International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 9; Issue 04 (C); April 2020; Page No.21958-21962
DOI: http://dx.doi.org/10.24327/ijcar.2020.21962.4325

Research Article

BENEFITS OF REVERSE LOGISTICS APPLICATION IN THE FOOD INDUSTRY

Mariana Gallardo Sánchez[1], Dr. Jorge Luis Castañeda Gutiérrez[2] and Dr. Adrián Trevera Juarez[3]

[1]Administrative Engineering Department, Technological Institute of Apizaco, Apizaco, Tlaxcala
[2]Division of Graduate Studies and Research, Technological Institute of Apizaco

A R T I C L E I N F O

Article History:
Received 13th January, 2020
Received in revised form 11th February, 2020
Accepted 8th March, 2020
Published online 28th April, 2020

Key words:

Reverse logistics, Optimization, Food Industry, Out of use products.

A B S T R A C T

This article provides a state of the art approach to reverse logistics and its applications in the food industry, highlighting favorable results, benefits and application tools. The food industry uses organic and non-organic materials as packaging material it also places products close to the end of their useful life, products that due to breaches of quality specifications were not able to complete their life cycle or there was simply an apathy by the client. All these products are susceptible to reverse logistics models for execution and optimization.

The methodology of this article is documentary since it uses research from various sources, such as articles in virtual magazines, thesis papers, sources from national organizations. (INEGI, PROMEXICO, Secretary of Economy) sources of international organizations such as FDA (Food and Drug Administration).

INTRODUCTION

At present, factors such as climate change, high energy prices, constant change in markets, urbanization and globalization have redirected the thinking of society to adopting recycling and reuse measures as part of the culture. However, the laws are increasingly stringent given the concern of consumers for the environment, this same concern leads companies to think about the responsibility for the products and the uses that they are given (Rogers & Tibben- Lembke, 1999), by increasing production and consumption, a shortage of natural resources is generated. Therefore, society and companies seek sustainable alternatives and tools where the greatest number of resources are optimized. Such a tool can help reduce the environmental and incidental impacts add value to the product, and this company is Reverse Logistics (Cure, Meza & Amaya, 2006) which is in charge of the planning process, of efficiently developing and controling the flow of materials from a place of origin to consumption, satisfying the needs of the consumer and reintroducing the material to the supply chain in the best possible way.

Reverse logistics is responsible for correctly managing returns from the customer to the source, involving all links in the supply chain with the aim of creating a profitable opportunity for the organization. (Mihi, 2007). When managing returns, the task is not simple, the economic recovery of returns must have an efficient system where the design, development and control is able to collect the end of life products, which has stopped satisfying a need, creating a competitive advantage in production processes by replacing parts of the original raw materials (Rubio & Jiménez, 2016).

The food industry is key to the growth of any country, since it is necessary for the wealth of a nation and of course must comply with the first basic principle of survival. However, the food industry has undergone major transformations with consumption, factors such as climate change, changes in food availability, increase in income, increase in service prices and generating negative effects on companies (Von, 2007).

The food industry has as its main activities those related to the primary sector (agriculture, fisheries and livestock) linked to the processed food industry, which although the concept of industry not only entails "industry" as such, it also includes small and medium-sized businesses such as restaurants, supermarkets, coffee shops, commercial establishments where there is a process of food transformation. This article includes the application of Reverse Logistics work to small and medium business industries to transnational companies that although share their experience and work on the research that was carried out where economic, environmental and social benefits stand out.

METHODOLOGY

For the purposes of this article and publication, the information was collected from official international sources, FDA (Food and Drug Administration) and national sources such as Secretary of Economy, (PROMEXICO), INEGI, sources in electronic journals, doctoral theses and scientific articles.

The article is divided into three phases, the first is the work and information related to the after-sales logistics, the second

Corresponding author:* **Mariana Gallardo Sánchez
Administrative Engineering Department, Technological Institute of Apizaco, Apizaco, Tlaxcala

phase is divided into the works found with the post-consumer logistics and the third phase is the research carried out regarding the logistics or search networks of optimal routes for the recovery of products out of Use.

The food industry in the World

Globally, food production was 5,022 billion dollars in 2014 and growth is expected in the 2014-2020 period where it increases at an average annual growth rate TMCA (Average annual growth rate) of 4.5% (Table 1).

Table 1 World producción of processed foods. Source: own elaboration from IHS in PROMÉXICO, 2016

World producction of processed foods				
Position	**Country**	**2014 BN**	**% Participation**	**TMCA 2014-2020**
1	China	1,354.80	27%	5%
2	EE.UU.	754.70	15%	3%
3	Brazil	230.40	5%	-4%
4	Japan	228.80	3%	1%
5	Germany	173.30	3%	3%
6	France	156.10	3%	2%
7	Italy	143.10	3%	2%
8	India	141.80	3%	11%
9	Mexico	138.40	3%	4%
10	Russia	127.80	3%	-3%
	Others	1,572.90	31%	4%
	Total	**5,022.10**		**4%**

In the first place is China as the main producer of processed foods, the second and third place are occupied by countries such as the US and Brazil, Mexico occupies the ninth place, however Mexico was in seventh place in the world consumption of food PROMEXICO (2016).

The food industries use two important factors for sustained success such as technological development and research, and the countries with the highest production have alliances where seed companies, agrochemicals, agrobiotechnologies, agroindustrial companies are integrated into the productive chain, working integrally to gain a place in the market (Rendón and Morales,2008).

As planned for 2020, this year means an increase for the food industry, beyond the economic increase, wich generates a concern for companies with respect to perishable and non-perishable products, the first and foremost problem is about short shelf life and the second being ones such as cardboard, plastic packaging, glass bottles, aluminum cans, packaging material, pallets etc. They generate higher costs due to the increase in prices of raw materials and, of course, environmental problems. These problems lead to the need to rethink and find that the products have a second chance inside and outside the organization, for these problems an effective solution is the use of inverse logistics.

The applied of reverse logistics in the food industry

As previously mentioned, reverse logistics is related to the management returns from an inverse flow, that is, from the client to the company, with the objective of creating value and a profitable opportunity for the company. Among the procedures and methodologies applied to the reverse logistic the most frequently used are; Cost based on ABC Activities, Life Cycle Assessment, Process Mapping, New Products Development Process (APQP), and Research operations (Manquera, 2012). The methodology that is most used without a doubt is operations research since it allows managing quantitative data obtaining more accurate results, for the development of this article, some of the methodologies used by various authors where were applied reverse logistics related to the food industry and the benefits obtained.

In a briefly way, the direct and reverse flows of logistics interrelated with the production process are represented by figure 1. With the main elements of reverse logistics in mind, the 3R´s reuse, remanufacture and recycle. Reverse logistics model post consumption, post sale and recovery.

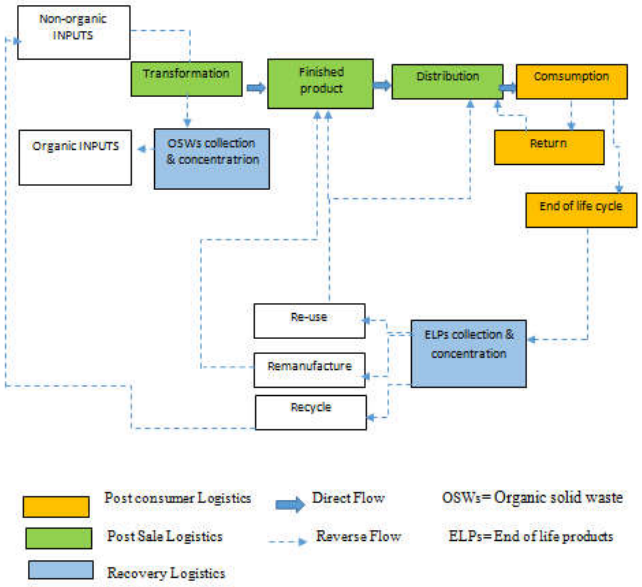

Figure 1 Reverse logistics model post consumption, post sale and recovery Source: own elaboration, with information of Castañeda (2011).

Figure 1. Reverse Logistics Model is based on the iconic model focused on genetic algorithms by Castañeda (2011) wich only representatively shows the necessary direct flows in the food industry where inputs of vegetable or animal origin (organic) are used that will be transformed and packaged with inputs such as plastic bottles, aluminum cans, tetrapac containers, etc. Preserving optimal content conditions of to become finished products and ready to be distributed and consumed.

Reverse logistics has two aspects; The first and most used is to occupy the goods that are generated with the products in green color, after-sales logistics such as containers, packing, packaging etc. either for the purpose of recovering, reusing or recycling, the second slope, with yellow color is focused on the after-sales service known as post-consumer logistics such as returns Cure L, Meza, JC, & Amaya R. (2006). An indispensable element in reverse logistics is the collection of end of life products for which there are network models the search for optimal routes, which some will be mentioned in the research carried out in the food business.

First phase; After Sales Logistics

The work of Huertas PJ (2014) which was based on designing management and control plans for various solid waste generated by the company dedicated to the preparation of ready-to-eat foods in sectors such as industrial, school and hospital in the Bogota city Colombia. For the implementation

of the reverse Logistics system, I use the OEDI cycle (Observe, Evaluate, Design and Implement) as a tool, the study led to the creation of environmental files which previously trained personnel served to correctly select the waste and identify which were ones that generated more volume and which could be reused or recycled, likewise with the information that was generated by filling in the environmental files, benefitted to the supply chain by modifying the raw materials to be acquired, the replenishment times and inventory levels were adequate to optimize costs.

Another contribution to reverse logistics made by Betancurt (2016) is in the agri-food sector whose application purpose was the proposal of a strategy through reverse logistics with the help of recovery, recycling and ensuring the efficient management of OSW (Organic Solid Waste) to convert it into compost and thereby make a business model proposal where compost is produced, distributed and marketed within the facilities of the "Paloquemao" market located in the city of Bogotá, Colombia. The techniques used in this study were through structured and unstructured observation, surveys and in-depth interviews with vendors in that market. The field work allowed determine that despite the established procedures, it was not working properly due to the lack of commitment of the management department and the market vendors. Affecting like processes of reverse logistic the waste process of separation, making it impossible to value composting. These system failures in the system led to the determination of some corrective actions and improvement proposals such as: points of sale redistribution according to the type of product, facilitating the recovery of the organic solid waste, conducting constant training to raise awareness among the sellers of not mixing garbage, conducting an organic solid waste storage site study to treat wastewater. The proposed business model for this work does not include the feasibility study, however, it is only limited to studies in the country of Colombia affirming the increase of the tendency on composting and at the same time as an opportunity to have the composting plant itself in Bogotá and with them be able to distribute all over country obtaining economic and environmental improvements for the supermarket and society.
A quite important contribution of reverse logistics based on evolutionary algorithms branch of artificial intelligence aided by sciences such as mathematics, computer science and biology in particular the theory of evolution use algorithms, which are defined as a set of cyclical objects and instructions that work in an orderly and defined way to find one or several solutions, these objects or entities are mixed to compete with each other, the most predominantly apt to maintain and evolve (Castañeda, 2011). The mathematical model proposed with the objective function of minimizing the cost of production, including the products costs of handling and storage per plant, plus the costs for recovery products of returned, representation costs for the elimination of end of life products, costs of collecting the center of recovery against capacity constraints, this model will serve for companies that wish to streamline their processes, obtaining economic benefits by introducing waste and end of life products back into the production chain, evidently companies or food industries can occupy said model.

Second stage; Post-consumer logistics

Talking about returns for many companies is the equivalent of products that did not fulfill the purpose or order of the business, or synonymous with customer dissatisfaction and some companies do not give importance to returns because they are somewhat complex to predict, nevertheless in the work of Santa Cruz GA (2011) seeing an opportunity analyzing the returns of the company "Danone Argentina", an international company specialized in the production of dairy products and desserts throughout the country of Argentina, from 2007 to 2010 there were increases in returns, tripling in Some regions of Argentina. The techniques for data collection were interviews throughout the supply chain from freight forwarders, prevention companies, sales managers to people who work daily with returns, as well as visits to the distribution center and some points of sale, in order to obtain a complete panorama of the information and to be able to take correct analysis. Thanks to this analysis it us create and improve new strategies and sales policies with the purpose of reducing returns. Some of the proposals were; standardize automatic orders with manuals to have more contact with customers, avoiding sending unnecessary products, suggesting making updates on the parameters and ordering formats and lifting of returns with which sellers worked from retail stores to change to wholesalers or wholesale media since not updating the returns the volume information it was high due to the policies for retail stores, these were less rigorous and with percentages of greater acceptance of return than with the wholesalers. Another proposal was to modify the shelf life of some products so that they would stay longer in gondolas and thus allow time to organize new offers, during visits and observation in the points of sale detected that the products with greater incidence in return for damage were by vendors poor arrangement in gondolas, the proposal was to train staff for proper product accommodation. With this analysis he showed that the return system had failures and with the improvements of the system would allow the company to have both economic and ecological savings.

Another contribution to the reverse logistic on returns was the contribution of Brahim & Romero (2013) made in a retail supermarket of consumer products in Argentina, specifically based on the food supply chain, having 36 stores and a distribution center, The techniques used were in-depth interviews with store workers, elaborated questionnaires and views of stores with the highest number of returns. The analysis of the information resulted in problems of leadership and work environment in addition to expressing disagreement with workers in factors regarding low salaries, large loads of activities, high turnover, lack of staff, lack of supervision, lack of training impacted closely with indicators for the performance of logistics such as: inadequate inventory levels, poor distribution in warehouses, demand forecast errors, unbalanced supplies, poorly stowed or accommodated products causing a huge increase in returns to the main warehouse and the transmission of the products, these effects had an economic impact on the organization, so that the following recommendations are based on what has been analyzed, have effective communication, training and commitment at the three levels of the chain, (operational, tactical and direct) strategies on the labor image, leveling of salaries according to skills and abilities, workload balancing, for branches identified with red category (those with the highest returns), decrease deliveries in stores 7 to 4 days a week to avoid over-stock and avoid Returns for breakages in the product and expiration date, granting days to order the cleaning and classifying of the products, as well as

reestablishing authorization order policies, improving communication between the Sales and Logistics department.

Logistics networks

The return flow of food products is a frequent problem of reverse logistics and as such include activities related to food distribution, packaging returns, recycling, reuse, recovery and disposal, the work done in Italy by Serra, Fancello, Mancini and Fadda (2016) propose an integration of the collection and distribution of food waste produced by businesses dedicated to the agri-food sector where they propose that such waste can be used as animal feed or fertilizer, through the use of entire programming For the problem of vehicle routing and the use of clustering algorithms, they identified optimal collection and delivery routes by applying a mixed combination designed with time and cost minimization functions. The management design was successful and was implemented in a software platform allowing favorable results for the province of Cagliari in Sardinia Italy.

The works of Calderón, Gómez and Góngora (2017) in which they made a routes design under the Reverse Logistics system of the Food Bank in the city of Cali, Colombia. This entity is non-profit, the main objective of the Food Bank is to work with non-perishable foods where surplus food or products are collected near the end of companies or businesses life cycle that wish to support the Food Bank. Given the importance and dainty of the non-profit entity, the recommendations for the creation of a methodology for route design and resourses optimization, the first step was to identify and analyze internal processes, identifying donors, the methods they use to collect the goods, the execution activities of each of the workers and the formats or documentation used to collect the merchandise. The second step was the determination of the available resources, being necessary the numbers of vehicles, weight capacity and volume of the vehicles, personnel assigned to the vehicles, type of merchandise, special conditions for their transportation, and number of customers and articles to deliver, for this last point, forecasting methods were used to establish the correct volume of items per vehicle. Step three, to determine the location of customers, for which it was necessary to create a database with the exact address to determine the coordinates. Step four, Route Determination, for which it was necessary to design routes with quantitative methods and the help of specialized software, finally, the routes were analyzed, allowing non-perishable products to reach the final customers in optimal conditions, obtaining reduction in time and cost.

One of the determining factors in reverse logistics networks is to have sufficient volume to guarantee the continuous flow and return of materials in a way that allows establishing a recovery and recycling network, this was a premise for the work of Monsreal and Cruz- Mejía (2014) whose objective was to design an reverse logistic system for the recovery and recycling of non-returnable packaging of a beverage (beer) industry in Mexico. For this reverse logistic system, models such as packaging recovery process, location and allocation of collection or recovery centers, packaging selection process as well as the location and allocation of recycling plants were designed, for which they used reverse routing algorithms as the algorithm of the nearest neighbor where the product load continuously moves towards the nearest neighbor without overcoming the restrictions such as vehicle capacity, maximum route time, with the indication of the routes determined by said algorithm, likewise They used a different "Cost-effective visit algorithm" (PVA) with the objective of reducing recycling costs and in turn increasing the quality of the material by collecting both materials such as aluminum can and glass bottle. In this study, it allowed profitable routes for both collection and storage as well as classification and separation of waste.

On the other hand, the extension of techniques to use reverse logistic beyond managing returns and designing routes, is waste management which entails a number of considerations so that it can be implemented efficiently, however reverse logistic flows can be addressed according to the typology of the products, García & Prado, 2004 carried out a job the Spanish food industry where it talks about the characteristics for the management of reverse logistics focused on packaging and packaging that have functions in logistics, marketing and environment Robertson 1990 (cited in García and Prado 2004). The objective of the study was to identify how established the companies are with respect to the good practices on the designs of the packages and packaging and what aspects they consider most relevant. The study was based on interviews with the food industry throughout the country, being divided into 3 important items; food distribution companies, packaging and packaging companies and finally product packaging companies. The most important factor to carry out a packaging design for packaging companies is undoubtedly the logistics aspect, which points out the protection of the product, another important aspect for manufacturing and packaging companies is the commercial aspect which enhances the characteristics of each product making a difference between one and the others. The least important aspect where the 3 groups of companies coincide is the environmental.

The techniques on "good practices" for the environmental aspect are 3 Life Cycle Analysis (LCA) in the design, packaging, packaging waste prevention plans and their reuse, only 13% of the group studied packaging companies and packaging manufacturers use the first technique, while the top 50% of manufacturing and packaging companies declare that they have a prevention plan, while the distribution companies only 30% have a certain plan, the latest technique such as the reuse of packaging has greater frequency of use and environmental acceptance than the first two. It is worth mentioning that the environmental aspect in food companies in Spain is not yet seen as an opportunity or strategy rather they see it as an obligation, paying more attention when designing package, and packaging not only from a commercial perspective but also environmentally and sustainably. Where not only will it bring environmental benefits but also economic benefits.

CONCLUSIONS

The food industry is constantly on the move and has included people´s current concern that of the environmental issue. You can not erase the footprint of man after many years of technological advances that has also generated benefits several have been sacrificed, but one human virtue is evolution and learning from its failures, therefore, reverse logistics is an incentive to create value and awareness for companies and society in common, like every field of study, it requires a continuous process and new ideas to acquire greater strength, where products that meet the life cycle have a second chance,

obtaining a place and acceptance within the same organization and generating new market niches.

As was seen in the bibliographic review, not only does reverse Logistics concern quantitative methods that although help to determine resources in an optimal and precise way, but also as in everything and for everything there are different paths and options to achieve a common objective, it is clear that the circumstances and characteristics of each food industry make them unique and special, although some models apply to some companies and others serve to generate new ideas and build new knowledge and theories, the decisions and strategies of logistics operations impact the food industry and these in turn to their customers and suppliers, it should be taken into account that when incorporated into the environment they must have identified elements such as the product's shelf cycle, operation life cycle, performance indicators, and the organizational policy that influences the environment (Sarkis, 2003) which will be the inclusion of these elements that will bring positive changes to organizations.

Bibliografhy

Brahim, M.A., & Romero., W.M. (2013) Reverse logistics of a massive food supply chain. Aeronautical university institute. Cordoba, Argentina recovered from: https://rdu.iua.edu.ar/handle/123456789/568

Calderón, J.H, Gómez A., & Góngora, A (2017) Methodology for the design of routes of an inverse logistics system case: Food Bank, Cali, Colombia recovered from: https://www.researchgate.net/publication/321022619_Metodologia_para_el_diseno_de_rutas_en_un_sistema_de_logistica_inversa_Caso_banco_de_alimentos

Castañeda J.L., G. (2011) Design of a Reverse Logistics model, using evolutionary algorithms. Autonomous Popular University of the State of Puebla, Mexico.

Cure V.L., & Meza G.J., & Amaya, M.R. (2006) Reverse Logistics: a tool to support the competitiveness of organizations. Engineering and Development, (20),184-202. ISSN: 0122-3461 recovered from: https://www.redalyc.org/articulo.oa?id=852/8520201

Food & Drug Administration (2019) How to Cut Food Waste and Maintain Food Safety recovered from:https://www.fda.gov/media/111704

Garcia-Arca, J. & Prado (2008) the reverse logistics of packaging in the Spanish food sector. Universia Bussiness Review. Recovered from: https://www.researchgate.net/publication/26543531_Los_envases_y_embalajes_como_fuente_de_ventajas_competitivas

Huertas, P.J.,(2014) Design of the Reverse Logistics or return process for the company Aldimark SAS, Bogotá Colombia. University EAN Bogota, Colombia https://repository.ean.edu.co/bitstream/handle/10882/5899/HuertasJavier2014.pdf?sequence=1&isAllowed=y

Manquera, G. (2012) Green and reverse logistics, corporate social and environmental university responsibility and productivity. Peruvian University Union, (1), 32-54. ISSN: 2304-0335 recovered from: https://biblat.unam.mx/es/revista/apuntes-universitarios/articulo/logistica-verde-e-inversa-responsabilidad-universitaria-socioambiental-corporativa-y-productividad

Mihi, R.A., (2007) Reverse logistics as a source of competitive advantage and its relationship with knowledge management. Rey Juan Carlos University, (1), p14. ISBN: 978-7356-500-4 recovered from: https://dialnet.unirioja.es/servlet/articulo?codigo=2516532

Monseal, B.M., & Cruz-Mejia, O. (2014) Reverse logistics of recovery and recycling of non-returnable beverage containers in the brewery industry. A profitable visit algorithm., 44 (7),577-596 ISSN: 0960-0035 recovered from: https://www.emerald.com/insight/content/doi/10.1108/IJPDLM-08-2012-0258/full/html

PROMEXICO (2016) Processed Food recovered https://www.gob.mx/promexico/acciones-y-programas/alimentos-procesados

PROMEXICO (2016) Processed Food, Sector Sheet recovered from: https://www.gob.mx/cms/uploads/attachment/file/75323/Ficha_Sectorial_09112015_Alimentos_Procesados.pdf

PROMEXICO (2016) Processed Food, sector diagnosis recovered from: https://www.gob.mx/cms/uploads/attachment/file/75326/04112015_DS_Alimentos_P.pdf

Rendon, T.A., & Morales, A.A. (2008) Economic groups in the food industry. Gruma's strategies. Argumentos, Mex., 21 (57), p 87-112 ISSN: 0187-5795 recovered from: http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0187-57952008000200005

Rogers, Dale S, & Tibben-Lembke, R.S. (1999). Going backwards: reverse logistics trends and practices. Pittsburgh; PA: Reverse Logistics Executive Council.

Rubio, S. & Jimenez-Parra, B. (2016) Reverse logistics in the cities of the future. Industrial economy,400, p 69-76 ISSN 0422-2784 recovered from: https://dialnet.unirioja.es/servlet/articulo?codigo=5687074

Santa-Cruz, G, A. (2011) Technological institute Buenos Aires, Argentina recovered from: https://ri.itba.edu.ar/handle/123456789/225

Sarkis, J. (2003). A strategic decision framework for green supply chain management. Journal of Cleaner Production. 11. 397-409. 10.1016/S0959-6526(02)00062-8. recovered from:

Sarkis, Joseph. (2003). A strategic decision framework for green supply chain management. Journal of Cleaner Production. 11. 397-409. 10.1016/S0959-6526(02)00062-8. https://www.researchgate.net/publication/230676084_A_strategic_decision_framework_for_green_supply_chain_management/citation/download

Von, B.J., (2007) The World Food Situation New Factors and Necessary Actions. International Institute of investigation on food policies, Washington, D.C recovered http://www.oda-alc.org/documentos/1312918005.pdf