

# Case Study: Possibility of Application of Cradle to Cradle C2C Theory for the Textile Context of Santa Catarina

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**Abstract:** This research presents possibilities for insertion of sustainable practices in the textile production process, from a systemic and sustainable approach in design. It was investigated the possibility of proposing the main concept of the Cradle to Cradle theory — Eco-effectiveness — in the context of the textile or clothing industries in Santa Catarina. The survey of existing literatures built the theoretical foundation, with emphasis on the authors William McDonough and the chemist Michael Braungart.

The research was set up as a Case Study. Data collection was done with semi-structured open-ended interviews, applied to six stakeholders of a medium-sized industry from northern Santa Catarina and using direct, spontaneous and systematic observation. The analysis strategy presents the results in a systematic way, in agreement with the research objectives. The aim is to disseminate information on sustainability practices applicable in the textile and clothing sector, which allow specific bases for the construction of new design projects

**Key words:** textile industry, sustainability, sustainable textile design

## 1. Introduction

The premise that it is possible to apply a sustainable and systemic approach to design in the textile industry, guided this research. We sought a design theory to achieve sustainability from the design point of view, considering the social and economic importance that the textile sector offers in the context of Santa Catarina.

The greatest emphasis is on field research and the construction of an effective method for it, which would bring to the surface data and information that are difficult to access in the academic arena. This is a design perspective that can be proposed in a specific context, northern Santa Catarina. It is necessary to have an accurate understanding of the nature of this research,

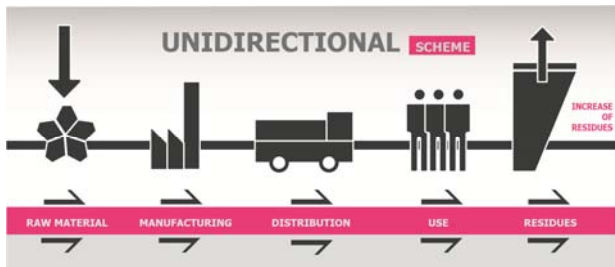
in order to understand its original value. In a Case Study, it is understood that the information collected in the field is as important as the theoretical information.

Designer and architect William McDonough and chemist Michael Braungart have created the Cradle to Cradle theory [1], which means “cradle to cradle”, where the first principle concerns WASTE = FOOD, residue is equal to food. Cradle to Cradle is a sustainable and systemic approach to design that started with the IE Green Industry studies [2], and is in line with sustainability seen from the Triple Bottom Line, a concept formulated by the British John Elkington [3], who considers sustainability in the aspect social, economic and environmental.

The name Cradle to Cradle makes a direct reference to the Cradle to Grave, the linear idea of birth and death, which indicates a modern manufacturing model, typical of the design premises of the Industrial Revolution (Fig. 1).

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**Fig. 1 Typical linear production of the Industrial Revolution.**

Cradle to Cradle [4] visualizes sustainability through a design concept that can subvert the prevailing logic. They introduce the concept of Eco-effectiveness, solution of the problem through a design prism, as opposed to the predominant thinking Eco-efficiency, vision of the problem through production management or production engineering.

The term Eco-efficiency was officially used by the World Business Council for Sustainable Development through a report called the Changing Course, launched simultaneously with the ECO92 Summit and signed by 48 industrial sponsors. It was found that industries have been able to reduce pollutant emissions, rationalize energy use and realize considerable financial savings. From this period, the eco-efficiency motto: the 03 Rs - reduce, reuse and recycle became widely known. According to Fig. 2, through Eco-efficiency, the residue can be recycled and become feedstock again (Fig. 2).

Over time, new companies adopted this strand and there were regulations in the form of audits, certifications, among other practices that ensured the difference of a “sustainable” company from a “non-sustainable” company. The main characteristics



**Fig. 2 Circular scheme proposed by ecoefficiency.**

of Eco-efficiency are: reduction, reuse; recycling; and regulation.

McDonough and Braungart, as well as Niinimäki and Hassi [5], criticize Eco-efficiency precepts. With regard to Reduce, they argue that it does not stop the exhaustion and destruction, but slows down. On reuse, they state that waste is transferred from place to place, often leading to toxins and contaminants. About regulation, they remember that they improve, but they do not get to the root of the problem of finding out what caused the pollution.

The most severe criticism of all concerns recycling, as it is a process that reduces the quality of a material over time, and which transform it into a hybrid that can increase contamination. To this type of recycling, which does not predict how it will happen is given the name of Downcycled. In addition to this term, the authors coined the concept of Upcycling, which means just the opposite, distinguishing the materials and their properties individually.

The systemic and sustainable design approach proposed by McDonough and Braungart intends to design a product or system considering the whole: "What are its goals and their potential effects, both immediate and future, with respect to time and place? What is the complete system — cultural, commercial, ecological — of what is done and what is done?"

The authors clarify that Eco-effectiveness does not eliminate Eco-efficiency, but sees it as a means of arriving at the concept of the project nature proposed by both. The difficulties are many because almost all industrial processes have side effects, so they guide following the complexity and intelligence of nature's activity, inspired by it to project some “positive side effects”. The beginning of the theory, considers the global planning that we are part of, as follows:

- The two main elements are Sun and Earth, or energy and mass. The sun is the main element for generating energy.
- There are two distinct metabolisms on the planet: the biological metabolism or biosphere

(cycles of nature) and the technical metabolism or technosphere (industry cycles).

- The products may consist of biodegradable materials, which become food for the biological cycles; and by technical materials, which remain in closed circuit technical cycles, circulating valuable nutrients to the industry.
- The vitality of ecosystems depends on relationships, uses and exchanges of energy and materials in a given place.
- All sustainability is local, understanding of material and energy flows, customs and local needs.
- Respect for diversity in the project, which means not only taking into account how it is done, but how it will be used and by whom.

## 2. Material and Methods

This research was delineated through a single case study, according to Gil [6] “The single case studies refer to an individual, a group, an organization, a phenomenon, etc. They are the most traditional mode of case study, although it is not the most frequent one today”.

The choice for a single case was for the following reasons:

- Exploratory case — coming from an exploratory research. It is intended to obtain basic information to generate a more in-depth study.
- Decisive case — seeks to confirm or contest a theory [7].
- A revealing case — the opportunity for the researcher to study a phenomenon inaccessible to other researchers.

For the Case Study, it was necessary to delimit the research, location, event and processes to be observed. To choose the sources of investigation from which it was intended to extract the data collection. The same was done with semistructured open-ended interviews, applied to six participants of a medium-sized industry

in the north of the state of Santa Catarina and using direct observation, applying spontaneous observation and systematic observation, elaborated in conjunction with protocol interview research, constructed through two concepts explained by Braumgart and McDonought:

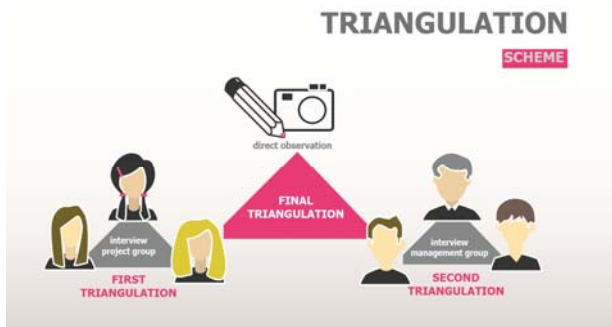
- The concept of Eco-efficiency: represents a management approach to sustainability, well studied in the traditional lines of research in the area.
- The concept of Eco-effectiveness: represents a sustainability approach derived from design, where the design role is present in its perspective.

In an industrial production, there are three main stages: pre-production (design and purchasing), production (manufacturing) and post-production (marketing and distribution). As the research is about the point of view of the design stage and the reflex in the production, it will cover the first two stages, having as interviewed:

- Three contributors, who are responsible for projects, including a designer;
- Three contributors, who are responsible for the management, including a production manager.

The selection of the interviewees established as a criterion the choice of people considered key informants, typical people in the organization who had functions established in other industries of the sector. Moreira and Caleffe [8] call it an intentional sample, when the researcher selects people who will contribute to the research, offering greater depth than the choice for a probabilistic sample.

The analysis strategy of this research is the triangulation of the different information collected: triangulation of the interviews between three participants of the project group, triangulation of the interviews between the participants of the management group; and triangulation between the results of the interviews of both groups with direct observation (Fig. 3).



**Fig. 3** Triangulation of the case study.

Approximately 250 pages of transcription and 500 documentary photographs were recorded. Although the research is deepened in one case, it brings hard-to-reach information to people who work or research design for sustainability in the textile and apparel sector. It allows the understanding of the current state of the Sector, in the northern region of Santa Catarina.

### 3. Results and Discussion

#### 3.1 Contextualization

The case study company was founded in 1993 by two brothers, providing the faction service, outsourced sewing of parts for textile industries. In the course of its development it has become a small confection, until it is recognized as an industry average, emerging and solid, in the present day. The family profile remains until now, with both partners remaining on the board of directors, each of whom has an heir working together, so that the succession can happen smoothly. The founding members are divided into the main management functions. One of them works with finances and accompanies the purchasing sector, the other manages sales and monitors the productive sector. While keeping the traits familiar, has acquired a professional management in recent years.

Currently company A is composed of four brands:

- Brand 01, which is the original brand, of the same name of the company. Aimed at the children's audience, offering products with lower added value.

- The 02 brand, which is exclusively aimed at the adult, male and female public.
- The 03 brand, intended exclusively for the female public, of large sizes, denominated in the fashion market as plus size.
- The 04 brand that also serves the children's audience, but is considered by all respondents as the group's most elite brand.

Brand 01 started the industry in question. With the opening of the Brazilian market, and consequent changes in consumption patterns, company A has launched another 03 brands over the years. The interviewees explained that the partition contributed to the participation of the industry in different markets. On the other hand, they demonstrate the difficulties with market and productive divisions within the same industry.

The current industrial plant was built in 1999 and has approximately twenty thousand square meters. With the construction of the first shed, the industry formed several production cells and started to count on all the productive sectors of a manufacturing industry, such as: Creation, Modeling and Engineering (product development); Cutting, Printing, Embroidery, Finishing, Sewing, Inspection, Ironing and Folding (production).

Currently there are 308 employees. During the interviews, it was discovered that the partners have a second small industry, designed to perform the weaving service to meet the needs of the parent company. The weaving has an average of 20 employees and is physically separated from its matrix, also has an individualized management, carried out professionally by a direct heir of the family.

The chosen industry has a similar profile of the other medium-sized textile and clothing industries in northern Catarinense (Fig. 4).

#### 3.2 Results on Ecoefficiency in the Researched Industry

Eco-efficiency was worked out methodologically to contemplate the reduction, reuse, recycling and regulation items.



Fig. 4 Synthesis of company history.

- The reduction has a positive result in general scope, but the toxic waste item allows for the expansion of practices within company A since it presents a partial result.
- The reuse was positive. It is found that company A works on reuse effectively.
- The recycling happens in partial levels, allowing its extension through practices.
- The regulation happens in partial levels. Although it is quite widespread, it has concrete possibilities of elevation.

The questions addressed in the Case Study, which involve Eco-efficiency are:

- If there are sustainable practices at the management level — Eco-efficiency.
- What sustainability precept is applied through Eco-efficiency.

Through the field research, it is concluded that there are sustainable management practices — Eco-efficiency — in the company. Of four precepts, two respond positively, being they the reduction and the reutilization. Recycling and regulation are carried out in part. The analysis of the discourses allows us to understand that the organization studied has great financial control and focuses its market strategy on prices, so the reduction and reuse are favored with this positioning.

It is concluded that there are no sustainable practices related to eco-efficiency in the industry studied.

Table 1 Overall analysis of Eco-efficiency results.

General Analysis of Eco-Efficiency Results			
Ecoefficiency	Toxic waste reduction	Partial	Yes
	Reduction of raw material and dematerialization	Yes	
	Reduction of energy and incineration	Yes	
	Reuse		Yes
	Recycling		Partial
	Regulation		Partial
Analysis	<p><b>Sustainability happens from the point of view of Eco-efficiency in the industry studied.</b>                      Reduction takes place in the industry studied in different practices.  <b>The reduction happens widely.</b>                      Recycling takes place at preparatory levels, but is not effective.  <b>The regulation happens partially, with possibility of expansion.</b></p>		

Table 2 Overall analysis of Eco-effectiveness results.

Eco effectiveness	Energy sources	Not
	Biological metabolism and technical metabolism	Not
	Composition of materials — biodegradable and technical	Not
	Relations, uses and exchanges of energy and materials	Partial
	All sustainability is local	Partial
	Project Diversity	Not
Analysis	<p><b>Sustainability does not happen from the point of view of Eco-effectiveness in the industry studied.</b>                      Do not use energy sources from the sun or wind.  <b>Biological and technical metabolism are not considered.</b>                      The compositions of the materials are not worked in practice.  <b>The relations of uses and exchanges happen in part.</b>                      Sustainability is practiced locally and some actions.  <b>There is not understanding of project diversity.</b></p>	

Of six precepts, four presented negative results and two presented partial results. The two partial results concern the relations of uses and exchanges of energy and materials, and all sustainability is local.

In the process of the interview, it is noticeable the great data collection regarding Ecoefficiency, and the small amount on issues that permeated Eco effectiveness. Short answers, such as “I do not know” or “no, we do not have” were very present when we talked about sustainability from the design level. The logical explanation is that there is nothing to record when it has not been configured, or implemented.

It is important to emphasize that the company represents in a reliable way the profile of medium-sized companies in the north of the state of Santa Catarina, which could be the starting point for the projection. This research offers data surveys and mainly detects the points to be worked out so that the precepts of C2C can materialize. Follows some guiding project propositions:

**About solar energy being the main source of energy:**

There is the possibility of implementing solar panels in some sectors of the company, as well as in similar manufacturing industries. The new plant can be partially designed so that the cost is not high.

**On the biological metabolism or biosphere (cycles of nature) and the technical metabolism or technosphere (the cycles of industry)**

The company can develop tissues that meet the biological metabolism and the technical metabolism, because they own the own weaving, responsible for the main raw material of the confection. In this case, they would solve another important Eco-efficiency issue, recycling, which does not happen in textile products due to their hybrid compositions.

**Products made from biodegradable materials or from technical materials.**

It should be taken into account that the products made need the use of supplies and inputs of the same composition of the fabric, to accompany the main raw

material. In this case, more information is needed from suppliers and requests for developments that take a new approach into account.

**The vitality of ecosystems depends on relationships, uses and exchanges of energy and materials in a given place.**

The company has concrete partners according to the data collection presented. A physical organization is needed that places independent industries close to one another. As well as eliminate divisions within the company itself. It is necessary to check the workflows and redraw it so that there is more internal information exchange.

**All sustainability is local, understanding of material and energy flows, customs and local needs.**

The union of the industries to generate local improvements, dissemination of information and strengthening of the region as an industrial ecosystem, generating force to the design for the sustainability. The company has as its favor, its location in a city of the interior, with several industries developed. Another point to be raised is the excellent interpersonal relationship of the owner. The scenario also allows creating a regional brand of union and support for sustainable design practices in the local textile industry.

**Respect for diversity in the project, which means not only taking into account how it is done, but how it will be used and by whom.**

A change in the way the product development department works is a must. You can start with the highest value-added brand, to be worked through brand identity and lifestyle, and no longer with trends. The project team should approach the end users of the products and capture their needs without intermediaries.

For the realization of C2C at the design level, the following suggestions for future studies are pointed out:

- Carry out a case study with the industries appointed as partners of the company;

- Conduct research with suppliers;
- Conduct research with environmental companies;
- Run C2C project correlating all involved.

#### 4. Conclusion

The development process of this article brings hard-to-reach information to people who work or research design for sustainability in the textile sector. Although the research is deepened in one case, it is possible to understand the manufacturing situation in the northern region of Santa Catarina. We have come to a concrete experience, with reliable results that can offer the effectiveness of this study at the design level.

The research shows that there is a wide field of study for the proposed theme, that it is a global problem that can be worked locally. It is believed that this study will bridge the gap between industry and academic research. It was perceived receptivity of the industry studied and a high degree of commitment to the people, showing that generalizations about the disinterest of industrialists or entrepreneurs with the theme, is something to be rethought. The difficulty of the industry demands that prejudices be put aside and that we start working with design for sustainability together with all stakeholders.

We need to redesign industry, redesign consumer relations and redesign practices. We can use the interdisciplinary essence of design to dialogue with other areas of knowledge. The break with the fractionation of work can make us more complete. The largest paradigm to be broken in the region is the relationship between companies, which should see themselves no longer as direct competitors, but as regional partners.

Cradle to Cradle is a theory focused on design, presents a systemic and sustainable approach to design, that is, based on design and not just on production. The design emerged with the industrial revolution, contributed to the modern structure of production is configured, on the other hand, was born an area of knowledge able to solve various problems through the project and methodological activity, which innovates introducing concepts and merging several areas of knowledge. Today the design focuses on different issues and presents solutions of the most diverse, in different media, supports and markets. On the one hand, design has contributed to modern industrial activity, but it can use all design capacity to deal with complex variables and propose solutions to real problems of our times.

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