Logistics Operator in the Cuban Pharmaceutical Supply Chain

Ing. José Andrés Hernández Rech
Departamento de Ingeniería Industrial, Universidad Central "Marta Abreu" de las Villas, Cuba
jandres@uclv.cu

Dr. Rene Abreu Ledon
Departamento de Ingeniería Industrial, Universidad Central "Marta Abreu" de las Villas, Cuba

Prof. Dr.-Ing. Dr. h.c. Prof. h.c. Norge Isaias Coello Machado
Departamento de Ingeniería Mecánica, Universidad Central "Marta Abreu" de las Villas, Cuba

Prof. h. c. Dr.-Ing. Dr. h. c. (UCLV) Elke Glistau
Institute of Logistics and Material Handling Systems, Otto von Guericke University Magdeburg, Germany

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Abstract
The current state of the pharmaceutical supply chain in Cuba demands the intervention of an operator for the global and effective management of logistic operations. Considering the structure and positioning in the supply chain, the Drug Commercialization Company has potential characteristics that favour its transformation into a logistics service provider. This paper analyses the requirements and perspectives of the company, in order to establish the theoretical basis for the development of pharmaceutical logistics in Cuba. As a result of the specialized bibliographic review, ten primary functions for a logistics operator are defined. According to the challenges presented, the preliminary results of a national wide survey identified logistics integration variables that currently affect the supply chain management. In addition, the paper presents specific strategies and research works to be implemented, in order to achieve a higher integration level through the implementation of a logistics operator in the pharmaceutical supply chain.

1. Introduction
Recently, the disruptions caused by the COVID-19 pandemic have demonstrated the need for coordinated and integrated logistics operations in supply chains. Pharmaceutical supply chains have had to face low inventory levels [1], long distribution times [2], government-mandated shutdowns and strict travel restrictions, affecting, above all, procurement, warehousing and distribution processes and operations. Thus, strategies and practices designed for a normal business environment have proven not to be viable [3]. Therefore, these systems have been evolving from linear processes to complex networks of organizations, resources and capabilities [4].
In this sense, logistics integration is defined as the degree to which a customer strategically collaborates with logistics operators to manage intra- and inter-organizational processes [5]. Logistics service providers have enabled the supply chain to effectively coordinate its operations among stakeholders. In recent years, the need to strengthen logistics capabilities in the Cuban pharmaceutical sector has become a prime factor. Evolution to higher levels of integration involves operational, design and relationship changes. The establishment of logistics operators in Cuba is still in the research and development phase. There are companies that fulfil many of these functions, however, they do not really operate as logistics service providers. The Drug Commercialization Company (EMCOMED) is the only one of its kind in the country and has been the main distribution, storage and commercialization centre for supplies and medicines. The transformation of this company into a logistics service provider is essential to achieve high levels of integration, but this process implies significant changes in strategy management. To this end it needs to study the company's current conditions and identify its new roles as a logistics operator in the Cuban

pharmaceutical supply chain. The main goal of this paper is to analyse the current requirements and perspectives for the transformation of EMCOMED into a logistics operator.

2. Methods

To achieve a critical analysis on the statement of a logistics operator in the pharmaceutical supply chain, an exhaustive review of specialized literature was carried out. The keywords used for the literature review were: *"integrated supply chain management"; "logistics integration"; "logistics operators"; "logistics service providers"; and "pharmaceutical supply chain".*

A nationwide survey is applied based on five dimensions of the strategic management of a logistics operator. The managers of 30 companies out of the 48 companies currently involved in the flow of materials through primary distribution were interviewed. The survey considered the evaluation from their experience and logistics functions performed along the supply chain. The statements were evaluated according to the application level in the current supply chain management. Finally, the strategies are presented to increase the integration level among stakeholders and lay the groundwork for implementing a logistics operator in the pharmaceutical supply chain.

3. Results and Discussion

The definition of specific functions is a fundamental issue, since the operations performed by the logistics service provider are determined by the level of integration of the chain. To identify these primary functions, the criteria of several authors with studies published in the last 10 years were analysed. Figure 1 shows the variation in the inclusion or non-inclusion of some primary functions.

The criteria depend on the degree of specialization, level of complexity and scope of the operator in the supply chain. In general, the authors agree that the key and support processes of logistics are the most frequent. However, there is evidence of the incorporation of other functions that characterize the operations carried out by this type of company.

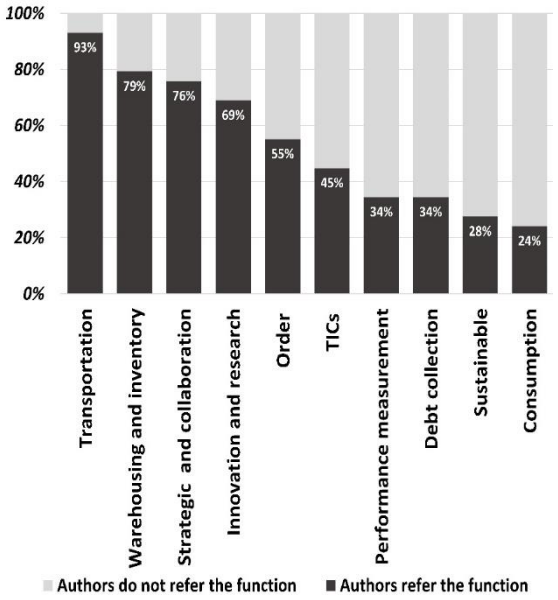

Figure 1: Primary functions of a logistics operator according to 22 studies consulted [4], [6], [15]–[24], [7], [25]–[28], [8]–[14]

3.1. Current state of the functions

3.1.1. Strategic management and collaboration

A logistics operator must achieve long-term planning strategies in continuous coordination with customers. In addition, the update of the risk prevention and control manual is challenging. Concerning strategic management and the strengthening of inter-organizational relationships, the need to achieve a human resource profile that understands the scope of the company has also become evident. This requirement is one of the most immediate, since the training and development of labour competencies takes time, especially for the confrontation with new work methods and concepts.

3.1.2. Order management

The order-taking and all subsequent processes are at the core of the company's internal operations. Specialists emphasize the importance of technological support for automating these operations. This is one of the processes where the logistics operator demonstrates its ability to provide real-time information with a high level of support from IT systems. Tracking orders in real-time allows the participants to manage their capacities, favouring decision-making in the face of interruption situations.

3.1.3. Consumption planning

The Cuban National Medicines Program (PNM) was created in 1991 to achieve efficiency in the pharmaceutical supply chain and has been updated over the years until its most recent version in 2014.

In integrated supply chain management, demand forecasting and planning are keys activities of logistics operators. These companies, with the support of information systems and the collaboration of the participants, are responsible for capturing market consumption and coordinating successive operations for the effective satisfaction of customer needs.
Therefore, the planning of drug consumption in Cuba and the role of EMCOMED as the new manager of supply chains entails high-level modifications. Due to the high uncertainty of this type of consumption, logistics operators are responsible for providing detailed investigations of demand behaviour as a result of the use of advanced prediction tools with minimal risk.

3.1.4. Transportation management

According to transportation management, several authors insist that the use of optimization tools must focus on continuous improvement. This indicates that transportation management should include, from the most operational levels, the use of specialized software to maximize transportation capacities at lowest cost.

3.1.5. TICs management

In the particular case of EMCOMED, it has been shown that the standardization of information is a current problem, hence the integration of information systems and the use of real-time data must be a priority for the transformation into a logistics service provider. This function is also the basis for the development of all the functions of this type of company. The level of logistics integration required demands real-time information exchange for inventory management and warehousing, transportation management, drug traceability and order management.

3.1.6. Warehousing and inventory management

Logistics operators must be able to coordinate the material flow, eliminating excess handling or intermediate storage of loads. In this regard, the specific characteristics of the products and their form of distribution make delivery to the points of consumption difficult. These require the prior extraction of units packed in a superior unit (pinking), being a basic function for order management. This process again involves capacity and load balance studies, distribution requirements planning and a high degree of real-time exchange of stocks in each territory.

3.1.7. Performance measurement

To achieve effective execution of operations among participants, monitoring must be done from the base of the logistics operator to the boundaries of the supply chain itself. This is an element that favours communication, showing the result of each of their relationships and their contribution to the performance of the chain. The creation of the system requires the joint participation of both academics and specialists from the different members of the chain. Although these measurement models should focus on continuous improvement, a first proposal would help to monitor the relationships that currently exist. Business practice and the chain's own performance will demand the modification of these indicators, always in the constant search for effective control of operations.

3.1.8. Sustainable management

Sustainability approaches in logistics operations are becoming more frequent. Even if the specialized literature does not widely record the role of logistics service providers in environmental protection, there has been a growing interest in specifying their functions in this aspect.
Supported by the large amount of information logistics operators handle, they most collaborate in the calculation of carbon footprint and environmental impact studies throughout the material flow. They are also responsible for the final disposal of waste, a function in which EMCOMED has extensive experience.

3.1.9. Debt collection management

The economic and financial framework is undoubtedly one of the issues that will change the most during the transformation process. The main change lies in the company's own mission, because a logistics operator does not generate revenue by marketing products, but by providing logistics services to its customers.
First, the financial flow changes in the current structure of supply chains. The logistics operator acts as an intermediary between customers and suppliers. On the other hand, the company's finances completely change their structure and it is crucial to define the specific services to be provided and the rate for each one. Obviously, prices vary depending on the load. In relation to this factor, the supply chain presents a particularity; many of the products are large in volume and light in weight. Prior to the implementation of new operations, a detailed feasibility study is essential. The company must rely on the record of historical operations to make a balance of the activities to be carried out in the future and the benefits generated.

3.1.10. Innovation and research management

Finally, innovation on the implementation of logistics integration strategies is one of the main functions of a logistics operator. Although some authors do not make explicit reference to the role

of this type of company in the processes of continuous improvement, all the functions explained above imply that the process of transformation of EMCOMED requires:

1. The use of scientific tools for decision support.
2. Design and implementation of integrated logistics solutions.
3. Development of a human capital profile with capabilities to provide advanced competencies from strategic to operational levels.
4. Possessing the Know-How to coordinate logistics activities with a focus on continuous improvement.
5. Systemic support of Information and Communication Technologies for the automation of information flows and real-time management.

3.2. Survey application

3.2.1. Sample selection

For the application of the survey, the 48 companies participating in the material flow of the primary chain were considered. Of these, 30 were completed, resulting in a 95% confidence level for a sampling error of 5%, so the sample is considered significant.

3.2.2. Evaluation criteria

For the rating, specialists and managers quantified the current level of application of the proposed statements as follows:

- 5 if it is fully applicable and there are procedures and working methods that corroborate this statement.
- 4 if it is currently applied; although this type of action is still in the development phase.
- 3 if it is partially applied; specific actions for its implementation have not yet been established.
- 2 if not applied in the company but there is knowledge about this type of actions in management.
- 1 if there is no knowledge of this type of management action.

3.2.3. Validation

For the validation of the survey, a reliability analysis is performed based on the calculation of Cronbach's Alpha coefficient, where the value generated must be greater than 0.7. In addition, the analysis is performed for the 5 dimensions of the survey. A Cronbach's Alpha coefficient of 0.946 was obtained for the entire survey. Table 1 shows the result for each dimension, with all values being greater than 0.7, thus demonstrating the reliability of the survey.

Table 1: Cronbach's alpha for each dimension

Dimension	Cronbach's alpha
Integration among participants	0.883
Internal integration	0.818
Integration with customers	0.804
Integration with suppliers	0.847
Technology and planning integration	0.782

3.2.4. Rating similarity

To examine the similarity of the variables and, therefore, the degree of correspondence among ratings, the deviations of the criteria for each variable in question are analysed. First, the maximum deviation that could exist between the experts' judgments according to the measurement scale is obtained. This value is calculated by deviation in the case where exactly two halves of the sample give a completely opposite evaluation. Therefore, the maximum deviation that could exist between the criteria issued by the experts is 2. Taking this deviation (lower degree of agreement as a reference), the percentage of remoteness from the deviation of each variable with respect to the maximum deviation is calculated, which makes it possible to contrast the degree of similarity of the evaluations. The results indicate that 11 of the survey variables are similarly rated, with at least 50% of remoteness from the maximum deviation. Four of these belong to the customer integration level, which means that the experts' evaluations find a high degree of similarity for this dimension. They are followed by internal integration with three variables, integration among participants and technology and planning integration with two variables each.

3.2.5. Coefficient of variation

To analyse the deviation of the variables with respect to a mean value, the coefficient of variation is calculated. In this case, the value of 3 on the measurement scale represents not only the mean, but the evaluation criterion that qualifies the integration approaches or variables as management elements for which no specific implementation actions have been established. Figure 2 shows the result of calculating the coefficient variation for fixed rating values. This analysis makes it possible to identify the degree of similarity between experts' judgments with respect to a specific rating. The greatest homogeneity of criteria for the logistic integration variables in the supply chain is found in the range of 3 to 5.

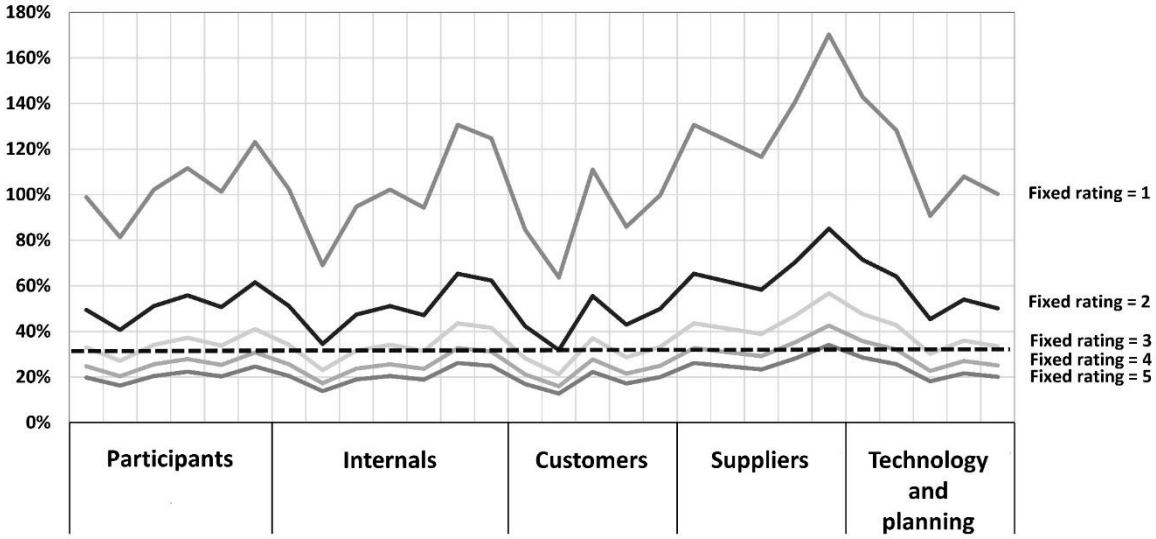

Figure 2: Coefficient of variation for fixed values of the rating

Considering the results, the Cuban pharmaceutical supply chain has a medium level of integration. The lower index for most of the variables indicates that specific actions for implementing logistics integration strategies have not yet been established.

3.3. Requirements for transformation

Following the analysis of the primary functions of a logistics operator and the current variables affecting the integration of the supply, the basic requirements to be met are detailed in Table 2.

4. Conclusion

The Drugs Commercialization Company in Cuba has a structure and positioning in the pharmaceutical supply chain that favours the evolution towards a higher level of coordination of logistic operations. However, managers, specialists and academics must focus on several issues that have not yet been answered in the current functioning of the supply chain.

The primary application of a nationwide survey showed a certain degree of homogeneity in the experts' criteria about the variables that currently influence the logistics integration. According to the experts' ratings, the supply chain has a medium level of integration, since most of the variables were evaluated in the range of 3 to 5. These ones are mainly affected by the absence of specific tools for the implementation of integration actions.

Table 2: Requirements for the implementation of the logistics operator

Primary functions	**Requirements for transformation**
Strategic management and collaboration	Joint business plan design in the supply chain
Order management	Automated system for order management
Consumption planning	Implement quantitative tools for consumption forecasting
	Update National Drug Plan
Transportation management	Incorporate specialized software for transportation management
TICs management	Integration of information systems
Warehousing and inventory management	Design of a joint planning system for storage, order management, and transportation
Performance measurement	Design performance measurement system for the supply chain
Debt collection management	Upgrade financial and accounting system
	Define pricing rates
Sustainable management	Update environmental management system
Innovation and research management	Update research and development process

In this sense, the paper presented specific requirements for the implementation of a logistics operator in the pharmaceutical supply chain. These future researching works must focus on the role of EMCOMED as a future logistics service provider company. However, there are certain limitations on the fulfilment of these requirements, for most of them depend on wide investments processes.

Fulfilment of these requirements depends on research projects, joint work among the participating entities and the result of an investment process along the chain, based on strengthening technological capabilities.

5. References

[1] R. Tat, J. Heydari, and M. Rabbani, "A mathematical model for pharmaceutical supply chain coordination: Reselling medicines in an alternative market," J. Clean. Prod., vol. 268, 2020.

[2] A. Burinskiene, "The Concept of Medicines Shortage: Identifying and Resolving Shortage," in Pharmaceutical Supply Chains. Medicines Shortages, A. P. Barbosa-Povoa, H. Jenzer, and J. L. de Miranda, Eds. Switzerland: Springer, 2019, pp. 203–214.

[3] C. Lekha, T. Ahmed, S. Ahmed, S. Mithun, A. Moktadir, and G. Kabir, "Improving supply chain sustainability in the context of COVID-19 pandemic in an emerging economy: Exploring drivers using an integrated model," Sustain. Prod. Consum., vol. 26, pp. 411–427, 2020.

[4] S. A. R. Khan and Z. Yu, Strategic Supply Chain Management. Switzerland: Springer, 2019.

[5] B. B. Flynn, B. Huo, and X. Zhao, "The impact of supply chain integration on performance: A contingency and configuration approach," J. Oper. Manag., vol. 28, no. 1, pp. 58–71, 2010.

[6] A. Tilahun, G. Da, A. Ma, B. Geleta, and B. Taye, "Assessment of Integrated Pharmaceutical Logistic System for the Management HIV/AIDS and Tuberculosis Laboratory Diagnostic Commodities in Public Health Facilities in Addis Ababa, Ethiopia," J. Pharm. Care Heal. Care Syst., vol. 3, no. 2, 2016.

[7] G. G. Akman and K. J. Baynal, "Logistics Service Provider Selection through an Integrated Fuzzy Multicriteria Decision Making Approach," J. Ind. Eng., vol. 2014, 2014.

[8] L. Cavaignac, A. Dumas, and R. Petiot, "Third-party logistics efficiency: an innovative two-stage DEA analysis of the French market," Int. J. Logist. Res. Appl., vol. 24, no. 6, pp. 581–604, 2021.

[9] C. Chandra and J. Grabis, Supply Chain Configuration. Concepts, Solutions, and Applications, 2nd ed. Springer, 2016.

[10] M. Cichosz, C. M. Wallenburg, and A. M. Knemeyer, "Digital transformation at logistics service providers: barriers, success factors and leading practices," Int. J. Logist. Manag., vol. 31, no. 2, pp. 209–238, 2020.

[11] C. N. da Silva Cândido, L. F. Cândido, and S. H. de Oliveira Lima, "Analysis of the performance measurement process of a 3PL provider: The case of a multinational company," Gest. e Prod., vol. 28, no. 4, p. 0, 2021.

[12] M. L. Domingues, V. Reis, and R. Macário, "A Comprehensive Framework for Measuring Performance in a Third-party Logistics Provider," Transp. Res. Procedia, vol. 10, pp. 662–672, 2015.

[13] F. Fulconis and G. Paché, "Supply Chain Monitoring: LLPs and 4PL Providers as Orchestrators," Procedia - Soc. Behav. Sci., vol. 238, pp. 9–18, 2018.

[14] B. Gregorutti, S. Line, and P. Saint-pierre, "Correlation and variable importance in random forests," no. May 2014, 2017.

[15] T. Gruchmann, "Advanced Green Logistics Strategies and Technologies," in Operations, Logistics and Supply Chain Management, H. Zijm, M. Klumpp, A. Regattieri, and S. Heragu, Eds. Springer International Publishing, 2019, pp. 663–686.

[16] W. van Heeswijk, M. Mes, and M. Schutten, "Transportation Management," in Operations, Logistics and Supply Chain Management, H. Zijm, M. Klumpp, A. Regattieri, and S. Heragu, Eds. Springer International Publishing, 2019, pp. 469–492.

[17] M. B. Ç. Kalkan and K. Aydın, "The role of 4PL provider as a mediation and supply chain agility," Mod. Supply Chain Res. Appl., vol. 2, no. 2, pp. 99–111, 2020.

[18] S. T. Kim, H.-H. Lee, and T. Hwang, "Logistics integration in the supply chain: a resource dependence theory perspective," Int. J. Qual. Innov. 2020 61, vol. 6, no. 1, pp. 1–14, 2020.

[19] W. Liu, J. Hou, X. Yan, and O. Tang, "Smart logistics transformation collaboration between manufacturers and logistics service providers: A supply chain contracting perspective," J. Manag. Sci. Eng., vol. 6, no. 1, pp. 25–52, 2021.

[20] A. Meyer, W. Niemann, G. Uys, and D. Beetge, "An exploration of supply chain risk management in the South African third-

party logistics industry," Acta Commer., vol. 19, no. 1, 2019.
[21] D. Pamucar, K. Chatterjee, and E. K. Zavadskas, "Assessment of third-party logistics provider using multi-criteria decision-making approach based on interval rough numbers," Comput. Ind. Eng., vol. 127, pp. 383–407, 2019.
[22] S. P. Sarmah, "Supply Chain Performance Measurement of Third Party Logistics," Benchmarking An Int. J., vol. 21, no. 6, pp. 944–963, 2014.
[23] P. Schönsleben, Integral Logistics Management. Operations and Supply Chain Management Within and Across Companies, 5th ed. CRC Press, 2016.
[24] G. Uys, A. Meyer, and W. Niemann, "Taxonomies of trust in supply chain risk management in the South African third party logistics industry," Acta Commer., vol. 19, no. 1, pp. 1–14, 2019.
[25] T. van Staden, W. Niemann, and A. Meyer, "Interpersonal and inter-organisational relationships in supply chain integration: An exploration of third-party logistics providers in South Africa," Acta Commer., vol. 20, no. 1, pp. 1–13, 2020.
[26] W. P. Wong and K. L. Soh, "Review of Pharmaceutical Sea Freight and Malaysian Third-Party Logistics Service Providers—A Supply Chain Perspective," in Pharmaceutical Supply Chains. Medicines Shortages, A. P. Barbosa-Povoa, H. Jenzer, and J. L. de Miranda, Eds. Springer, 2019.
[27] A. Vinajera Zamora, F. Marrero Delgado, N. Coello Machado, and E. Glistau, "A methodological tool to improve the supply chain performance," 2016.
[28] E. Glistau, M. Schenk, and N. Coello Machado, "Tools for improving logistics processes," Ann. Fac. Eng. Hunedoara – Int. J. Eng., vol. Tome XIV 2, pp. 211–216, 2016.