"Using the method adapted TRIZ as a tool to support the implementation of Cleaner Production"

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FIERGS SENAI

Centro Nacional de Tecnologias Limpas SENAI – CNTL

UNIDO

UNEP

- Established in 1995. CNTL was the tenth NCPC implanted in the world and the first in Latin America.

- 42 NCPCs established all over the world

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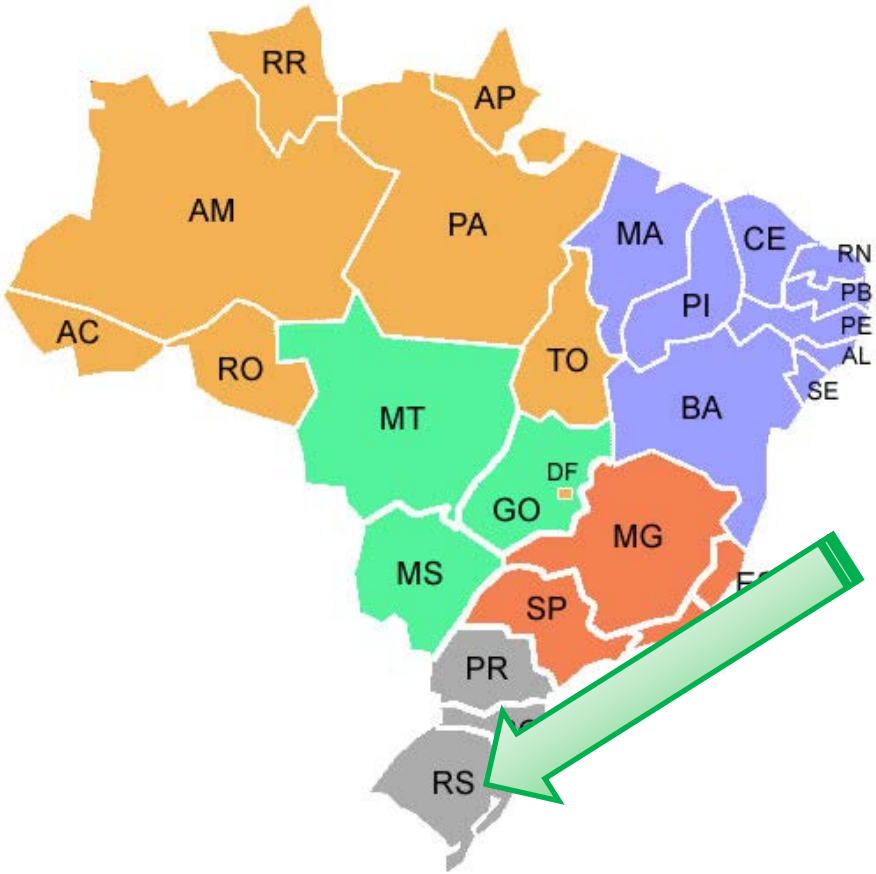

- FIERGS - Agency of industries of RS
- SENAI - Professional Education and Technological Services
- CNTL - Environmental issues and CP

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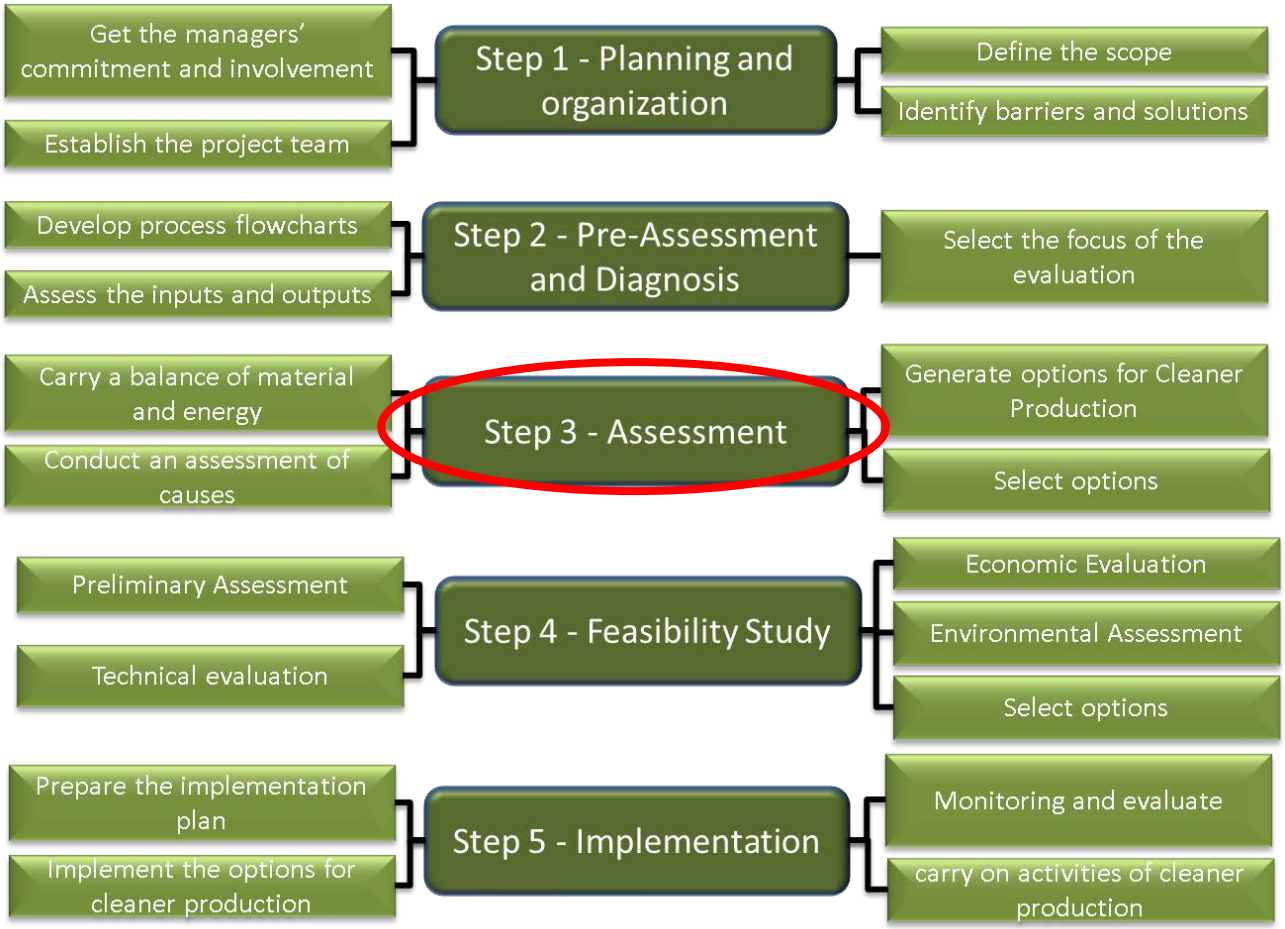
Environmental Solutions offered to Companies

- Cleaner Production implementation / methodology
- Industrial Solid Waste Management
- Environmental Passives
- IMS 9001/14001/18001, ISO 14001,
- OHSAS18001
- Environmental Diagnosis
- Environmental Audits
- Materials Conformity Audits
- Legal Compliance Audits
- Ecodesign
- Technology evaluation
- Projects for Effluents Treatment
- Stations
- Due Diligence
- Toxicity survey

Cleaner Production implementation / methodology

Context: Toys and industrial components manufacturer



Cleaner Production implementation / methodology

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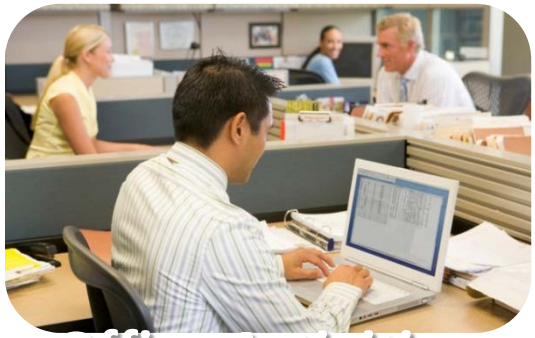
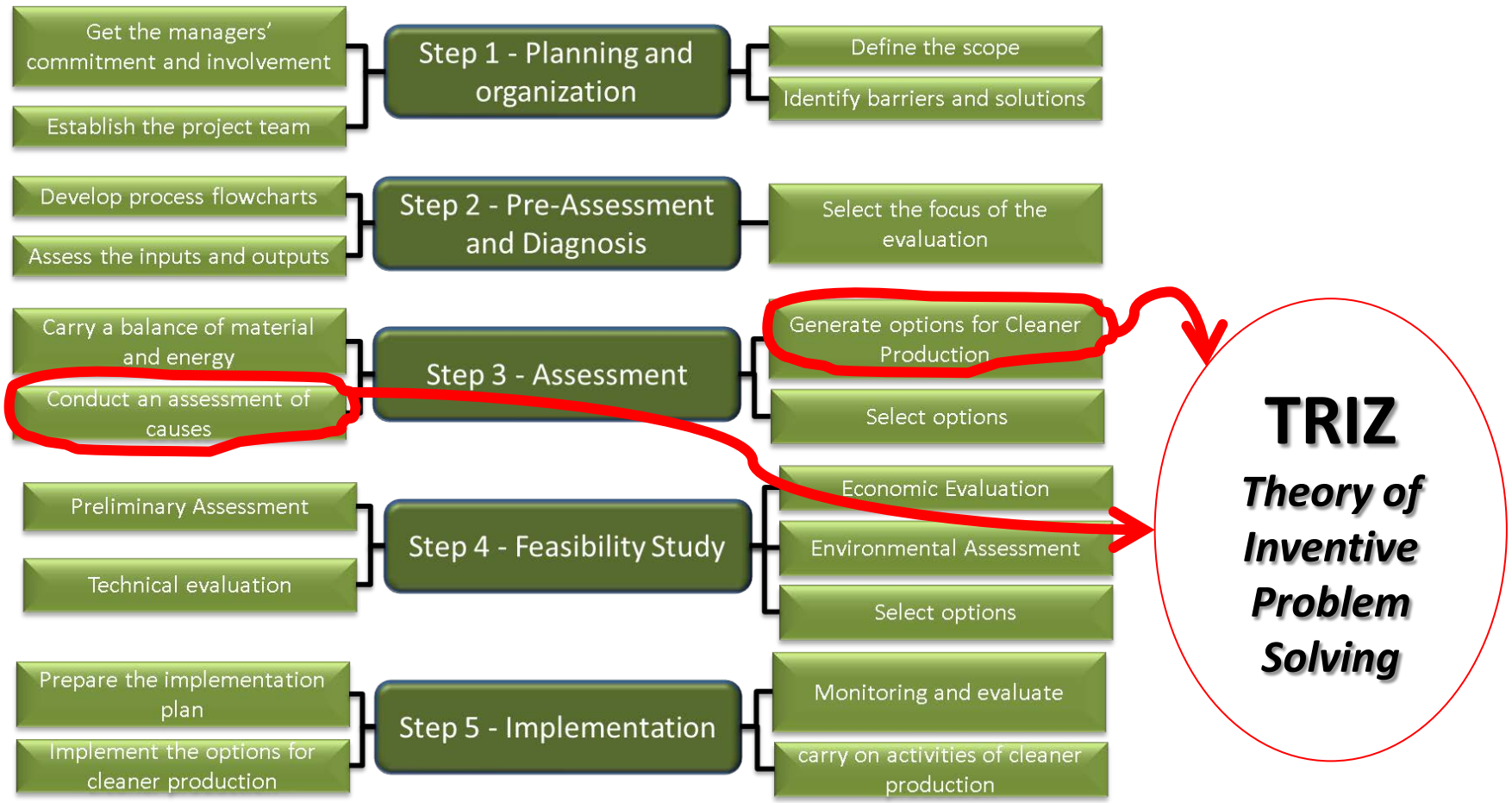
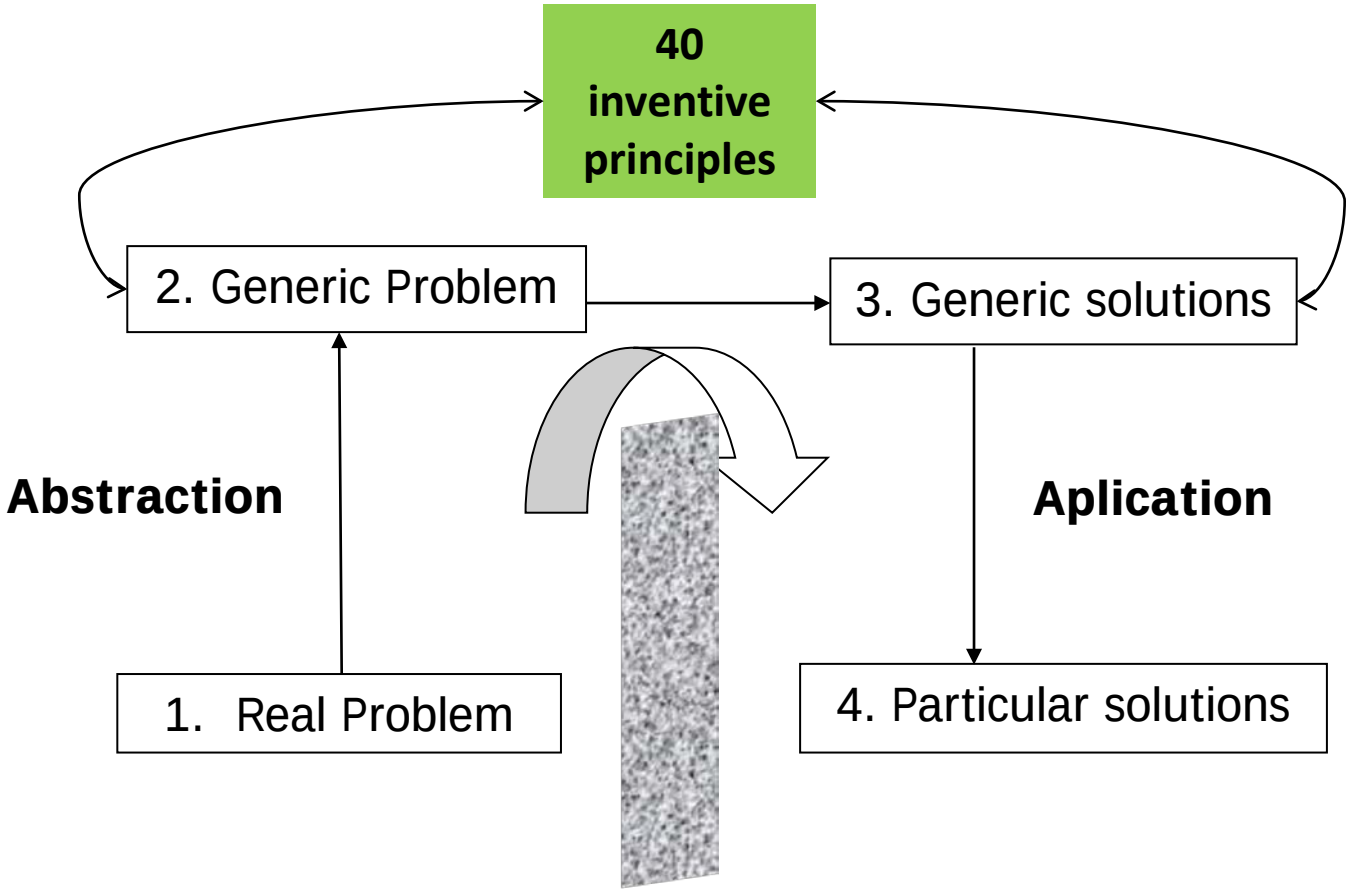


Cleaner Production and TRIZ



Steps for solving problems in TRIZ Method Adapted



Inventive Principles

The 40 inventive principles were obtained by generalization and grouping solutions repeatedly used in the creation, development and improvement of technical systems of different areas. These solutions were analyzed based on a large number of patents. They suggest some solutions for certain types of problems at the level of abstraction, which can be interpreted and transformed into a real solution.

Matrix of Contradictions

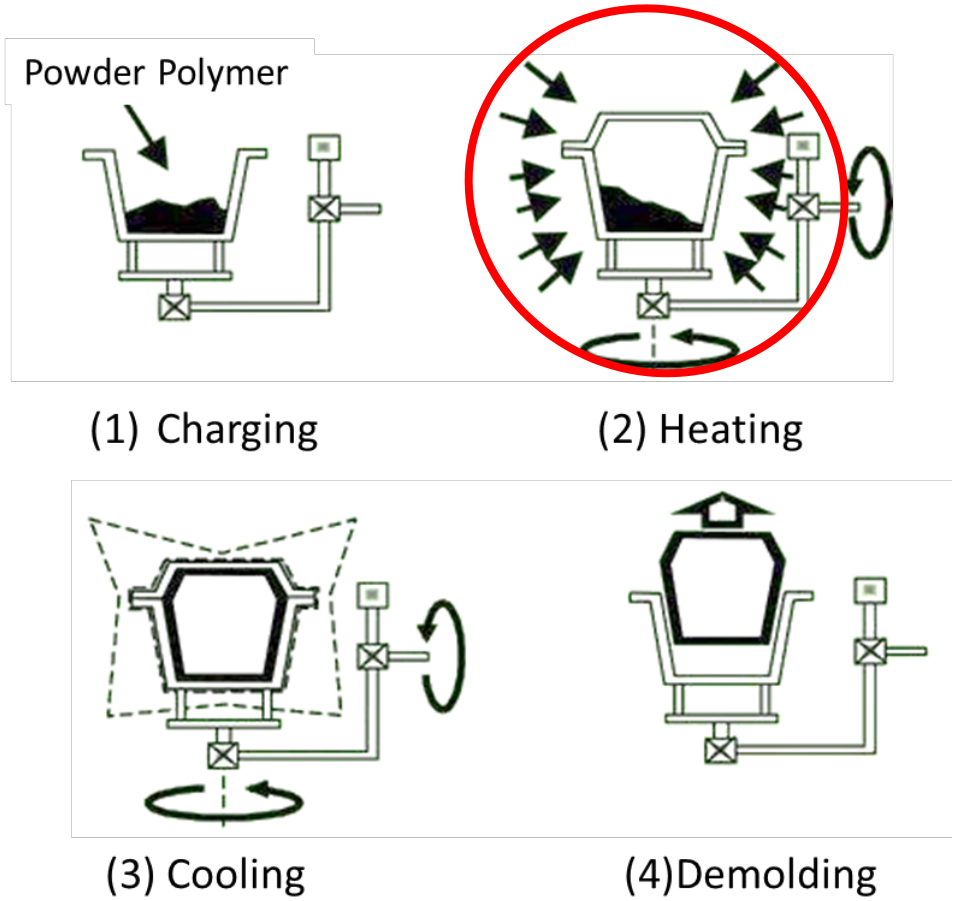
39 engineering parameters – undesirable results (conflict)

39 Engineering parameters to be improved

Inventive Principles to be applied (total = 40)

	Resultado indesejável (conflito) / Parâmetro a ser melhorado	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1	Peso m em	•	-	15, 8, 29,34	-	29, 17, 38, 34	-	29, 2, 40, 28	-	2, 8, 15, 38	8, 10, 18, 37	10, 36, 37, 40	10, 14, 35, 40	1, 35, 19, 39	28, 27, 18, 40	5, 34, 31, 35	-	6, 29, 4, 38	19, 1, 32	35 3
2	Pes to	-	•	-	10, 1, 29, 35						8, 2, 0, 27					-	2, 27, 19, 6	28, 19, 32, 22	19, 32, 35	
3	Com o m do	8, 15, 29, 34	-	+	-	15 4		4, 35		6	4	35	10, 29	13, 34	, 35, 29, 34	19	-	10, 15, 19	32	8,
4	Com obj do lo	-	35, 28, 40, 29	-	+	-	17, 7, 10, 40	-	35, 8, 2,14	-	28, 10	1, 14, 35	13, 14, 15, 7	39, 37, 35	15, 14, 28, 26	-	1, 10, 35	3, 35, 38, 18	3, 25	
5	Área m em	2, 17, 29, 4	-	14, 15, 18, 4	-	•	-	7, 14, 17, 4	-	29, 30, 4, 34	19, 30, 35, 2	10, 15, 36, 28	5, 34, 29, 4	11, 2, 13, 39	3, 15, 40, 14	6, 3	-	2, 15, 16	15, 32, 19, 13	1
6	Áre to	-	30, 2, 14, 18	-	26, 7, 9, 39	-	+	-	-	-	1, 18, 35, 36	10, 15, 36, 37	-	2, 38	40	-	2, 10, 19, 30	35, 39, 38	-	
7	Volum m to em	2, 26, 29, 40	-	1, 7, 4, 35	-	1, 7, 4, 17	-	+	-	29, 4, 38, 34	15, 35, 36, 37	6, 35, 36, 37	1, 15, 29, 4	28, 10, 1, 39	9, 14, 15, 7	6, 35, 4	-	34, 39, 10, 18	2, 13, 10	
8	Volu eto	-	35, 10, 19, 14	19, 14	35, 8, 2, 14	-	-	-	+	-	2, 18, 37	24, 35	7, 2, 35	34, 28, 35, 40	9, 14, 17, 15	-	35, 34, 38	35, 6, 4	-	
9	V	2, 28, 13, 38	-	13, 14, 8	-	29, 30, 34	-	7, 29, 34	-	+	13, 28, 15, 19	6, 18, 38, 40	35, 15, 18, 34	28, 33, 1, 18	8, 3, 26, 14	3, 19, 35, 5	-	28, 30, 36, 2	10, 13, 19	8 3
10	Fo	8, 1, 37, 18	18, 13, 1, 28	17, 19, 9, 36	28, 10	19, 10, 15	1, 18, 36, 37	15, 9, 12, 37	2, 36, 18, 37	13, 28, 15, 12	•	18, 21, 11	10, 35, 40, 34	35, 10, 21	35, 10, 14, 27	19, 2	-	35, 10, 21	-	19
11	Tensão essão	10, 36, 37, 40	13, 29, 10, 18	35, 10, 36	35, 1, 14, 16	10, 15, 36, 28	10, 15, 36, 37	6, 35, 10	35, 24	6, 35, 36	36, 35, 21	•	35, 4, 15, 10	35, 33, 2, 40	9, 18, 3, 40	19, 3, 27	-	35, 39, 19, 2	-	14 1
		8, 10,	15, 10,	29, 34,	13, 14,	5, 34,		14, 4,		35, 15,	35, 10,	34, 15,		33, 1,	30, 14,	14, 26,		22, 14,	13, 15,	2,

Rotomolding Process



Root of waste:

- **generation of scrap;**
- **product quality problems;**

Identifying the real problem and its main cause

Consequences:
- Need for warehouse space
- Cost of hand labor and energy in the recycling of waste;
- Loss of material properties;
- Difficulty of reprocessing

Why I want to solve this problem?
- Reduce the costs to the company

Concrete Problem:
Generation of scrap and nonconforming product in the rotational molding process

What is preventing you from solving this problem?
- Difficulty of finding efficient insulating material
- Unfavorable geometry

Causes:
Cause 1: Geometry Product
Cause 2: process characteristics
Cause 3: difficulty managing the different temperatures in the mold
Cause 4: difficult in thermal insulation

Matrix of Contradictions and possible solutions to the problem

The contradiction formulated for the specific problem **"Generation scrap and nonconforming product in the rotational molding process"** is: If characteristic **LOSS OF SUBSTANCE** is improved with the process of turning the mold for example, then the characteristic **EASE OF OPERATION** will worsen due to the difficulty of supplying the mold and clogging the valve.

Feature that worsens (Parameters Engineering) → / Feature to be further improved (Parameters Engineering) ↓	33. Ease of operation
23. LOSS OF SUBSTANCE	2. extraction 4. asymmetry 28. Replacement of mechanical system 32. Color change

Extract the "disturbing“ part or characteristic of an object. Extract only the necessary part or property of an object.

Real solution: isolation of some parts of the mold in the rotational molding process, thus avoiding loss of material due to temperature problems / isolation.

Results

Generation of scrap: a project was developed to apply thermal insulation in parts of the existing mold . There was a 77% reduction in the generation of scrap in this product. This scrap reduction provides an annual cost savings of around R$ 23,000.00, avoiding the consumption of 6.37 kg of virgin plastic (Polyethylene Linear Medium Density) also the reduction of energy consumption in grinding scrap and labor.

+ complementary actions improvements to reduce scrap by 89%

Only one product , the rotomolding process has 270 different products in this company

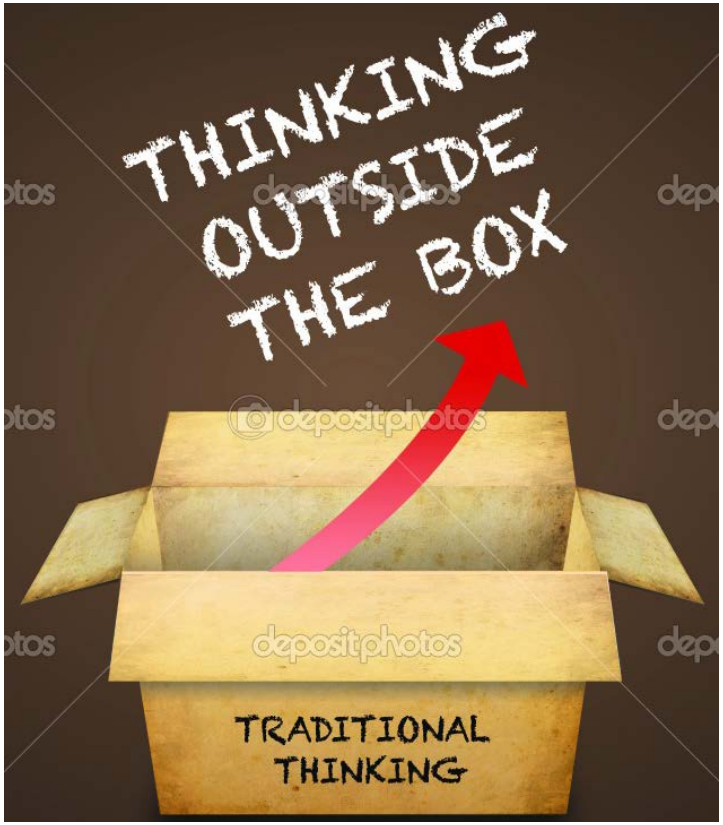
Results

Generation of nonconforming product: improvements were developed in the air outlet valve and in the material cover coating from the mold. Such actions have been implemented in existing mold and have the potential to reduce the generation of waste by 30%, which represents an economic benefit of R$ 13,000.00 / year and reducing consumption of 912 kg of virgin plastic.

A new mold will be produced with this improvements and will bring a 50% wastes reduction and a payback of less than two years.

Conclusions

The mix of cleaner production with the method adapted TRIZ was positive, although it wasn't the only factor responsable for the development of the solutions. The expertise of the working group was a key element, being enhanced with the introduction of the adapted TRIZ.



Thank You!

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