Collaborative framework in Cuban food supply chains

Dipl.- Ing. Yalili Rodríguez Romero
Department of Industrial Engineering, Universidad Central "Marta Abreu" de las Villas, Cuba
yrromero@uclv.cu

DrC. Rene Abreu Ledon
Department of Industrial Engineering, Universidad Central "Marta Abreu" de las Villas, Cuba

Prof. Dr.-Ing. Dr. h.c. Prof. h.c. Norge Isaias Coello Machado
Department of Mechanical Engineering, 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
As a consequence of the COVID-19 pandemic, supply chains (SC) were interrupted, causing disruptions in the supply and demand of products. Food SCs in Cuba are also affected by high prices and limited integration among their activities. Specifically, the food SC of the basic food basket, which is the object of analysis of this paper. Moreover, the SC do not have a collaborative framework to manage the chain in the face of the impact of disruptions and make it more resilient. Therefore, the objectives of this research are: creating a collaborative framework that allows for integrated work in the SC of multiple companies. We also studied the papers that has been conducted in Cuba on this topic, their commonalities and limitations. The main contribution of this research is a methodology for the creation of a collaborative framework in the SC analyzed that enables integrated work and improves the resilience of the SC. To this end, the proposed methodology is subjected to the analysis of a group of experts using The Iadov technique. Subsequently, the overall satisfaction index is calculated, resulting in a level of 0.86%. With this work, it is possible to initiate the implementation of a collaborative framework for integrated work and increased resilience in the food SC analyzed. However, the effective application of this methodology requires the development of TIC platform and the training of its working personnel.

1. Introduction
Logistics plays a fundamental role in customer satisfaction. Within it, distribution management is considered one of the most important logistics functions and on which logistics costs depend to a large extent. Logistics service providers, seek alternatives to remain competitive in the market [1]. Transportation, with its decisive role, has experienced greater growth in recent years due to industrialization, technological advances, increased trade and human movements. It is shown by the fact that, in 2020, global expenditures on logistics reached nine trillion USD - about 11% of global PIB - according to the consulting firm Armstrong & Associates; third-party logistics, of which freight transportation is a large part, accounted for almost one billion USD [2].
As a result of the COVID-19 pandemic, all those companies that claimed to have a world-class distribution channel and logistics found themselves faced with a problem that put all their resilience systems to the test. Increased disruptions in global commodity production, mobility restriction and social distancing impacted labor, as well as freight and freight services, which were forced to reduce supply [3]. The war in Ukraine, more recently, has led to an imbalance between supply and demand, transportation instability and disruptions on major international routes, rising inflation and stagnant economies. The price of a barrel of oil on the world market rose from USD 77 to USD 115 from

February to May 2022. In Spain, for example, food prices have skyrocketed: sunflower oil, 75%; margarine, 35%; pasta, 31% [4]. The Food and Agriculture Organization of the United Nations (FAO) itself has stated that we are exposed to an imminent food crisis unless measures are taken quickly to keep global food supply chains active and mitigate the effects of the pandemic on the food system [5]. It has also recognized that the sharp slowdown in all the world's economies and particularly in the most vulnerable ones - such as Cuba's - will make it difficult for countries, especially those that depend on food imports, to have the necessary resources to buy food.
Cuba, in addition to dealing with all these consequences, lives a scenario aggravated by the intensification of the economic, commercial and financial blockade imposed by the United States, under restrictive measures that have tended to inflation and exchange rate differences, insufficient results of the development plans and a slow growth of the opening to foreign trade. In our country, not all the SCs show a satisfactory development; some of them suffer from certain problems. This is corroborated by studies related to the state of logistics in Cuban companies carried out by the Logistics and Production Management Laboratory of the Technological University of Havana since 1999, where the lack of integration and collaboration among the members of the chains is reflected as a weakness, with subcontracting of transportation services being a marked trend on the part of the companies in order to achieve the satisfaction of the final clients of the SC [6]. Authors such as [7] corroborate the need to design integrated logistics systems through analysis, characterizations and designs in Cuban organizations. Research in Holguin companies [8] have described that there are no references that many efforts have been made in the introduction of modern trends related to logistics systems, nor an integral conception of the subsystems that integrate it. In addition, aggravating factors are often detected that show that companies carry out their management independently, instead of working in an integrated manner to ensure the arrival of products in an efficient manner at the lowest possible cost [9].Marketing companies are not oblivious to this reality; on the contrary, they are subject to negative influences of all kinds. An example of this is the Wholesale Enterprise of Food Products and Other Consumer Goods (EMPA) of Villa Clara, which has among its main functions the distribution of the decent live family basket to the population. This supply chain is complex to analyze due to the large number of actors involved and the wide range of activities it encompasses. According to data presented by the Minister of Domestic Trade Betsy Díaz Velázquez, "the basic food basket today reaches more than 11 million registered consumers in Cuba and moves more than 100 000 tons of products monthly, which end up in 13 000 retail establishments that sell the basket (stores) and goes from ports to wholesale warehouses and then to the retail network" [10]. Currently, the EMPA has been presenting problems fundamentally linked to the issue of transportation, an activity that depends on the vehicles sent by the Santa Clara Cargo Base, subordinated to the provincial Transportation Company (TC). These have been analyzed since previous studies such as [11] and [12], who highlight its main irregularities. There is one main disruption that encompasses this problem: transportation problems due to the lack of collaboration between the actors in the chain; this is the focus of the research. Therefore, the general objective is to propose a procedure for collaborative management between the Wholesale Company of Food Products and Other Consumer Goods and the Transportation Company in Villa Clara. This document is structured in four sections. The next section describes the procedure and the tools to be used. The third section proposes the analysis of the tools used. Finally, conclusions, limitations and future research are proposed.

2. Proposed methodology

Collaborative SC is understood as two or more autonomous companies establishing relationships over the long term, working closely together and establishing common goals to plan, achieving more benefits than they could achieve if they acted independently [13].
From an operational and logistical point of view, there are three types of collaborative strategies, differentiated in terms of their structure: vertical collaboration, horizontal collaboration and lateral collaboration [14]. Collaborative practices between successive links in the same chain – supplier maker deliver - are called vertical collaboration (VC) and occur when two or more organizations such as manufacturer, distributor, transporter and retailer share their responsibilities, resources and performance information to serve in a relatively similar way the end customer [15]. Collaborative practices between firms at the same level in SC, i.e., between competing and non-competing logistics services providers, are generically referred to as horizontal collaboration (CH), and constitute a business arrangement between two or more firms at the same supply network level in order to further facilitate working and cooperating to achieve common goals [16]. Integrated logistics and intermodal transportation are examples of lateral integration application (combination of vertical and horizontal collaboration), which pursues the synchronization of carriers and

transportation users from multiple firms in an efficient and seamless freight transportation network [17].

According to [18] the functioning in recent years of the Cuban economy manifests a set of symptoms that reflect difficulties in the management of microeconomics, where the development of the structuring and integrated management of SC plays a fundamental role. Consequently, companies are making concerted efforts in achieving competitive advantages, through the implementation of the collaborative strategy along the logistics chain [9, 19].

Table 1 shows a comparison between some collaborative supply chain strategies that have been implemented in our country, highlighting which are those aspects where each one is most focused, and those that they have in common with the others. The aspects that do not have the cross (X) do not necessarily mean that they are not included in the procedures, but rather that they may be included because of other management techniques or tools beyond the procedure itself. Where:

- GOM: General Organizational Model [9]
- GGCPSC: General Guidance on the characterization of potential SC [18]
- VNRM: Value Networks Reference Model [6]
- MAPSC: Methodology for the analysis of production chains in Cuba[20].
- ISCMM: Integrated Supply Chain Management Model [21].

When we delve deeper into its contents, we see a weak deepening in the use of ICTs. Specifically, in the distribution processes, the use of information technology for route programming and combination of routes in external transport is not highlighted, nor is the use of quality tools. It is essential that collaborative management models in SCs include the use of software, systems and networks that optimize decision making and enable access to and exchange of information [22]. The use of technology-based management systems is an important part of the logistics cycle, to the extent that it allows finding a balance between costs and services [23]. These reasons support the need to propose new procedures for collaborative management between companies that take these requirements into account.

The proposed collaborative framework procedure for chain management aims to provide EMPA and the TC with the methodological tool (figure 1) that will enable them to manage their processes and activities in a way that will increase their effectiveness, efficiency and resilience. The phases and stages that compose it are explained as follows.

2.1. Definition of the object of study (Phase 1)

2.1.1. Strategic business and policy analysis of government agencies

The starting situation of the organizations must be known in order to trace the path towards the integration of their work systems and/or modify them in order to manage change. In order to analyze this information, a SWOT Matrix is proposed for each of the companies. This is the starting point for strategic planning and subsequent activities.

Table 1: Table comparing strategies for integrated supply chain management in Cuba

Aspects	**Strategies**				
	GOM	GGCPSC	VNRM	MAPSC	ISCMM
Strategic analysis of the environment		X		X	X
SC identification and characterization	X	X	X	X	X
SC mapping or design	X	X	X	X	X
SC diagnosis	X	X	X	X	X
Order management		X	X		
Capacity and inventory management		X	X		
Demand management		X	X		
Dynamic balance of the logistics system	X	X			
Coordination of process cycles and variables	X	X			X
Use and implementation of ICTs for process and activity management			X		
Evaluation of impact and/or performance indicators		X	X	X	
Definition of problems, risks and/or critical points	X	X		X	
Collaborative planning and training		X	X	X	X
Staff training and development.	X	X	X	X	X
Evaluation and implementation of improvement proposals	X	X		X	X
Follow-up and control of development projects		X			

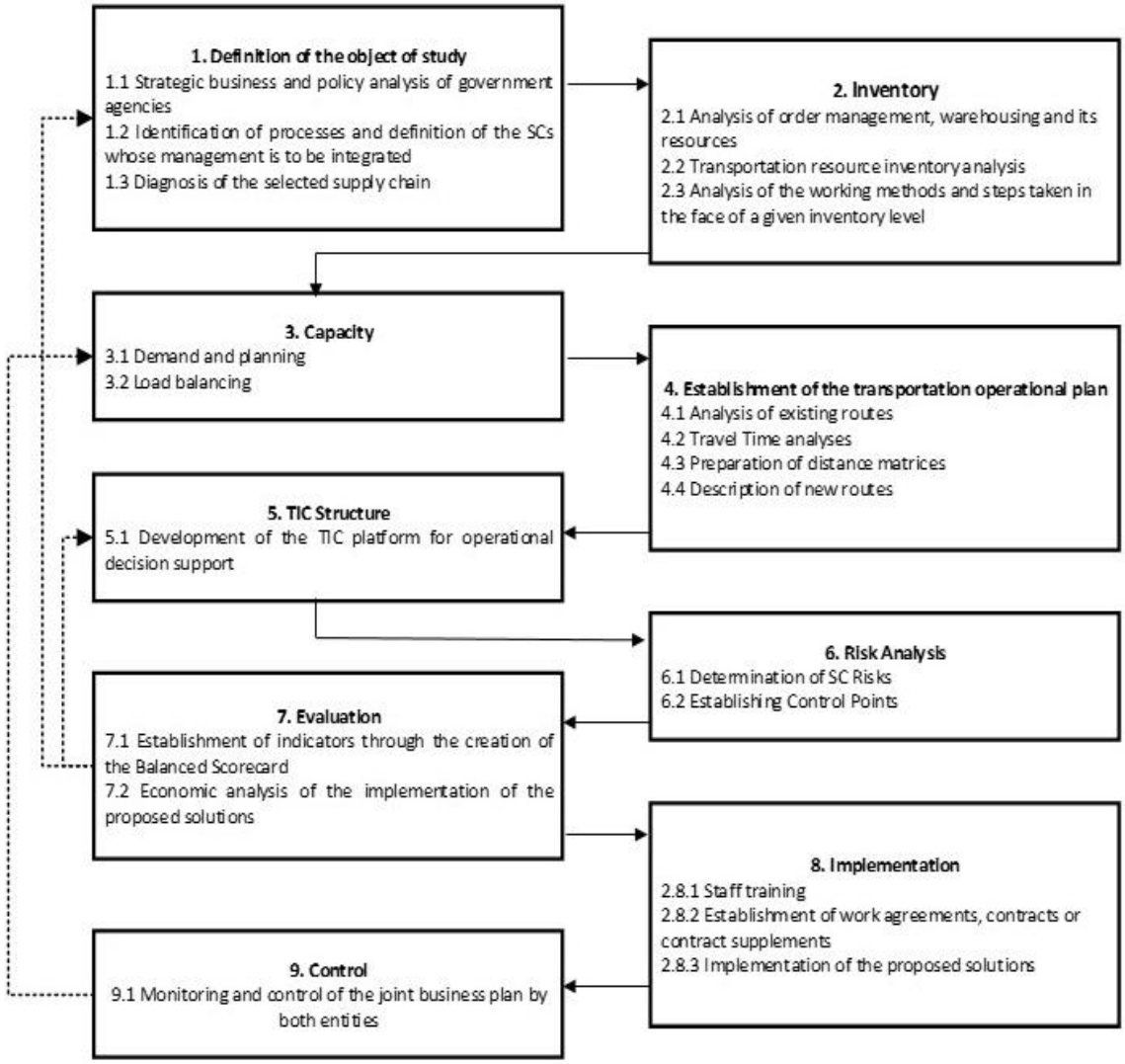

Figure 1: Proposed methodology

2.1.2. Identification of processes and definition of the SCs whose management is to be integrated

Using the SCOR (Supply Chain Operations Reference) model as a reference, the processes that support the SCs must be identified in the EMPA. Based on this information, a process map is drawn up for each SC of the entity, with its corresponding diagrams and process sheets. Next, a SC is selected for its development and collaborative planning among the companies under study.

2.1.3. Diagnosis of the selected supply chain

Once the SC whose management is to be integrated has been selected, the next step is the diagnosis. For this purpose, it is proposed to use as a tool the "Guide for the characterization of potential supply chains" of the Logistics and Production Management Laboratory of the CUJAE by [24].

2.2. Inventory (Phase 2)

2.2.1. Analysis of order management, warehousing and its resources

The elements to be considered for its analysis are: classification of the warehouse, technical-constructive characteristics of the warehouses, sequence of steps to be followed from the time the product arrives at the warehouse until it leaves, conservation procedure of the stored materials, quantity of storage means, quantity of handling equipment, labor force requirements, product location and localization system, product rotation, and work safety and hygiene. The storage demand-capacity balance is proposed. This step will provide a comprehensive characterization of the order and storage management activities, as well as the resources available.

2.2.2. Transportation resource inventory analysis

According to Model BC-1 and Model BC1-A of the load balance [25], an inventory of transportation capacities (in tons and cubic meters) is made for each means of transport, recording the type of vehicle, the make, the consumption standard in

km/L, the technical condition, among other data. The work rhythms, schedules and maintenance cycles established for this equipment should also be analyzed, as well as whether they have the current technical inspection certificate and report and proof of the Transport Operating License.

2.2.3. Analysis of the working methods and steps taken in the face of a given inventory level.

Some of the issues to be analyzed are: storage standards, product traceability and rotation, priority relationship between destinations, priority relationship between goods, availability of schedules, transport planning, ways of grouping goods, compatibility of loads. At the end of this step, information will be obtained on other elements that must be considered because of their role as conditioning factors in the activity and which, together with transportation inventories and storage resources, will be fundamental when carrying out capacity studies and balance sheets.

2.3. Capacity (Phase 3)

2.3.1. Demand and planning

It is proposed to use analysis and forecasting by means of statistical tools or scheduling.

2.3.2. Load balancing

This step corresponds to the load balancing. An analysis of load flows and the demand-capacity relationship must be carried out in order to adopt measures to maximize the use of existing capacities and resources, particularly fuel, based on demand forecasts and resource inventories.

2.4. Establishment of the transportation operational plan (Phase 4)

2.4.1. Analysis of existing routes

The planning of distribution routes suggests a prior diagnosis of elements such as: the state of the distribution system, existing routes, travel times, fuel consumption, costs involved, loss indicators and customer experience. With this, the shortcomings and strengths of the current routes are identified.

2.4.2. Travel time analyses

Using the timing technique, loading and unloading times should be measured, as well as those associated with other activities that take place before, during and after the routes are completed, and which are directly linked to the distribution activity (dispatching, receiving).

2.4.3. Preparation of distance matrices

Here the distances between the stores under study are established.

2.4.4. Description of new routes

To plan the new distribution routes, it is proposed to implement a software adapted to the company's requirements, which facilitates the recording of the data obtained in the two previous steps, as well as information related to highways and roads: typologies, topographies, traffic levels and transit zones, distances, access limitations, among others.

2.5. TIC Structure (Phase 5)

2.5.1. Development of the TIC platform for operational decision support

In this stage, an integrated TIC platform must be developed to plan, design and optimize dispatch and delivery operations in the most efficient way by assigning schedules, product quantities and vehicles. To achieve total and efficient control of the operation, this platform would be made up of at least five modules. In order to achieve total and effective control of the operation, this platform would consist of at least five modules:

1. the inventory module would have updated and real-time information on warehouse inventory levels.
2. the routing module integrates the transportation software proposed above, and would allow the analysis of routes and the assignment of routes based on the adjustment of parameters according to the distribution, considering multiple criteria such as: type of vehicle, capacity and number of routes, fuel required, amount of cargo, weight, volume, fragility, compatibility, organoleptic characteristics in the case of food, delivery schedules and travel times.
3. The customer module would have updated information on their demand levels and would facilitate the establishment of historical records.
4. the communication module would provide a solid, secure and fast way for the exchange of information between companies, eliminating data redundancy and delays in the delivery of information, while facilitating planning and management in an integrated manner.
5. the indicators module would facilitate the calculation, recording and analysis of indicators that will allow managing the control of the fulfillment of strategic and operational objectives in the processes.

2.6. Risk Analysis (Phase 6)

2.6.1. Determination of SC Risks

In this case, it is proposed to use the Failure Mode and Effects Analysis (FMEA) method [26]. This is a tool aimed at achieving quality assurance.

2.6.2. Establishing Control Points (CP)

The logical and structured way of proceeding to identify the CP can be facilitated by the use of a decision tree [27].

2.7. Evaluation (Phase 7)

2.7.1. Establishment of indicators through the creation of the Balanced Scorecard

A Balanced Scorecard (BSC) is proposed because it allows to detect deviations from the strategic plan and to express the objectives and initiatives needed to redirect the situation. This step will provide control mechanisms at all levels, so that the implementation of strategies can be readjusted when necessary and appropriate [28].

2.7.2. Economic analysis of the implementation of the proposed solutions

This step involves carrying out a cost-benefit analysis, a very useful process to determine whether the decisions taken are economically sound or not.

2.8. Implementation (Phase 8)

2.8.1. Staff training

Training courses are to be conducted jointly with the university, and training plans on logistics, use of TIC and collaboration are to be established for workers and managers through workshops and meetings.

2.8.2. Establishment of work agreements, contracts or contract supplements.

According to the needs and characteristics of the institutions involved, a legal instrument will be applied in accordance with current law [29], although it is proposed that collaboration agreements be signed to support a cooperation contract.

2.8.3. Implementation of the proposed solutions

This is a fully operational stage in which it must be considered that resources must be managed efficiently. What was established in the previous phases is put into practice: techniques, working methods and, mainly, the use of the TIC platform for distribution management.

2.9. Control (Phase 9)

2.9.1. Monitoring and control of the joint business plan by both companies

It is crucial that both companies keep a systematic watch on the functioning and evolution of the solutions implemented as part of the collaboration strategy, as well as the agreements signed for integrated work.

3. Results and Discussion

It is applied with the objective of validating the proposed procedure for collaborative framework management among the companies under study. The selection of the sample, in order to determine its distribution with respect to the population, was by strata and intentional, which allowed the direct and explicit selection of the specialists who were considered likely to offer the greatest amount of information. They belonged to different work groups of the EMPA, the TC and the university. The questionnaire applied has a total of five questions. It is based on the relationships established between three interleaved closed questions (1, 3, 5) whose relationship is unknown to the subject. At the same time, the open or complementary questions (2, 4) serve as an introduction and support of objectivity for the respondent, who uses them to position himself and contrast the answers. The three closed questions are related through Ladov technique [30], shown in table 2; the resulting number indicates the position of each subject on the satisfaction scale, that is, his or her individual

Table 2: Ladov technique

Question 5: Do you believe that by applying this procedure, an effective and efficient integration of the management of the actors involved in the development of the EMPA's supply chains will be achieved and the proposed objectives will be met?	*Question 1: Did you find the design of the phases and stages functional and adequate?*								
	Yes			I DO NOT KNOW			NO		
	Question 3: Do you feel that this procedure covers the aspects necessary to organize work methods, plan the management of resources, optimize the application of techniques and tools, and achieve an adequate exchange of information among the actors in the EMPA's supply chain?								
	yes	I do not know	no	yes	I do not know	no	yes	I do not know	no
Clear satisfaction	1	2	6	2	2	6	6	6	6
More satisfied than dissatisfied	2	2	3	2	3	3	6	3	6
Not defined	3	3	3	3	3	3	3	3	3
More dissatisfied than satisfied	6	3	6	3	4	4	3	4	4
Clear dissatisfaction	6	6	6	6	4	4	6	4	5
Contradictory	2	3	6	3	3	3	6	3	4

satisfaction. The satisfaction scale used is as follows: 1) clear satisfaction, 2) more satisfied than dissatisfied, 3) not defined, 4) more dissatisfied than satisfied, 5) clear dissatisfaction, 6) contradictory.
This technique also makes it possible to obtain the Group Satisfaction Index (GSI), and is calculated by the following equation:

$$GSI = \frac{A(+1) + B(+0.5) + C(0) + D(-0.5) + E(-1)}{N}$$

where A, B, C, D, E, represent the number of subjects with individual index 1, 2, 3 or 6, 4, 5 respectively, and where N represents the total number of subjects in the group. The GSI value obtained in this research was approximately 0.86, which indicates a high satisfaction with the proposed procedure and validates its usefulness (being in the interval between 0.5 and 1). This indicates that the procedure is apt to be implemented and contribute to improvement in the organizations under study
These results of the specialists' satisfaction with the procedure were reaffirmed by their answers to the open-ended questions (Question 2. What problems, in your opinion, limit collaboration between the companies mentioned above and hinder the proper functioning of EMPA's supply chains? Question 4. How important do you think it is to establish a collaboration strategy between the TC and EMPA? What results would it bring?). Among the most frequent criteria were that the low level of computerization of both companies and the differences in their interests according to their fundamental activity limit their collaboration and the proper functioning of the SC of the EMPA. Likewise, the establishment of a collaboration strategy between the TC and EMPA would result in greater financial savings for both entities and greater agility in the provision of services, which would have an impact on increased customer satisfaction.
Other opinions are linked to the current economic situation in the country (fuel availability and technical condition of vehicles) and to supply disruption, a premise that was initially put forward as one of the causes of the problems in EMPA's SC, but which goes beyond the scope of this research. In fact, it is ideal for studies to be carried out in response to supply problems, since their solution is a prerequisite for the successful implementation of this procedure. In a general sense, it is considered that the respondents are satisfied with the proposed procedure.

4. Conclusion

The procedure proposed for collaborative framework management offers the methodological instrument that will allow them to manage their processes and activities, so as to increase effectiveness, efficiency and resilience. The process of validation of the procedure in the food wholesale company and the transport company, by means of the Ladov technique was satisfactory, expressed quantitatively in the high Group Satisfaction Index obtained (GSI=0.86) and qualitatively in the criteria issued by the experts that demonstrate the usefulness they grant to the procedure for its future application.
As future research, it is proposed to continue working on the TIC platform that will allow the development of the collaborative framework between both institutions. In addition, it is intended to apply this procedure to other institutions with collaborative work characteristics with a transportation company.

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