Study of the sustainable transformation of environmental liabilities into the Collective Food Industry

Estudo da transformação sustentável do passivo ambiental na Indústria Alimentar Colectiva

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ABSTRACT
Goal: The research aimed at the search for alternatives to sustainability in the transformation of environmental liabilities into economic assets, managed through the A3 Report. Design / Methodology / Approach: Due to economic issues, there was significant increase in cost with materials, low availability of credit for investment, the companies saw the opportunity for adoption and implementation of the lean production system and the green production system. The A3 Report method for problem solving was applied as the basis for research. The mindset behind the A3 method is divided into five sections for solving the definition of the business requirement, current conditions; the target situation; action plans and indicators. It must be said that this adoption makes possible not only the reduction of waste and quality improvement, but also the competitive advantage and greater profitability of the invested capital. Results: The results showed with the implementations of the countermeasures have generated reduction of cost with the transportation and destination of the organic waste and began to generate revenues with the sale of recyclables making possible to the sustainability in the transformation of environmental liabilities into economic assets. Limitations of the investigation: The research only portrays the disposal of waste from the company of collective meals. Although the entire operation is in accordance with the country's environmental regulations, it was decided to replace the company name with the choice of a fictitious name, "The Collective Food Industry”. Practical implications: The world is going through a new industrial revolution and this fact makes it necessary for companies to proactively manage their resources. Originality / Value: A small step towards environmental sustainability using the lean production system method in conjunction with the green production system essential to the success of the project.
**Keywords:** Economic Sustainability, Lean Philosophy, Green Production, Food Industry, Natural Resources.

**RESUMO**

Objectivo: A investigação destinada à procura de alternativas à sustentabilidade na transformação de passivos ambientais em activos económicos, gerida através do Relatório A3. Concepção / Metodologia / Abordagem: Devido a questões económicas, houve um aumento significativo dos custos com materiais, baixa disponibilidade de crédito para investimento, as empresas viram a oportunidade para a adopção e implementação do sistema de produção enxuto e do sistema de produção verde. O método do Relatório A3 para a resolução de problemas foi aplicado como base para a investigação. A mentalidade por detrás do método A3 está dividida em cinco secções para resolver a definição do requisito empresarial, as condições actuais; a situação alvo; planos de acção e indicadores. Deve dizer-se que esta adopção torna possível não só a redução dos resíduos e a melhoria da qualidade, mas também a vantagem competitiva e uma maior rentabilidade do capital investido. Resultados: Os resultados demonstrados com as implementações das contramedidas geraram redução de custos com o transporte e destino dos resíduos orgânicos e começaram a gerar receitas com a venda de recicláveis tornando possível a sustentabilidade na transformação de passivos ambientais em activos económicos. Limitações da investigação: A investigação apenas retrata a eliminação de resíduos da empresa de refeições colectivas. Embora toda a operação esteja de acordo com a regulamentação ambiental do país, foi decidido substituir o nome da empresa pela escolha de um nome fictício, "A Indústria Alimentar Colectiva". Implicações práticas: O mundo está a atravessar uma nova revolução industrial e este facto torna necessária uma gestão proactiva dos seus recursos por parte das empresas. Originalidade / Valor: Um pequeno passo para a sustentabilidade ambiental utilizando o método do sistema de produção magro em conjunto com o sistema de produção verde, essencial para o sucesso do projecto.

**Palavras-chave:** Sustentabilidade Económica, Filosofia Lean, Produção Verde, Indústria Alimentar, Recursos Naturais.

1 INTRODUCTION

The ecosystem of the planet is the most precious patrimony of humanity, because from that we can extract all-natural resources to all and diverse ends. With the evolution of technology having grown to exponential extraction of natural resources and with this resulting in countless environmental problems, because of the inefficiency of the process, creating a lot of waste and recycling (LACERDA, 2013, p.32 apud LOMASSO et al., 2015). To Barry and Rondinelli
(1998), the world is passing through a new industrial revolution, requiring the proactivity to manage the environment and natural resources.

Due to the current global conditions and exponential growth of material, transport cost and low credit cards to invest and others, many companies adopted in their production system the lean Philosophy and green Production, because the enterprises that use these methods became more competitive and profitable (BERGMILLER; McCRIGHT, 2009 apud SANTOS; VANALLE, 2016). In this context Larson; Greenwood (2004); Wong; Wong, (2014) conclude that the lean philosophy and the green they have a very significant competitive advantage, as well as self-sustaining management in the organization.

The "collective food industry" generated 6,840 tons of waste, such as organic, tailings, grease and recyclables I (cardboard, plastic, oil and metals); more than 2,467 m³ of organic waste in the RC (corporate restaurants) and 1,672 units of recyclable wastes II (lamps and tires), which amounted an annual cost of R$ 1,237,371.98 with transportation and destination waste. Despite all the legal process, the responsible sector did not increase opportunities for improvements to reduce costs and/or even the generation of revenues from the sale of this waste.

Due to the volume of waste generated annually, there is an increasing potential for productive demand and for this reason the "Colective Food Industry" seeks alternatives for the transformation of environmental liabilities into economic assets managed through Report A3 and find sustainable solutions for organization. In view of these facts, the research has a specific objective the reduction of 10% in the costs with the residues of the fat box and the generation of R$ 40,000.00 in revenue from the sale of the recyclables I.

Using as a basis for research the A3 report method for problem solutions requires the researcher's involvement in data collection, analysis of facts, development of plans of action and implementation of improvement actions, which will be measured through indicators of performance allowing the researcher to act directly and indirectly in the management of results in search for perfection.
2 BIBLIOGRAPHIC REVIEWS

2.1 SUSTAINABLE DEVELOPMENTS

The term sustainable development was first used in the 1980s emerging from the relationship between preservation of the planet and meeting human needs (IUCN, 1980). The concept of sustainable development adopted internationally as described in the Brundtland report in 1987 composes the needs of the current generations without compromising the ability of future generations to meet their own needs (IPIRANGA et al., 2011). To Mikhailova (2004) these actions improves the man's life quality and at the same time respects the ability to build production ecosystem, that is, to (PHILIPPI, 2001) the ability to self sustain itself, self-maintain.

Campus et al., (2013) cited in Bellen (2005) points out that the concept comes from a long maturing process resulting from historical events on such topics as: The United Nations Conference on Man and the Environment held in Stockholm (1972), published in the Meadows Report; the emergence of the theme of ecodevelopment in 1973, followed by the Cocoyoc Declaration (1974); the Brundtland Commission (1987) and the Brundtland Report; the Montreal Protocol (1989); UN Conferences on the man and the environment (Eco92 or Rio / 92, Rio + 5 and Rio + 10) held in 1992, 1997 and 2002; the Kyoto Protocol in 1997; and eco-systemic evaluation in 2005. Since then, countless sustainable practices and technologies have been developed and implemented in the industry and some indicators have been adopted to measure and manage sustainability (CNI, ABIA, 2012).

The philosophy of the lean production and the green production systems.

Philosophy of the lean production system.

Following the publication of “The Machine That Changed the World” in 1990 by authors Womack, James; Jones, Daniel; Roos Daniel spreading the TPS - Toyota Production Systems translation by calling it the Lean Production model (WOMACK et. al. 1990). This model in addition to its application in various types of manufacturing processes, (Projects, Jobbing, Batches, Pasta and Continuous) could be easily implemented in service processes such as: offices - lean Office;
logistics - lean logistic; projects - lean Project and civil construction; lean construction and Health - lean Healthcare (BARBOSA; ASSUMPÇÃO, 2016).

For Ohno (1997); Azevedo et al., (2010) The focus of lean philosophy is to mitigate the cost of waste elimination by involving changes in quality management practices, operations management, and management of the production processes generated by the seven wastes: defects; overproduction; waiting; transport; movement; improper processing; stock. For Hidalgo Martins; Cleto (2016) and Lean Institute Brasil (2017) the lean philosophy aims to reduce costs, increase productivity and improve quality in order to increase the added value of the product to the customer and consequently increase profitability. According to Womack and Jones (2004); Almeida (2007) The goals of lean philosophy are classified through the five lean principles:

1-Determine the value per specific product from the end customer perspective;
2-Identify the value stream for each product;
3-Make the value flow without interruption;
4-Let the customer force the production;
5-Seek perfection.

2.2 PHILOSOPHY OF THE GREEN PRODUCTION SYSTEM

The green production system has been adopted by various industrial areas in order to comply with standards and laws (BARBOSA; ASSUMPÇÃO, 2016). Kraemer (2005) classifies industrial waste as the most unenvironmentally friendly, as it includes chemicals, metals, chemical solvents, among others, which can threaten the natural cycle of the place where it is disposed of. For this reason, wastes must be disposed of properly and no disposal in the workplace of any contaminants that may compromise the safety and health of workers (NR 25, 2011).

The pursuit of meeting the objectives guided by the principles of the green production system are fundamental for any organization to obtain the highest profit and return on invested capital (CORAL, 2002); (RABBIT et al., 2008).
Defined by Donaire, (2010) the author presents a set of objectives for green production defined by the value associated with ecological responsibility; compliance with legal requirements; the safeguarding of the company; the reputation / image; the protection of personnel; quality of life and profit guiding four principles:

Products and services: environmentally friendly and safe in their life cycle; durable, recyclable; compostable, returnable and biodegradable; produced and packaged with minimal materials and energy consumption (DONAIRE, 2010);

Processes: reduction, elimination or recycling of waste and co-products; no emission of substance harmful to human health and the environment; conserve energy and reduce material consumption; workplace environment free from chemical, ergonomic and physical threat (DONAIRE, 2010);

Workers: motivation for creativity and increased efficiency; safety and welfare; talent and capacity development; participation (DONAIRE, 2010);

Community: respect for economic, social, cultural and physical aspects (DONAIRE, 2010).

For this, the corporate sustainability model to be applied by companies has been developed, emphasized by (KOTZ; QUIZANI, 2016) are the reasons why companies are under pressure to modernize environmental management systems providing higher quality of their products, contributing to sustainable development ensuring its competitiveness and profitability presented by Figure 1.
2.3 THE RELATIONSHIP BETWEEN LEAN PHILOSOPHY AND GREEN PRODUCTION

In this context between the two approaches (lean and green) there is a reciprocal interest in waste reduction and cost reduction to increase the organization's competitiveness.

In the article entitled, "Is there synergy between lean manufacturing and environmental management? Mapping the "state of the art" the authors (FERREIRA et al., 2015) analyze the discussion between the published themes between the relations of lean and green philosophy. The authors base their research on the article entitled “Green as the New Lean: How to Use Lean Practices as a Catalyst for Greening Your Supply Chain” (DÜES et al., 2011), in
which research emphasizing lean philosophy and its correlations with green production. In this article we have pointed out what are the areas that diverge and converge between systems (lean and green), focusing on outlining a path to Florida's proposal (1996) in his published article “Lean and Green: The Move to Environmentally Conscious Manufacturing”, which describes how the converging points between lean and green philosophies can help reduce environmental impact on industrial activities (FERREIRA et al., 2015). In the analysis of this discussion (Ferreira et al., 2015) the paradigms between lean and green production system philosophy illustrated in Annex I are pointed out, what are the benefits of adopting lean philosophy practices and green production and how these practices corroborate the synergy between some components of these philosophies.

For Vasconcelos et al., (2013) the joint use of lean philosophy techniques and green production contribute in a systemic way to achieve better organizational results and intensify the understanding of the clients' needs and should be aligned with environmental management practices in mitigating the environmental impacts caused by industrial operations. Already for Gamma; Cavenaghi, (2009) Organizations need information about their performance that portrays operational reality and provides feedback that can guide actions and decisions. In this regard Porter; Linde (1995) mentions that lean philosophy comes as an example to obtain competitive cost advantage in reducing process waste and green production uses the strategy of differentiation in reducing the environmental impact caused by operations with a strong interaction with the objectives of operations in organizations. Defined by Vasconcelos et al., (2013) The adoption of lean practices influences the environmental proactivity of companies, the more widespread the lean and green philosophies, the less waste and the final costs of the production process promoting a growth in the performance of the areas in the organization.

For these reasons lean and green production systems are seen by consumers as important factors in purchasing decisions because they require companies to carry out the activities in order to ensure constant innovation and
quality improvement offered to their consumers (PORTER, 1989; EPELBAUM, 2004).

3 METHODOLOGICAL APPROACH

3.1 STUDY OBJECT

The “Collective Food Industry”, object of study for the construction of the research was founded more than half a decade ago and operates with the provision of food service in several states in Brazil.

3.2 SURVEY METHODOLOGY A3 REPORT

The A3 thinking that Toyota started in the 1960s as a problem-solving method as a format called “Quality Circles” took systematic steps to find a better way to work. As it evolved, it became the standard format for problem solving with proposals, plans, and status (SHOOK, 2010).

The A3 Report has emerged as a method by which two important work management processes have been joined: Hoshin Kanri (strategy management) Annex II and the PDCA in problem solving Annex III. For the macro enterprise level, the Hoshin Kanri method aligns organizational goals and objectives with operations and activities, while at the micro, or individual level, the PDCA method formalizes problems by generating operational learning (SOBEK, 2015).

The A3 Report is a method, which establishes a concrete framework for implementing PDCA management and helps to understand deep understanding of problems or opportunities to facilitate cohesion and internal alignment with the best course of action (SOBEK; SMALLEY, 2010). An A3 is essentially a PDCA (Plan-Do-Check-Act) process documentation which the team works on solving a problem to improve a business process. The key aspect of the A3 focuses on capturing all relevant information on one side of the paper. For Schwagerman (2013) the A3 establishes a complete plan or reports, large or small. When the story is told on a sheet of paper, anyone can understand. As one reflects on Toyota's experiences, one finds that the organization's priority is to cultivate
people's intellectual development in the thinking of the A3 mentality (SOBEK; SMALLEY, 2010). This thought is classified into seven elements:

3.3 LOGICAL REASONING PROCESS

Toyota encourages employees to think through their decision-making and problem-solving processes. A3 thinking creates built-in and consistent approaches so that members of the organization spend less time running around without leaving their seat (SOBEK; SMALLEY, 2010).

4 OBJECTIVITY

Is at the heart of the A3 thinking mentality, as solvers continually test understanding of a situation by analyzing its assumptions, biases, and misunderstandings. It tries to reconcile the various points of view, as this relationship includes multiple perspectives and is usually more objective than any single point of view (SOBEK; SMALLEY, 2010).

4.1 OUTCOME AND PROCESS

Aggressive business and operational goals are set and both individuals and teams are evaluated based on how many of these goals they can achieve. The results are not preferable to the process and the process is not taken above the results (SOBEK; SMALLEY, 2010). Both are necessary and critical for organizational improvement and team development.

4.2 SYNTHESIS, DISTILLATION AND VISUALIZATION

The most efficient way to convey information is almost always through graphical representations. Thus, A3 thinking encourages visual management to communicate the message more clearly and efficiently (SOBEK; SMALLEY, 2010).
4.3 ALIGNMENT

Alignment typically involves three-dimensional communication: horizontal (across the organization), vertical (across the hierarchy), and deep (forward and backward in time). Report history is an important role as it ensures that monitoring and evaluation will be consistent and in line with the original plan (SOBEK; SMALLEY, 2010).

4.4 INTERNAL AND EXTERNAL CONSISTENCY

Internal consistency in the problem-solving approach is of paramount importance for successful problem solving as it increases the visibility of coherence. External consistency quickens communication and assists in establishing a shared understanding (SOBEK; SMALLEY, 2010).

4.5 SYSTEMIC POINT OF VIEW

Solutions that solve a problem in one part of the organization and create another in another sector must be avoided. The point is that the problem solver must understand the context situation to be sufficiently broad and the recommendations should promote the overall good of the organization (SOBEK; SMALLEY, 2010).

4.6 APPLICATION MODEL

Comprising all seven elements of the mindset the A3 method is divided into five sections for problem solving defined business requirement, current conditions; the target situation; action plans and indicators. The following is the adapted application model of Shook (2008) and presented by Figure 2.
5 APPLIED RESEARCH

The A3 report was used as a research methodology because it is named after the improvement project to be executed on an A3 sheet of paper (measures equivalent to 29.7cm x 42cm) and was developed by Toyota Motors in Japan to perform different applications in order to be used freely with great powers and effectiveness. Toyota uses the tool as a systematic guide to problem solving through a rigorous process, documenting key issues with proposed process improvements (SOBEK; JIMMERSON, 2015).

According to Ferro (2009) it is a process which identifies, addresses and acts on the problems and challenges encountered at all levels, making it the key to the entire problem-solving development system. In agreement Sobek; Smalley (2010) states that the report facilitates the organization's cohesion and internal alignment with the best course of action, i.e., a flexible tool that can be adapted to most problem-solving situations.

For both Shook (2009) and Sobek; Smalley (2010) and Ferro (2009) the mentality behind the A3 methodology is divided into five sections: The title, business requirements, current situation analysis, target situation analysis, planning and indicators.
5.1 TITLE

Sobek and Smalley (2010) The report begins with the theme or title that should be very descriptive and focuses on the problem to be presented to the public aiming at the problem to be discussed in the report. The theme “Sustainability in the transformation of environmental liabilities into economic assets in the “Collective Food Industry” managed through Report A3” arose from the analysis of the problem due to the high cost of transporting and disposing of 6,840 tons of waste generated in 2016 by company.

5.2 BUSINESS REQUIREMENTS

This part is essential to understanding the importance and extent of the problem, i.e., answering the question “Why is the problem important to the goals of the organization”? SOBEK; SMALLEY (2010). The business requirements arose from the analysis of the survey studies conducted in the survey, which is aligned with the focus on transforming liabilities into economic assets by reducing the cost of transporting and disposing of waste from the fat box and generating revenue from the sale of recyclables I.

5.3 ANALYSIS OF THE CURRENT SITUATION

Current conditions are always derived from facts pointed out in Gemba and visually detailed through drawings, maps, and graphs, among others (SOBEK AND SMALLEY, 2010). At first it was necessary to search for information from the responsible department, but as the data was stored in folders inside drawers, this information was not sent when requested. However, the information arrived after a few days of waiting. As there was a certain urgency of information, this need was transformed into an opportunity for improvement. At this time a spreadsheet was created to record all types of waste, quantities and values generated by each business unit of the company to make the visual management safe and fast.
5.4 TARGET SITUATION ANALYSIS

This phase clearly describes the expected result in the project, always detailing the specific objectives, such as quality, deliverables, cost and others. Analyze and report on the situation and causes that created “the space” between what you have today and what you hope to achieve. Show the relationship of the cause and the effect that generated the problem. Define which corrective actions should be implemented to achieve the desired goal. According to Ferro, (2009) you must answer the following questions: “What is your proposal to achieve the future situation, the target condition? Or how do your recommended countermeasures affect the root cause to reach the goal?” (SOBEK AND SMALLEY, 2010). After analyzing the records of information in control software, which was visually obtained information of all types of waste, quantity and annual cost spent on disposal and transportation. The goal of sustainability in the transformation of environmental liabilities into economic assets in 2017 and managed through Report A3 was determined. The search for these results will be accomplished by the specific objectives of reducing the fat box cost by 10% and generating revenues of R$ 40,000.00 from sales of recyclable waste. Implementations make business units more profitable.

5.5 PLANNING

This step details the action plan clearly and in addition to indicating who is responsible for and the date of completion of the counter measures and shows which activities will be required for the implementations and which will be the performance indicators (SOBEK; SMALLEY, 2010). With the countermeasure implementations, some actions were taken. Such as: The feasibility to exchange point collection waste suppliers for recyclables I; the cost reduction with the fat box due to process improvements such as the review of the collection method, the application of cubes with bacteria in the fat box to reduce the fat volume; reforms in the sanitation sector such as the expansion of the waste sink and the construction of a closed circuit for waste disposal, training with school attendants on the correct way of waste disposal, negotiation of the price paid with
transportation destination and others. In this way, it executed the actions within the established deadline using the performance indicators for cost versus benefit monitoring and the indicators for cost reduction of the fat box and others for the sale of recyclables I.

5.6 PERFORMANCE INDICATORS

The focus is to anticipate problems that may arise and to share with others at the company what was learned in the SOBEK AND SMALLEY process (2010). At this stage, four performance indicators were developed to monitor and assist the management of the A3 Report, two indicators to track the cost and benefit with the implementation of improvements in the fat box and sale of recyclables I and two other indicators to track the financial performance against the project target, both illustrating the visual management of the results helping control and decision making.

6 DATA ANALYSIS

6.1 THE TITLE

The title of the sustainable project arose with the objective and the need to transform environmental liabilities into economic assets in view of the growing demand for the provision of collective food service.

6.2 BUSINESS REQUIREMENTS

Sustainability in transforming environmental liabilities into economic assets.

- 10% reduction in fat box waste costs;
- Generation of R$40,000.00 in revenue from the sale of recyclables I.

6.3 ANALYZES OF THE CURRENT SITUATION

Of the 6,840 tons generated in the company between organic waste, tailings, fat box and recyclables I, which together had an annual transportation and destination cost of R$ 1,237,371.98. The project focused on 18% of this
amount and 17% with (1,149) pounds were waste generated in the fat box at a cost of R$ 305,071.33 per year and 1% with (102,000) pounds recyclable waste I, at a cost (R $ 703.97) year. The cost of destination and transportation is illustrated by Graph 1 fat box end Graph 2 recyclable waste I, totaling R$ 305,775.30 in the year.

Graph 1 - Yearly cost of recyclable fat box

Source: The author
7 TARGET SITUATION

7.1 BOX FIT

For it was necessary to monitor and analyze the process to apply improvements in the collection method. The object is to obtain 10% savings by reducing the transportation cost and disposal of the fat box waste. According to Graph 3, it follows the target established for the cost reduction for the transportation and disposal of this waste.

7.2 RECYCLABLE WASTE I

In order to generate revenue from the sale of recyclable waste I, it was necessary to replace new service providers (collectors) with new ones to enable the sale of the material. This allowed the definition of the target to measure the evolution of the sale of recyclables I, which is presented by Graph 4.
In order to generate revenue from the sale of recyclable waste I, it was necessary to replace new service providers (collectors) with new ones to enable the sale of the material. This allowed the definition of the target to measure the evolution of the sale of recyclables I, which is presented by Graph 4.

Graph 4 - Mended for generating revenue from recyclable waste I

Source: The author

7.3 PLANS OF ACTION

The action plans were developed from the analysis of the information collected in the process in the previous phases (current situation and target situation). In the course of the research, in the initial phase of data collection, opportunities for process improvements were observed, in which the proposed action to solve problems with changes in the fat box collection method, switching of recyclable suppliers I and among other applications in the re-adaptation of the sanitation sector process and training with school attendants on how to properly dispose of waste. The actions focused on achieving sustainability goals by transforming environmental liabilities into economic assets. Follows Table 1 of actions implemented in the process.
### Table 1 – Action plan – 5W2H

| Date of creation of the plan: | 01/04/2017 | Resp | A | Objective: | Sustainability in the transformation of environmental liabilities into economic assets | Goal | 10% Reduction of cost with the Cr of Fat and R$ 50,000 Revenue Recyclables I. |
|--------------------------------|------------|-----|---|------------|---------------------------------|------|--------------------------------------------------|
| Plan review date:             | 12/12/2017 |     |   | Indicator: | Costs x Benefits                  |      |                                                   |

| What?                                      | How?                                                                 | When? | Where?                           | Why?                                                                 | How much? | Planned | Realized | Status |
|--------------------------------------------|-----------------------------------------------------------------------|-------|----------------------------------|----------------------------------------------------------------------|------------|---------|----------|--------|
| Start of operations with the new substitute supplier of recyclable waste II | Start with the delivery of the drums (gallons) for the storage of the used oil | D     | 02/01/2017 30/01/2017 | Araucaria Plant and RC’s | Containers used for storage of the used oil in the units and later to be collected. | R$ -       | 100%    | 100%     | ✓      |
| Fat Box Cost Reduction                    | Follow the process and analyze fat box collection data                | A/B/C | 06/06/2017 08/07/2017 | CX Fat Araucaria Plant | Pilot test with water drainage at the Araucaria Plant Treatment | R$ -       | 100%    | 100%     | ✓      |
| Facilities and start-up with the new substitute supplier of recyclable waste | Installation of equipment (Presses, buckets and containers) landing to carry out activities | A/B/C | 11/09/2017 15/09/2017 | Waste Center | Waste Center Equipment must be available to start operations | R$ -       | 100%    | 100%     | ✓      |
| Bacterial Cubes Test                      | Application of the product in the fat box                             | C     | 01/09/2017 31/11/2017 | Araucaria Plant | Plant The application proliferates the amount of bacteria in the fat box. These bacteria feed on fat, reducing the volume of the waste. | R$ 1.000 | 100%    | 50%      | ✓      |
| Disposal of organic waste                 | Readjustment of the hotbox cleaning process                           | A     | 15/01/2018 30/01/2018 | hygiene sector | Adjust the process with closed circuit for the disposal of the organic, ergonomic suitability. | R$ 10.001 | 100%    | 100%     | ✓      |
| School solid waste treatment Training     | Training                                                              | C     | 01/02/2018 15/02/2018 | Central plant | Adequacy of the sanitation flow in the process of separation of organic waste, recyclable, and tailings | R$ -       | 100%    | 0%       | ✓      |
8 PERFORMANCE INDICATORS

8.1 THE FAT BOX

The total costs with the fat box in 2016 was R$ 305,071.00, thus generating proposals for improvements in the environmental management method to reduce 10% in the cost of disposal and transportation of waste. The annual costs presented with improvements in the collection method were R$ 257,305.00, ie a reduction of R$ 47,766.00, with 16% savings in annual costs, solely due to the reduction in volume. Other benefits were added through transportation and disposal, as some actions implemented enabled cost reductions in the hiring of a smaller number of trucks for waste collection and the water, which was destined for the landfill, was treated internally. According to Graph 5, the actions implemented added up to economic benefits of R$ 78,538.00 for the year.

Graph 4 – Cost-benefit Box of Fat

Source: The author

8.2 RECYCLABLE WASTE I (CARDBOARD, PLASTIC, METALS AND OIL)

One of the implemented and fundamental actions for the success of the project was the replacement of the collection suppliers, as a better negotiation with the sale of recyclables was obtained. For these reasons the project goal initially set at R$ 40,000 was exceeded by 10%. As illustrated by Graph 6, the
negotiation with the sale of recyclable waste (garbage) with the new collecting suppliers generated revenues of R$ 44,385.00 for the year and eliminating the costs generated.

Graph 6 - cost-effective - Recyclable wastes I

Source: The author

With the closure of the research data analysis of item 4.0 it is necessary to present the five-step application model of the five steps of report A3 (business requirements, current situation analysis, target situation analysis, planning and indicators) represented by Annex IV.

9 FINAL CONSIDERATIONS

The “Collective Food Industry” generated a cost / year of R$ 1.2 million with transportation and disposal of waste. Despite all the legal procedures, the environment sector did not enhance the opportunities for improvements with cost reduction of organic waste or the generation of revenues from the sale of recyclable waste. For these reasons the opportunity arose to enhance the problem through a sustainable goal in transforming these environmental liabilities into economic assets by reducing the cost of transporting and disposing of waste from the fat box and the sale of recyclable waste I.

Through the analysis of the collected data and observations made in the research, countermeasure actions can be developed and implemented. In In
2016, the “Food Industry” generated a cost/year of R$ 1.2 million with transportation and disposal of waste. Through the approach applied by the A3 method, one can analyze the current situation of the object of the research, to identify opportunities for improvement. It was observed that 18% of the waste generated was concentrated in the fat box and 1% in recyclable waste I. The analysis of the current situation made it possible to identify the causes and effects of these operations and allowed the construction of value for a desired scenario, ie, the target situation, with objectives and targets. For these reasons, the research opportunity arose to find sustainable solutions in the transformation of these environmental liabilities into economic assets, with a 10% reduction in the costs of transporting and disposing of waste from the fat box and generating revenue of R $ 40,000 from the sale of recyclables. I.

In order to reduce the fat box cost by 10%, improvements were made, and improvements were made to the internal waste collection method for both transport and destination. All the water concentrated in the fat box was collected and sent with the waste. In the research, this water started to be drained in the effluent treatment station and only the waste started to be transported and destined to the disposal site. In this way, it enabled the reduction of two costs, one paid for the quantity of trucks used in the collection and the other in the cost per ton destined to the landfill. This improvement in the collection method generated savings of R$ 47,766.00 in the cost of the fat box in the year, that is, 16% less than in 2016. In addition, a renegotiation in the amounts paid for both transport and destination presented plus a new savings of over R$30,772.00 per year. The totalities of these applied actions totaled R$ 78,538 in savings in the year, that is, when compared to the cost generated in 2016 of R $ 305,071.00, a reduction of 25% was obtained in the year.

Another significant result is in the generation of revenue from sales of recyclable waste I. With the substitutions of suppliers (waste collectors), it allowed the opening of new negotiations on the amounts to be received for each type of waste and the average results presented with the generation of revenues from
the sale of recyclable waste I was R$ 44,385.00 accumulated over the long year of 2017.

With the favorable trend in the implementation of improvements in environmental waste management, the project made the goal sustainable in transforming the environmental liability into an economic asset applied by the A3 method, presenting with the cost reduction with the collection of the fat box by 26% (R$ 78,538.00) and the sale of recyclables (R $ 44,385.00) totaling savings in 2017 of R$ 122,896.00 for the company.

I emphasize that this small step taken towards environmental sustainability used the lean philosophy production system method in conjunction with the green production system, does not even represent 1% of the company's revenue, but that this small step, added to others, represents a set of better results.
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ANNEX I - PARADIGMS LEAN PHILOSOPHY AND THE PRODUCTION SYSTEMS (GREEN)

Figure 3: Paradigms lean philosophy and the production systems (green)

Focus: Reducing cost and flexibility

Consumer: Driving by cost, satisfaction by cost, cost and delivery time

Practice: increasing refueling frequency

Manufacturing: JIT high manufacturing average

Residue: 7 waste

Product design: Maximize performance and minimize cost

End of life: without concern for impact

Practice: increasing refueling frequency

Production: Lean value and process flow mapping

Dominant cost: physical cost

✓ Focus: Reduction of waste, technique of reduction of waste, reduction in delivery time, relationship in the supply chain.

✓ Indicator: Service level, tool / practice.

Focus: sustainable development and ecological impact.

Consumer: driven by awareness and satisfaction by helping the environment.

Manufacture: remanufacturing capacity.

Waste: inefficient use of resources, without scrap and emissions as outputs.

End of life: consider the impact of the use of the product and recover the end of life in the form of reuse and recycling.

Green Production

Product design: life cycle assessment

Dominant cost: cost of future generations.

Main practice: life cycle assessment

Practices: reduce refueling frequency

Source: Adapted Dües (2011)
ANNEX II - HOSHIN KANRI

The Japanese symbolism hidden behind these two words: Ho - direction, shin - needle, Kan - control, ri-logic / reason. Despite a simple meaning, few organizations have their true north (LOPEZ, 2016).

Hoshin, with widespread clear definition known throughout the organization, serves as a guide for each of the company's strategic actions. According to Witicher (1999); Tennant; Roberts (2001) Hoshin Kanri (HK) is a four-pillar strategic management tool: (1) providing a focus on organizational direction with an annual focus on vital priorities; (2) align strategies with local plans and programs; (3) integrate these with daily management; and (4) provide a framework for systematic review of business progress. For Lopez (2016) these four pillars are fundamental to ensure the success of the strategy deployment process, and they guarantee the solidity of the Hoshin house as illustrated by Figure 4.

Figure 4: The structure of the house Hoshin Kanri

Source: Adapted Lopez (2016)
ANNEX III - PDCA CYCLE

The plan-do-see cycle developed by (Shewhart, 1939) in his work entitled Statistical Method from the Viewpoint of Quality Control proposes that the production model viewed with one system should be applied cyclically. According to Moen and Norman (2009), a few years later, the Shewhart cycle is taken to Japan and is broadcast by Deming as a plan-do-check-action (PDCA). In 1950 the PDCA methodology was adopted by the Japanese, following the presentation at the seminar of the “Union of Japanese Scientist and Engineers (JUSE)”. For Gomes (2006) the PDCA cycle prevails from a sequence of fact-based, logical, data procedures, which aims to locate the root causes of a problem and then eliminate them. In this cycle, quality tools will act as tools for collecting, processing and disposing of information, enabling reliable decision making. According to Carpenetti (2012), the method involves four steps, as shown in Figure 5.

Figure 5: Deming Wheel-1950

1. Prepare a plan;
2. Implement the plan;
3. Evaluate the results;
4. Take action based on step breakthroughs.

Source: Adapted Hosotani (1992) apud Oribe (2008)

The potential of using the PDCA cycle is fully realized in the systematic approach to A3 thinking. At a broad level, effective use of A3 ensures that the PDCA process Figure 6 empowers and captures operational learning, as the framework enables a way to generate productive dialogue by converting multiple
broad and abstract management goals into real results while simultaneously being an organizational competency deep (SOBEK, 2015).

Figure 6: PDCA Cycle

| PDCA | FLOW | STAGE               | OBJECTIVE                                           |
|------|------|---------------------|-----------------------------------------------------|
| P    | 1    | Identification of the problem | Clearly define the problem, and recognize its importance |
|      | 2    | Observation          | To investigate specific characteristics of the problem with systemic vision |
|      | 3    | Analyse              | Discover the root causes                           |
|      | 4    | Action Plan          | Designing a plan to block root causes               |
| D    | 5    | Action               | Block the root causes                               |
| C    | 6    | Verification         | Verify that the lock was effective                  |
|      | 7    | (Blocking was effective?) |
| A    | 7    | Standardization      | Preventing recurrence of the problem                |
|      | 8    | Conclusion           | Recap the whole process of solving the problem for future work |

Source: Adapted Campos, (1996)
ANNEX IV - REPORT A3

**Company:** Collective Industry Food

**Author:** Gleison Hidalgo Martins, Kleiton de Paula Silva, Caro Domêncio Tito, Roberto Pacheco Jr.

**Title:** A3 Case - Sustainability in the transformation of environmental liabilities into economic assets in the "Collective Food Industry" in Brazil

*Case published in Journal of Lean Systems V3 p.156-136 (2011)*

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**Problem / Root Causes:**

Lack of opportunity for the transformation of environmental liabilities into economic assets with a focus on cost-reduction and revenue generation.

**Current Situation Analysis:**

The project focused on 18% of the 6,140 tons generated in 2016. The cost with destination and transportation as illustrated in Chart 1, added a year cost of R$ 395,775.30.

![Graph 1](image1)

**Result and Conclusions:**

The project presented savings of R$ 122,923.00, of which R$ 78,530 was the cost reduction in the fat box by Graph 2 and R$ 44,393.00 with the generation of revenue from the sale of recyclable waste presented by the Graphic 3.

![Graph 2](image2)

![Graph 3](image3)