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## ► To cite this version:

Jesus Gonzalez-Feliu, Amir Hasnaoui, Joëlle Morana, Feizar Rueda. Digitalization, traceability and Supply Chain Performance in social improvement logistics: the case of Bienestarina distribution, Colombia. Prolog 2022, Sep 2021, Nantes, France. halshs-03530048

**HAL Id: halshs-03530048**

**<https://shs.hal.science/halshs-03530048>**

Submitted on 17 Jan 2022

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## **Digitalization, traceability and Supply Chain Performance in social improvement logistics: the case of Bienestarina distribution, Colombia**

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**Keywords:** Supply Chain Traceability; Social Improvement; Digitalization; Performance; Food assistance programs

### **Introduction**

The performance of a supply chain is crucial for its daily execution, but also for its technical and economic continuity. This is the case of not only commercial supply chains, but also those of humanitarian nature. Indeed, although goals and objectives are not the same (Holguin-Veras et al., 2012), the efficiency and efficacy of humanitarian supply chains results on reaching those goals, which are mainly the decrease of suffering and diseases. In humanitarian supply chains, different categories can be established (Gonzalez-Feliu et al., 2019), related to the type of crisis they deal with: long-term crises, exceptional crises, recurrent crises or social improvement needs. Indeed, social improvement systems are those issued to bring inclusive growth and welfare to populations in difficulties (Maldonado and Moyá, 2013; Thomas and Hedrick-Wong, 2019), via economic/financial support, nutritional improvement of resource/logistics help (Gonzalez-Feliu et al., 2018). In this last category, less studied, we find many schemes having important lacks that affect performance. This is the case of food assistance programs (Rueda-Velasco et al., 2021), which are often seen as governmental humanitarian projects where supply chains are not explicitly highlighted. However, the main difficulties of those programs' efficiency (in fighting malnutrition) arise on the lacks of such projects to distribute the proposed food supplements to beneficiaries. Indeed, few studies can be found (either in scientific or practice literature) about the assessment of food assistance programs efficiency, mainly in those countries having a high number of families facing malnutrition (Information Resources Management Association, 2021).

To improve those programs' supply chains, digitalization can play an important role (Rueda-Velasco et al., 2019). Indeed, the main problems those supply chains face are related to the lack of information tracking, traceability and synchronization/integration, issues that can be improved by digitalization and ICT tools, since main dysfunctions are related to the lack of tracking and exchanging information concerning the efficiency of the whole supply chain process and its components (Gonzalez-Feliu et al., 2018). However, the adoption of digital technologies and traceability is not always easy, and although traceability is a popular subject in food supply chains, it is not the case in distribution systems related to food assistance programs (Rueda-Velasco et al., 2021).

For those reasons, this paper aims to address how a traceability and digitalization strategy can be sustainably deployed in food assistance programs, via the case study of Bienestarina in Colombia. To do that, a participative research case study is developed and proposed. First, the main issues of digital transformation, traceability and ICT adoption will be presented. Then, the proposed methodology will be described, as well as the case presentation. After that, as results, the main characteristics of the Bienestarina supply chain will be presented and analysed, to identify the main information disruptions. After that, two proposed traceability tools will be analysed and compared, identifying the levers and limits of their respective deployment, to understand on which bases the final implementation choice has been made.

### **Methodology**

The methodology proposed here is that of case study research (Eisenhardt, 1989). In other words, we will start by presenting the case of Bienestarina supply chain in Colombia (managed and organized by a centralized stakeholder), then we tried to identify the main traceability issues and generalize it mainly for transferability issues.

To do this, we propose the following methodological frameworks organized as follows:

1. Characterization of the Bienestarina supply chain.
2. Identification of the main problems and dysfunctions due to lack of traceability.
3. Definition of traceability needs.
4. Proposal of two solutions: a combined and an integrated traceability alternatives.
5. Suitability assessment and deployment issues.

The Bienestarina supply chain characterization will be made via an adapted framework issued from Cooper et al. (1997) but extended to social improvement supply chains. It will combine a supply chain process modelling, an analysis of social improvement management components and an assessment of the resulting network structure, in the sense of Lambert (2001).

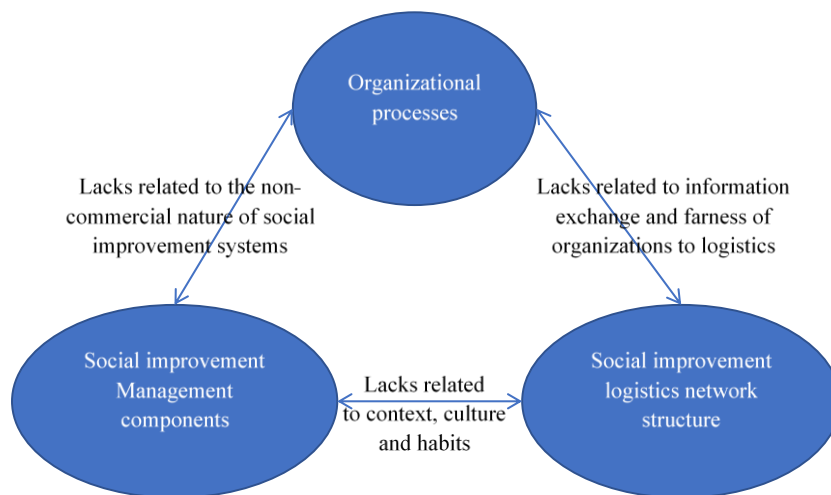


Figure 1. Framework to characterize the supply chain in social improvement systems and identify the main lacks (authors' elaboration, adapted from Cooper et al., 1997)

As a second step, we propose the description of the main logistics problems regarding the product traceability. This is done as a conclusion of the interviews' analysis and the application the AFNOR (2014) framework, to identify which dysfunctions in the four base activities (plan, program, execute and control) are observed at each stage of the supply chain integration level.

As a third step, there is an analysis about the needs of the stakeholders involved in the Bienestarina Supply Chain, also on the basis of the interviews results. Finally, the fourth and fifth step consist on the comparison of two tools: an integrated one, issued from Rueda-Velasco et al., (2019), and the combination of a commercial traceability tool for B2B commercial logistics and the implementation of an ad hoc traceability solution for final deliveries (Monsalve Salamanca, 2019). Those two tools are assessed and compared using a framework that combines risk assessment, adoption issues and functional ICT assessment. Finally, a discussion about the proposal is presented, as well as the main generalization issues.

The data needed to build the case study and prepare the research work has been collected in different steps, on a logic of action-research (and in the context of an applied research program funded by Colciencias, the Colombian Agency of Research). First, an exchange with the department of malnutrition fighting at the Colombian Institute of Familiar Wellness has been

carried out, with different interviews, to set the problem and develop the action-research plan. Then, a 24 month research period has led to the observation of the Bienestarina Supply Chain, various exchanges with the different stakeholders involved, a set of quantitative surveys, an analysis of the current traceability tools, the identification of current problems and the proposal of solutions to improve the current lacks, some of which have been implemented and followed.

## First results

The results allowed to identify a set of dysfunctions, which main causes are:

- Registered Beneficiaries accuracy.
- Disintegration between supply chain processes and lack of integral information traceability.
- Disfunctions related to the different ways of consumption.
- Lack of last mile tracking.
- Lack of primary data about efficiency of the Bienestarina program in fighting malnutrition.
- Loss of product because improper storage or packaging
- High levels of unclaimed product.
- Important levels of distributed product for an improper use.

Those causes highlight the importance of having a robust traceability and transparency of information, and the main disjoining point of the information low continuity seems to be the link between regional distributors and executing units (i.e. the volunteers that finally bring Bienestarina to beneficiaries). Those units are composed of volunteers and the current tracking tools stop at the regional point level, the last part of the supply chain relying only on paper-based registers, most of them being difficult to verify its accuracy. For that reason, an analysis of traceability solutions to improve the continuity and transparency of that information have been assessed.

Two main solutions are proposed. The comparison of such solutions shows some important concerns. In technical terms, the information applications must be synchronized to an address where the server is located; it could be an issue for the update process of all devices. The server as a central entity may have defaults; all devices must be pointing to a specific URL or address, if it is changed, it is necessary to update each application by tracking. The system proposed may allow after few testes to be an example to implement similar systems on a different first need products that are distributed to vulnerable populations.

In consequence, it is important to a comprehensive development logistics for this case, the implementation of ICT strategies, methods and techniques of various kinds, according to each region's nature of the Colombian territory to bring Bienestarina just in time and make compliance with the fundamental rights of the vulnerable population. More in depth studies of supply chain operators and logistics information technology allows to strengthen the Bienestarina logistics system and to get more sustainability efficient results.

However, traceability issues are not the only ones to be considered. The human factor, the regional disparities and the lack of accessibility of some regions (which need specific transport modes, such as barges or helicopters since roads are sometimes absent) need to be taken into account in the proposal of efficiency management tools. The case study shows the complexity of the problem, the strengths of action-research and the central place of traceability issues that go beyond the only technical issues to consider also social and human factors. All those elements play an important role in assessing the efficiency and ensuring a good functioning of food assistance programs based on the distribution of dietary complements.

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