine the growth and development of companies. Today is the efficiency with which they can make improvements to their design and production processes, for this reason more and more companies are integrating simulation into their analysis processes as a powerful and effective tool within this This area of competition where change is the only constant in the markets and customers who now have a high range of access to information faster thanks to the technology of the means of sale, making the way of capturing the attention of the end customer increasingly selective and changing,

For this reason, in this changing environment and technological development, simulation is considered to have the advantage in decision-making with a minimum of risk at a low cost, based on the experimentation of various scenarios through computer models that represent real processes. One of the areas that shows the greatest development regarding these changes in the application of digitization of information and application of process simulation is the supply chain of manufacturing companies, where the use of efficiency in the use of available spaces within logistics areas is a priority to correctly operate internal production processes.

The concept of simulation is not a new concept since the second world war. The use of various mathematical tools of linear programming was popularized with the aim of making the use of resources and logistics of materials more efficient, however with the development of new technologies in the field of computing, simulation models have taken on a greater dimension in terms of the application and a variety of uses to simplify capacity analysis and statistical processes by interacting with thousands of possible scenarios to make quick and based decisions.

Today, simulation plays a crucial role in business decision-making, as it allows managers to evaluate different scenarios before implementing changes or strategies in the real world in a safe mode. By using models that replicate operational and logistical processes, companies can analyze the impact of various variables, such as demand fluctuations, adjustments in the supply chain, among others. This enables the identification of risks and opportunities, optimizing resources and improving operational efficiency. In summary, simulation is a key tool that supports data-driven decisions.

This article aims to explore how these simulation tools have been applied, the types of companies that have implemented them, and the primary simulation methods used to successfully integrate them into the internal supply chain as a powerful tool for operational improvement.

2. METHOD AND CLASSIFICATION FRAMEWORK

In this section a methodology framework is described, with the main objective being the analysis of high-impact contributions to model their importance in understanding the system, supported by precise evidence to outline future research (Klug, 2013).

From a methodological point of view, this literature review addresses a systemic, explicit, and reproducible approach for the identification, evaluation, and interpretation of the existing information as a key tool for decision making (Al-Qatawneh & Hafeez, 2015).

In the present review it will be important to have a methodological structure to follow and which is presented below through sections A) Data collection, B) Data analysis and C) Synthesis and classification framework.

A. Data collection

The data collection used in this article review was organized according to the followed steps:

Step 1: Research question

These questions provide direction and focus to the analysis. The central questions of the research are:

1. How effective are discrete event simulation tools at solving warehouse efficiency problems?
2. How difficult is the application of discrete event simulation under real conditions of the problem to be solved?
3. How does the use of the earned value tool intervene in the efficiency of a project?
4. What are the most important challenges in the use of project management and discrete event simulation tools?

Step 2: Search for contributions

This step is based on selecting articles by a high impact database that is available to the analyst and the context of the research, such as ScienceDirect®, Scopus®, Emerald Publishing®, Web of Science®, Taylor & Francis Group®, IEEE®, Wiley® among others.

For this review, Scopus® source was selected, because it is a database of summaries and citations of worldwide scientific literature, covering a wide variety of disciplines and subject areas, in addition to being updated regularly to include new articles, guaranteeing the most recent information (Codina, 2017).

In database search for specific words, related to intralogistics 4.0, internal logistics, warehouse management and layout; the other topics is related to modelling simulation and discrete event simulation; and the last topics is about project management. In addition, selection criteria, such as research type articles (research articles and literature review), language (English) and period time (2011 - 2024).

The articles were found through the institutional resources of the Advanced Technology Center, CIATEQ, entered the database in March 2024 using the following standard chain:

("Intralogistics 4.0" OR "internal logistics" OR "In house logistics" OR "Warehouse Logistics" OR "warehouse management" OR "warehouse layout") AND ("modelling" OR "simulation" OR "software" OR "discret event simulation") AND ("project management") AND PUBYEAR > 2011 AND PUBYEAR < 2024 AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE , "re")) AND (LIMIT-TO (LANGUAGE , "English"))

Step 3: Classification and evaluation of selection criteria

The initial collection of 120 articles was reviewed to identify those contributions that did not meet either the research focus or the previously defined selection criteria. Only 108 could be retrieved in PDF format due to limitations in the institution's resources and the active network. It is important to note that no further discrimination of articles was applied.

B. Data analysis

The sample articles were considered with the clear objective of analyzing and identifying patterns by country, tools and other characteristics regarding the topics addressed. These insights can serve as recommendations for researchers interested in the topic.

The classification framework for this article is segmented into two parts with the aim of differentiating the classification pertinent to simulation tools, in the first part the general descriptive analysis items are detailed, consisting of year of publication, country where the

study was conducted, document type, knowledge area and source or Journal of publication of the 108 articles. In the second part, the simulation analysis items are detailed, considering the simulation tool that was applied to result a problem or proposal, the application area or industrial line of business, the challenges during application and the project management model or tool applied. It is worth mentioning that in this second part only articles that are considered of practical application type are considered.

Under the concepts discussed above and the filters applied to the set of articles, a digital spreadsheet database was utilized as a means of classification for this literature review. A specific taxonomy was designed to process the information and obtain relevant findings, considering the aspects described in Section C.

C. Synthesis and classification framework

The classification framework for this article is depicted below:

1) Publication year

To have a trend of evolution or growth of the topics of this literature review, the articles were reviewed identifying their year of official publication.

2) Countries involved in development

It is crucial to identify the country involved in the development of each article, not only to compare the international interest levels regarding specific topics but also to understand the context in which the research is conducted. The criteria for this field are based on most of the authors' country affiliation.

3) Document type

In the case of the classification by type of document, two classifications were used, such as "implemented" and "empirical", the first shows a real process of integration and results in the case study. In the second case of empirical documents, two classifications are established:

- Articles that propose a new framework or method from experimentation, surveys or discussions and whether have a validation process through a case study or scientific technique.
- Articles that present a purpose of solution of existing tools or methods to solve a problem whit a limited validation on an environment controlled. Then the contribution is considered as empirical (application of theory), because they only apply existing proposals, techniques or tools and are limited to only evaluating the application.

4) Knowledge area

According to Scopus (2020), it indicates that technical contributions are classified according to the thematic content they address in research, where it can be classified into computer science, engineering, decision sciences, business and management, mathematics, multidisciplinary, social sciences, chemical engineering, arts and humanities, economics and finance, materials sciences, agriculture and biological sciences, astronomy, environmental sciences, psychology, and planetary sciences, among others.

5) Source or Journal

In this area, the main objective is to identify the Journal where the article has been published to provide guidelines regarding the resources most used by the authors and trust in certain Journals for future publications.

6) Simulation tool

It is crucial to know what type of simulation tool is used to solve a problem, as each tool is designed to address different types of scenarios, models, and approaches. The correct choice allows you to optimize resources, improve the precision of the results and ensure that the analysis is appropriate for the characteristics of the problem in question.

In the case of the selection by simulation tool, it is proposed to concentrate the different simulation tools in 7 different categories:

1. Mathematical models. This category is made up of those tools of algorithm models and mathematical formulas such as matrix resolution models and linear programming, statistical and correlation algorithms, reliability coefficients, least squares, interactive mathematical models.
2. Research methodologies of literary reviews and analysis of evaluation of survey results. This category includes software for bibliographic research and data correlation, programs that use standardized RFD (Resource Description Framework) data structured through directed and labeled graphs to represent various data sources on the web.
3. Statistical software. Within this category are software for the development of mathematical models for structural equation analysis, analysis of covariance and causal models, quadratic relationships and Bayesian models, as well as linear optimization analysis.
4. Simulation software. They are simulation software for manufacturing and logistics processes with predetermined galleries for the 3D simulation of equipment, transport, personnel and preloaded plant layouts to design production models and generate dynamic results dashboards for resource analysis.
5. Financial formulas. They are mathematical formulas for calculations of the value of money over time such as ROI (rate of return on investment), NPV (net present value), VF (future value), among others.
6. Artificial intelligence technologies. They are algorithms and computational approaches designed to simulate and apply solutions through models that replicate logical-analytical cognitive and reasoning

skills and with mathematical and statistical solutions in machines and computer systems.

7. Others. They are made up of methods to represent in the form of maps the systems we want to represent, such as: diagrams, process flows, system mapping, among others, and simulation software for representing natural events such as disaster forecasting or for analyzing complex natural structures.

7) Application area or industrial line of business

The scope business of the organization refers to the main economic activity in which it performs, where you can find from public to private ones of different vocations.

8) Challenges

This classification is free to identify those challenges regarding the implementation of the simulation that the authors faced and that were explicit in the article.

9) Project management model or tool

In this section you are free to identify those methodologies on the use of project management that were used or suggested by the authors when providing a solution to the problem they faced with the use of simulation systems.

3. CLASSIFICATION RESULTS

This section describes the result of the classification to provide relevant information to answer the research questions below.

1) Results by publication year

The Figure 1 presents the behavior of publications. During the analysis period from 2011 to 2023, there has been an upward trend in the generation of bibliographic information regarding the application of simulation. Between 2011 and 2016, publications accounted for only 15% of the total, while in the last seven years (2017 to 2023), 85% of the total publications were concentrated. This data suggests that, as a relatively new tool, the dissemination of simulation has accelerated with technological advances.

The year with the highest number of contributions was 2022, with a total of 24 articles. However, a slowdown was observed the following year, with the number of publications decreasing by 50% to 12 articles. This highlights the need for continued research on the development of simulation models and the training of researchers and technical personnel to further their application in industry.

This trend underscores the importance of reassessing the use of new technologies and exploring more intuitive software solutions that facilitate the practical implementation of these tools across various productive sectors, thereby maximizing their benefits in the short and medium term. Despite the recent slowdown, interest in related topics within the scientific community continues to rise.

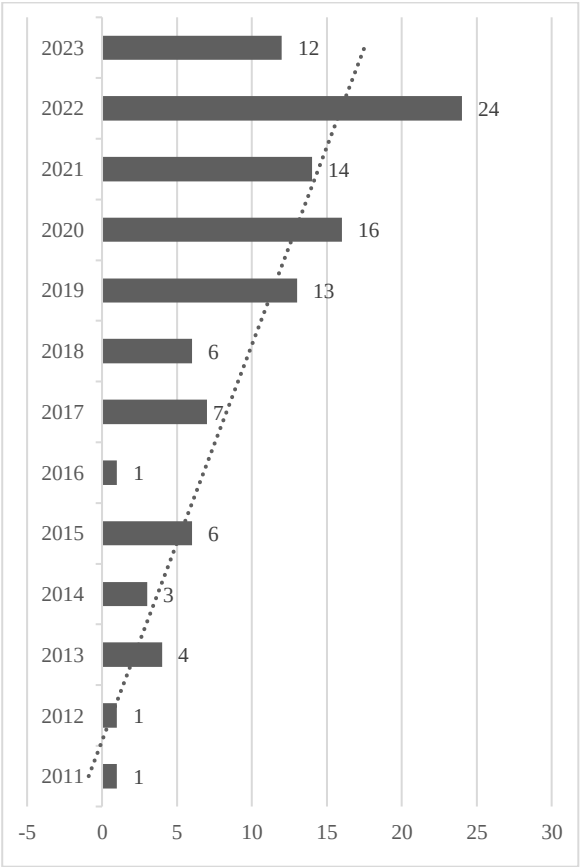

Figure 1: Results by publication year

There is an interesting trend from 2019 to 2022 where the number of publications has practically doubled compared to previous years. In 2023, a decrease in publications is observed, presumably due to the new pace of work post COVID-19.

2) Results by country

The classification results of the articles corresponding to countries involved in the development of each article are presented in Figure 2.

Based on the graph, it can be observed that the country with the greatest development in the literature on the use and application of simulation systems is Brazil, accounting for 9% of the total, with 10 publications during the analysis period. This is followed by the United States and China, each with 8%, representing a total of 9 publications, and India in fourth place with 7% (8 publications). Among the countries with significant contributions are Spain, Portugal, Germany, Poland, and Indonesia, with 6% and 5% respectively.

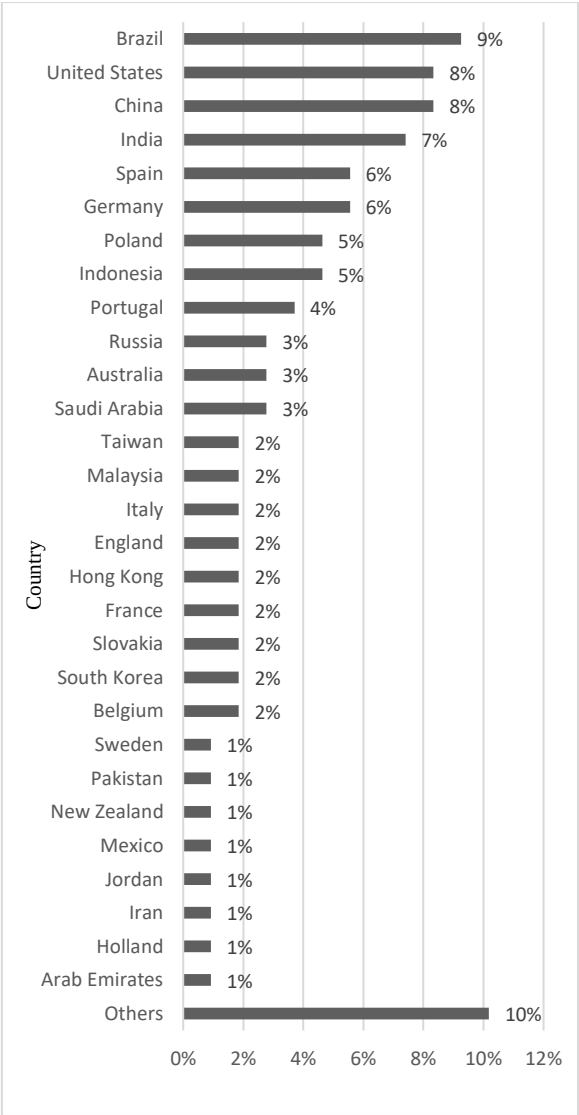

Figure 2: Results by country

Countries with lower participation, ranging from 3% to 2%, include Belgium, South Korea, Slovakia, France, Hong Kong, England, Italy, Malaysia, Taiwan, Saudi Arabia, Australia, and Russia. Lastly, countries with minimal participation include the United Arab Emirates, the Netherlands, Iran, Jordan, Mexico, New Zealand, Pakistan, and Sweden.

It is important to clarify that articles resulting from collaborations between multiple countries were categorized separately and not merged with the independent contributions of individual nations. Within this classification, no repeated combinations of countries were found. However, there were three countries: China, Germany, and Iran, that appeared in two separate multi-country collaborations.

In this context, Figure 3 shows the countries that published articles on this topic are observed, with a higher intensity of blue indicating a greater number of articles published.

From this Figure 3 and Table 1, it can be observed that Asia and America are the continents that publish the most on the topics of this review, showing opportunities to develop projects related to simulation systems in other continents.

Table 1: Incidence by continent

Continent	Qty of articles	Percentage
Europe	18	19%
Asia	47	48%
America	29	30%
Oceania	3	3%
Africa	0	0%

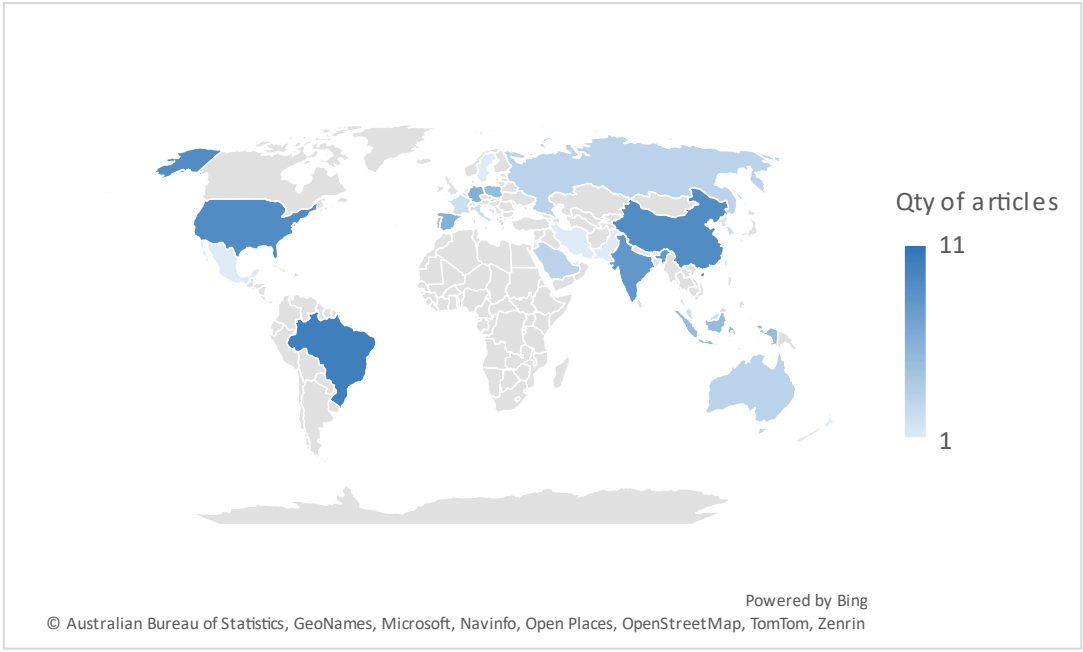

Figure 3: Incidence by country

3) Results by document type

The results of this classification are shown in Figure 4, where it can be seen that the most frequent type of document when analyzing the collection of articles is of the implemented type with 39% that represents real problems in the companies solved with simulation which is equivalent to a total of 42 articles, these solutions being taken towards the delivery of real data after implementation or projections of results in based on the implementation already carried out in its process.

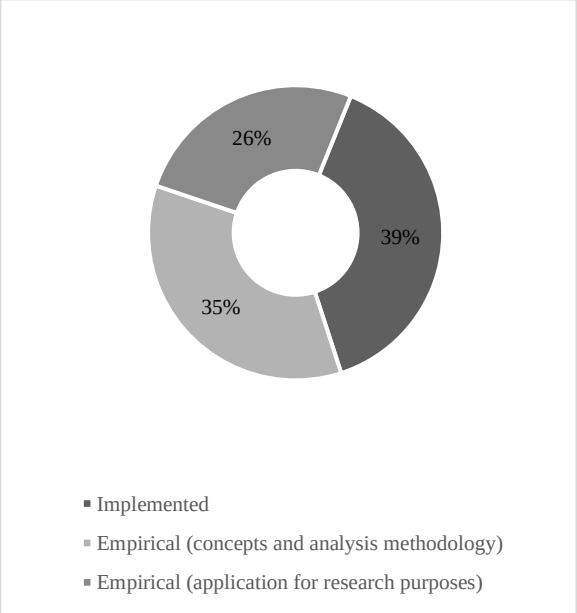

Figure 4: Results by document type

With reference to the collection of the classification as empirical (concepts and methodology) makes up 35% of the total bibliographic collection with a total. And finally, the classification as empirical (application for research purposes) makes up 26% of the total bibliographic collection collected.

4) Results by knowledge area

Understanding the knowledge area where simulation models have been applied is essential to ensure the relevance and effectiveness of these models in addressing specific problems. Each discipline has its own dynamics, variables, and requirements that influence the design and outcomes of simulations.

Additionally, identifying the knowledge area allows for leveraging previous experiences, comparing results, and adapting approaches to optimize processes. The Figure 5 show that business, management and accounting is the most popular topic where simulation models are applied with 21.3% of the articles reviewed, in second position engineering is ranking with 18.9% and the third and fourth places is for computer science and decision science with 14.3% and 13.6% respectively.

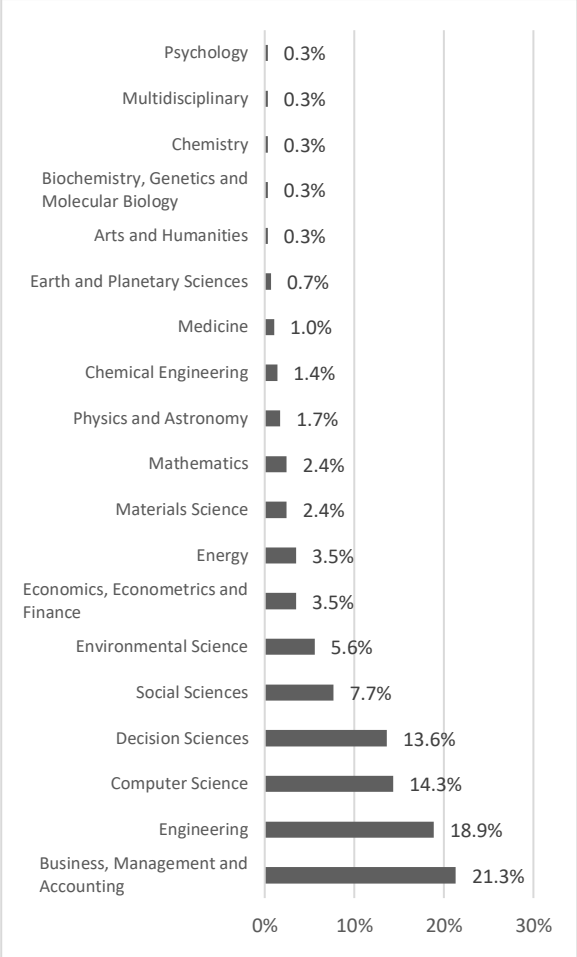

Figure 5: Results by knowledge area

It is important to note that knowledge areas such as psychology, chemistry, arts and humanities, and biochemistry, genetics, and molecular biology are among the least represented in the ranking, highlighting special opportunity areas for future research.

5) Results by source or Journal

For the reader to be able to judge in detail the use of the most used scientific Journals in the proposed topics, the Figure 6 was made with the purpose of exhibiting all those scientific Journals in which the articles of this literature review are registered, it can be observed that the Journal Sustainability (Switzerland) is the most records of the 108 articles reviewed, this resource has 7 contributions corresponding to 6% of the total collection.

The second Journal with the highest registration is the International Journal of Logistics Research and Applications and the International Journal of Production Economics, which are high-impact, and each contribute 4% of the contributions of the proposed collection, that is, 4 articles for each Journal correspond to those registered.

Figure 6: Results by source or Journal

In the Others category, all those scientific contributions that only have one record, where there are Journals such as Information and Communication Technologies, Alexandria Engineering Journal, Critical Reviews in Environmental Science and Technology, EMJ - Engineering Management Journal and Industrial Management and Data Systems to mention a few.

It is worth mentioning that 100% of the articles are published in a Journal that show a wide variety of approaches which guarantees a wide variety of topics related to simulation in this research document.

6) Results by simulation tool

For this case, the proportion of the most used systems are established based on the reviewed bibliography to determine the most frequently employed tools in the implementation of simulation models, as shown in Figure 7.

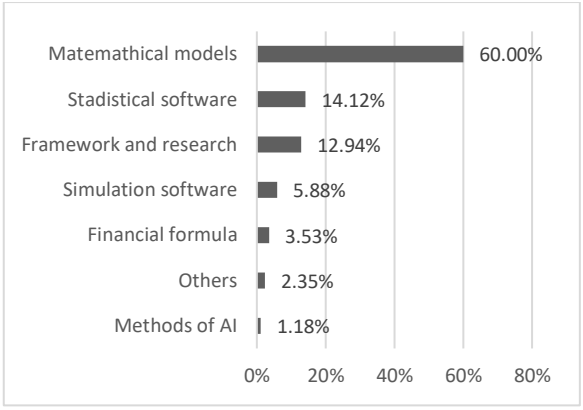

Figure 7: Results by simulation tool

Within this category, the tool with the highest usage is mathematical models, accounting for 60% of the tools identified for solving simulation problems. A total of 51 different applications of mathematical models were used, primarily for solving problems related to fuzzy analysis with multi-criteria decision-making through algorithmic solutions, evaluation functions, and co-relationship calculations for assigning relationships and weights to select the best option. Tools in this category include Electre II and III, genetic algorithm methods (NSGA-III), fuzzy process interaction analysis with mathematical equations, and other methods such as linear programming (Lambda Max), least squares correlation, the Bellinger algorithm, Bayesian methods, and reliability coefficients using the Cronbach alpha algorithm.

Statistical software models are the second most used, representing 14% of total usage, with 12 applications. Common tools in this category include Matlab, Amos Graphics 20 & 22, RISK by Palisade Corporation, EViews 10, Gurobi, Minitab version 19, and SCIP (for solving constraint integer programs).

It is important to mention that business simulation software ranks fourth in terms of preference, with 6% usage, corresponding to five applications. This category includes tools such as ARIS for business administration, FlexSim for simulating industrial and logistics processes, ExtendSim version 9.2 for discrete event process simulation, Simul8 for simulating discrete events in logistics and manufacturing processes, and DELMIA for planning and simulating logistics and manufacturing operations.

7) Results by application area or industrial line of business

Within this category, the classification is established according to the type of industry according to the industrial branch in which the application of the study is carried out, as seem in Figure 8. In this review it can be observed that the construction industry is the one with the most articles applied to its industrial branch with 7% of the articles reviewed.

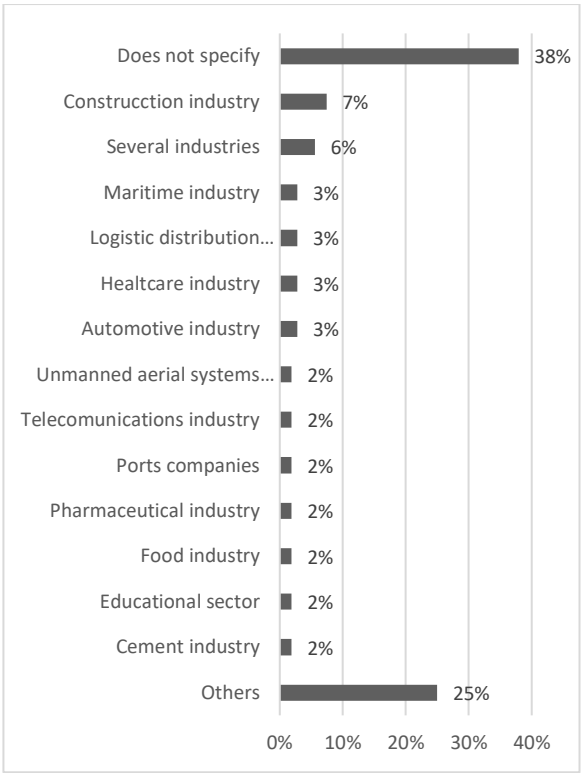

Figure 8: Results by application area or industrial line of business

It is worth mentioning that the classification of several industries are the publications where two or more companies are involved in the development of the application of simulation, for this reason it was defined to handle this category separately from the rest of the industries to maintain without alterations the level of the bibliographic information.

This classification contributed with specific solutions such as: 1) Identification, assessment, and quantification of new risks for Logistics 4.0 (automotive industry, pharmaceutical industry, fast moving products and digital commerce industry), 2) Waste reduction using lean tools in a multicultural environment (printing industry, storage processes, fault rectification and project processes, high turnover products and frozen fruit storage and packing), 3) A survey on industrial information integration 2016-2019 (agriculture, autonomous manufacturing, construction, healthcare industry, information and communication technologies, maritime transportation, security, supply chain, telecommunications, transportation, urban development, warehousing, among the main ones), 4) Industry 4.0 Disruption and Its Neologisms in Major Industrial Sectors: A State of the Art (agriculture, healthcare industry and logistics industries), 5) Managerial competencies of 3PL providers: A comparative analysis of Indonesian firms and multinational companies (Automobile Transportation Industry, Automotive Manufacturing Industry, Mineral Transportation Industry, Oil and Gas Transportation Industry, Oil and Gas Chemical Industry, Pharmaceutical Industry, Chemical Industry, Government), 6) A comprehensive survey of guaranteed-service models for multi-echelon inventory optimization (automotive industry, computer hardware industry, fast-moving consumer goods industry, digital imaging industry, electronic equipment testing industry, chemical industrial products industry, industrial electronic products industry, machinery industry, metal-mechanical industry, semiconductor industry).

8) Results by challenges

The intention of this section is to establish a reference point by analyzing the main difficulties that arise through this literature review when implementing simulation systems within their processes and obtaining valuable information about the solutions proposed.

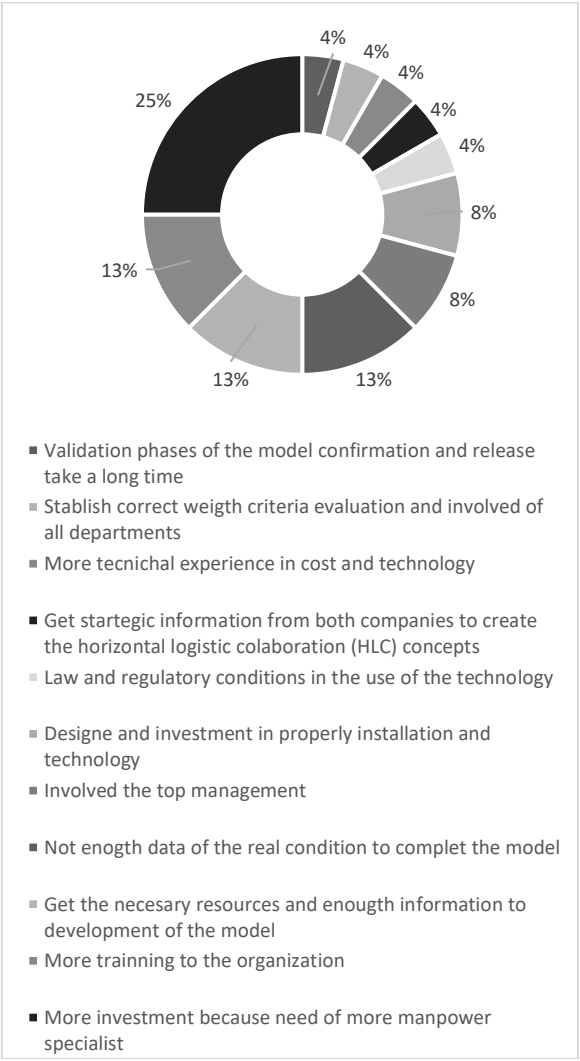

Figure 9: Results by challenges

Under this scope, it is possible to observe in the Figure 9 the main problems mentioned in the articles where the practical application of simulation was established, or scientific research was carried out verifying the veracity of the results obtained through statistical analysis methodologies and correlation.

It is important to mention that only 23 articles indicated in their development any problems during the implementation of simulation systems of the total of 42 "implemented" documents. The total of problems observed were summarized in 11 classifications, in the Figure 9 shows the 11 elements in which these problems are described, which were separated by description of the main affected element such as resource, labor, training, staff experience, collaboration with related areas, among others.

Based on this information, the main impact on the fulfillment of simulation integration projects is the need for greater investment due to the requirement of specialized technical human resources with 25% of the total participation. The second important problem is the need to provide greater training to the organization with 13% as well as obtaining sufficient resources and information for the development of the model and the correct development of specific indicators to evaluate the performance of the system to be modeled. The involvement of the Senior management occupies fifth place with an 8% impact.

Based on this information, it is important to mention that the main problems are due to initial development problems where having personnel trained in technical knowledge and the preparation and implementation of correct planning and involvement of senior management plays a crucial role for the project is developed in a continuous manner and with low impact problems, that is, the preparation of the way in which the priorities of the model are established, system planning and resources to carry out this execution are the main turning points that determine the condition.

9) Results by project management model or tool

As we can see in Figure 10 the graph of the percentage of use of management methodologies is only 19% of the article reviewed, with a total of 21 articles which denotes a low tendency to implement the support tools in simulation process, which may be caused by a low understanding of project management methods to successfully monitor and implement projects. due to the lack of formal structures within companies such as specialized areas within the organization for project management.

In the same context, the Figure 11 shows the proportion of project management tools applied to solve problems with simulation, where tools for the evaluation of cost analysis is the most common with 7%, time control diagrams and Pert and Gantt project sequence, as well as risk assessment tools, occupy second place as the largest application with 4% each, and the third position with 9% participation is occupied by the use of tools in the design stage. Planning, such as tools such as: strengths-opportunities-weaknesses-threats (SWOT analysis) and brainstorming are the most widely used in this area.

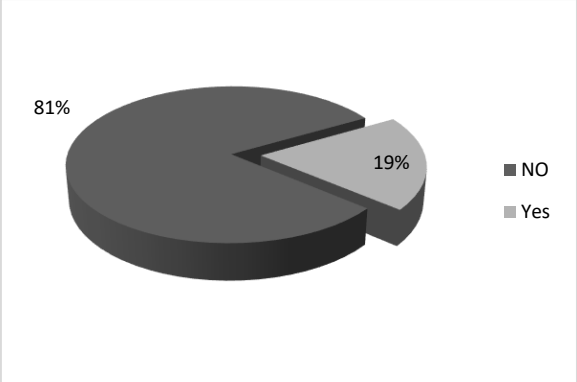

Figure 10: Results by use of methodologies about project management

It is important to note that there is no novelty in the application of project management tools that represents the largest proportion within this research, since newer technologies such as artificial intelligence and project management software each occupy 5% of participation, since the implementations of this type of systems are normally executed by specialists in systems and use of programs, greater participation in terms of methodologies would also be expected agile such as SMART method.

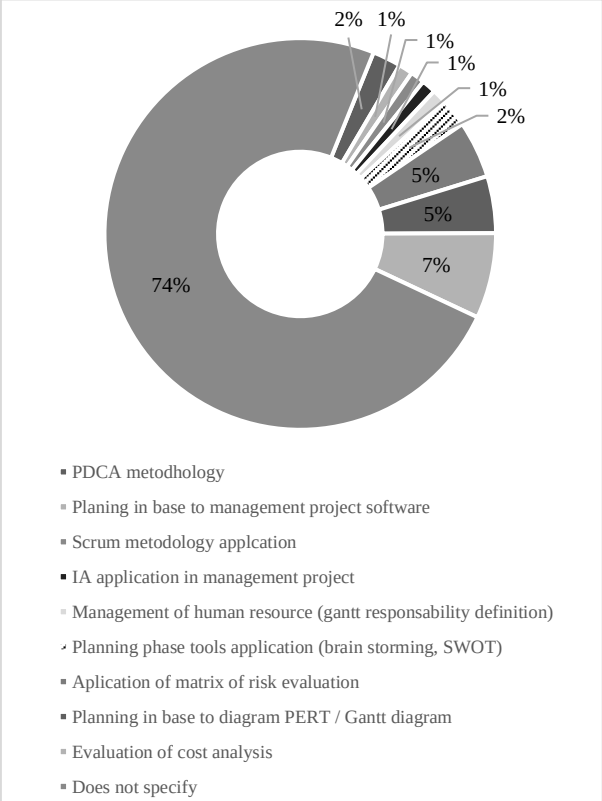

Figure 11: Results by project management tool

However, the same condition as with artificial intelligence programs and project management software, only one case that represents 2% of participation applied this type of methodology, which is why a marked trend is observed in the low application of methodologies

aimed at speeding up the implementation and obtaining positive results from the use of simulation systems integration technologies, with which the quality of results and project development time may be compromised and not deliver the desired results to the company's management in regarding the benefits initially proposed to approve the execution of the investment requested for the execution of the project.

Participation is occupied using tools in the design stage. Planning, such as tools such as: strengths-opportunities-weaknesses-threats evaluation analysis (SWOT analysis) and brainstorming are the most widely used in this area.

4. CONCLUSIONS

There is a recent trend in the number of publications meeting search criteria, with articles from the past five years and the current year accounting for 73.14% of the total, while the previous eight years represent only 86.11%.

The top three countries with the most publications are Brazil, United States, and China accounting for 9%, 8%, and 8%, respectively. Neither the Japan nor Canada have published any articles meeting the search criteria. The continents with the most publications were Asia and America, accounting for 48% and 19%, respectively.

During this systematic literature review, 39% of the selected articles focus on implemented simulation systems validated with a real case study, but also there are 35% of the articles considered as success cases although just validated the solution proposed with a no real case study. The rest of the articles just applied existing methodologies or tools without innovative purposes.

Curiously, most of the articles reviewed apply mathematical models to solve a problem, this fact is linked to the area of knowledge where most contributions are presented around Business, management and accounting, followed by areas such as engineering and computer and decision sciences.

In the case of more sophisticated simulation models such as statistics, manufacturing or logistics, they are positioned in second and third place after the use of mathematical models, leaving an area of opportunity for further developments in both engineering aspects about manufacturing and logistics such as the application of financial models such as Monte Carlo simulation and artificial intelligence modeling, given that they are the last positions in this review.

It is important to highlight that the industry that most applies simulation models is construction, followed by the maritime and logistics and distribution industries, leaving areas of opportunity to serve sectors such as the food industry, telecommunications, health, among others.

In this sense, the challenges that most frequently arise in the implementation of simulation models are related to the lack of existence and investment in specialized human capital, more information resources for model development, existence of reliable and real data for the solution. of problems and the need for involvement of general management, among others.

Finally, it is important to highlight that only 19% of the articles reviewed present some support in the use of project management tools, of which the majority focuses on cost evaluation, planning and PERT diagram, as well as the application of risk matrix for the execution and monitoring of implementation of a simulation model.

In In summary, the application of simulation methodologies are highly effective in generating substantial savings in internal logistics processes both in warehouses and in the operational processes of manufacturing since it is possible to reduce inefficiency in transportation, quantity of equipment, efficiency and reduction of spaces, and consequently of costs, the savings based on the application of the implementation of a simulation model can generate a reduction in operating costs by up to 50% compared to the conditions of the process before the proposals for the application of improvements with this we can say that the simulation, in addition to the benefits such as speed in obtaining optimal solutions as well as evaluation of multiple alternatives and cost reduction in unnecessary modifications to the process, the results based on The validation of the developed model (mathematical and statistical models) is highly reliable as a strategy in new designs of warehouse facilities or in projects to improve existing processes.

From the point of view of the use of management tools for appropriate development and successful implementation of simulation systems it is observed based on the reviewed bibliography that there is a marked lack of explicit methodology in the reviewed documents where practical implementation processes are carried out. Some of them are identified as follows:

- Greater support from specialists around simulation systems integration.
- Precise and correct plans establishing initial requirements.
- Absence of a procedure for step-by-step implementation from the conceptual design to the generation of a robust model validated.
- Adjustments to the proposed requirements are due to incorrect and weak initial planning.

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