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# Title: Value chain design to open a recycling plant in the municipalities of Huauchinango-Xicotepec, Puebla

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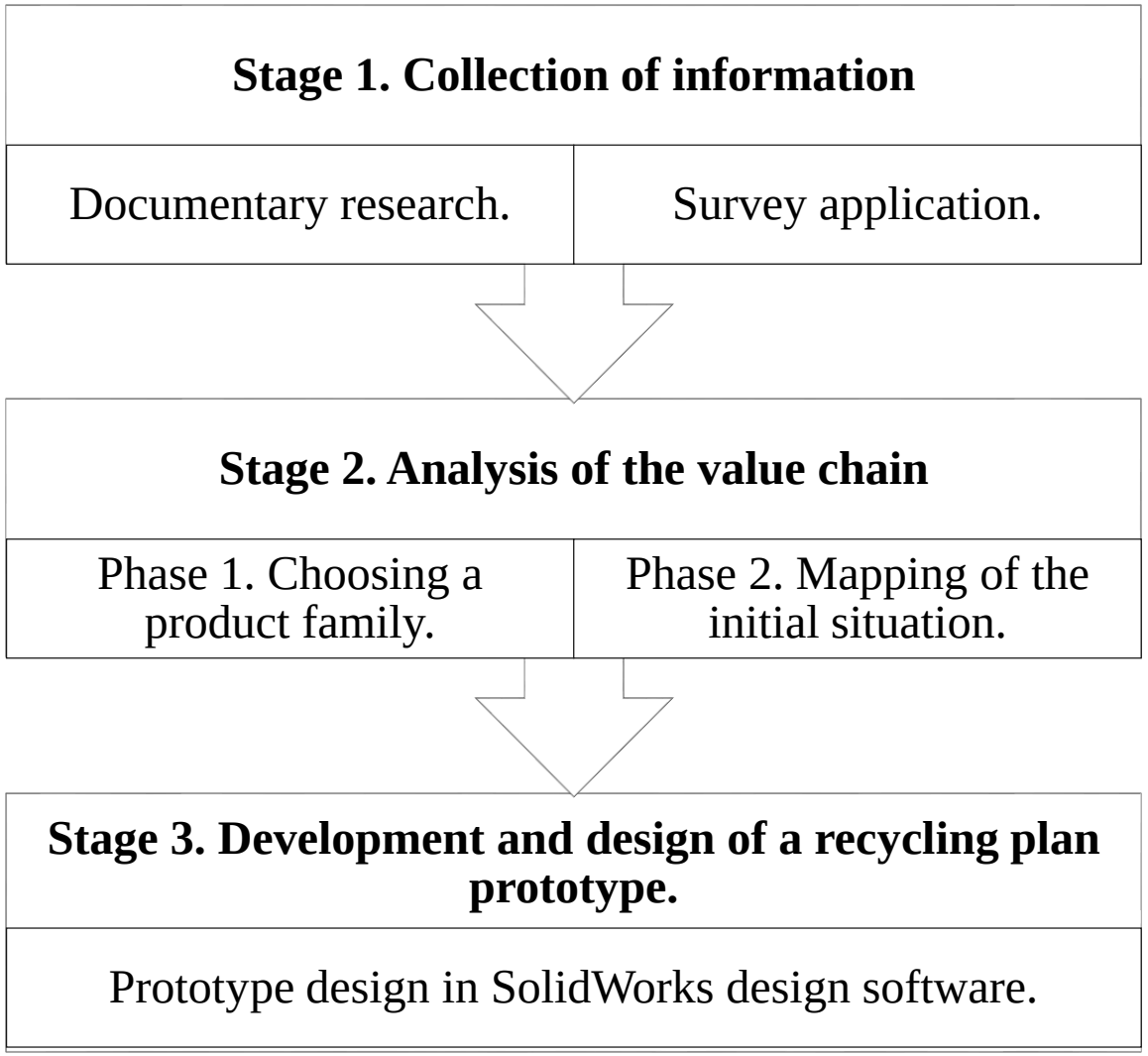
# Introduction

The indices of impact on the environment in Mexico grow exponentially to alarming levels, in recent years various problems have contributed to the generation of the aforementioned problem one of the factors with the greatest presence focuses on the availability and accumulation of various domestic solid waste in developing countries, which do not have physical infrastructures assigned as warehouses or processing units to promote the improvement of recycling systems; Due to the existence of a feasibility analysis that supports a proposal for the construction of validated recycling plants through the application of quantitative and qualitative tools. In response to the above, a correlational study is presented through the analysis of the "VSM" value chain for the opening of a recycling plant in 2 municipalities located in the Sierra Norte of the State of Puebla. In the first instance, a feasibility study was applied analyzing the habits and opinions of the inhabitants of the aforementioned area, then the value chain was created by identifying the main products to be manufactured, the potential suppliers and the target market. In this way, the cost margins are also calculated in comparison with the already established values of similar products. In order to optimize the production process, a mapping of the value stream is designed, determining the optimal operations involved in the processing of the selected waste. Subsequently, a prototype of a potentially recyclable MSW processing line is designed, in the SolidWorks technological software it shows the necessary machinery for each operating station. Applied research will enrich the sustainable development of the region by directly contributing to Sustainable Development Goal number 12 of the 2030 Agenda (SDG 12), efficiently managing a work system for the elimination of solid waste from the inhabitants, managing efficiently the availability of material resources of the municipalities.

# Methodology




*Consultation Source: Own elaboration.*

## Stage 1. Collection of information to determine degree of need and acceptance of the opening of a recycling plant

| Núm. | Question |
|---|---|
| **1** | ¿How many inhabitants are part of your household? |
| **2** | ¿How do you rate the garbage problema in your locality, neighborhood, or municipality? |
| **3** | How much waste do you normally accumulate per day? |
| **4** | ¿In your home do you have the habit of separating recycable garbage (PET, paper and cardboard) and classify? |
| **5** | It? If you separate and classify PET, cardboard and paper in your home what do you do with them? |
| **6** | ¿Do you know of any program, campaigns or movements on the classification of reciclable waste? |
| **7** | ¿Would it be integrated into programs for the separation and and classification of reciclables? |
| **8** | ¿If you had the opportunity to generate income with your recyclable solid waste (PET, cardboard, paper) through separation and classification, would you carry out recycling processes? |

| **Value corresponding to the Gauss distribution Z$\alpha$= 0.05** | **Z** | **1.96** |
|---|---|---|
| Expected prevalence of the parameter to be evaluated, in case of unknown and, considering equal probabilities to make the simple size larger. | p | 0.5 |
| 1-p, 1-.5 | q | 0.5 |
| Size of the population to study. | N | 112,656 |
| Mistake that is expected to be made with a good requerement of sampling. | e | .05 |

$$n = \frac{\boldsymbol{N} * \boldsymbol{z_a^2} * \boldsymbol{p} * \boldsymbol{q}}{\boldsymbol{e^2} * (\boldsymbol{N} - 1) + \boldsymbol{z_a^2} * \boldsymbol{p} * \boldsymbol{q}}$$

$$= \frac{(112656 * 1.96^2 * .5 * .5)}{((.05^2 * 112655)) + (1.96^2 * .5 * .5))} = 382.857$$

*Consultation Source: Own elaboration.*

## Stage 2 Analysis of the supply chain

Phase 1. Choosing a product family.
Phase 2. Mapping of the initial situation.

| Type of waste | Percentage |
|---|---|
| **Organic** | 50% |
| **Potenctially recyclable** | 30% |
| **Others** | 20% |
| **TOTAL** | 100% |

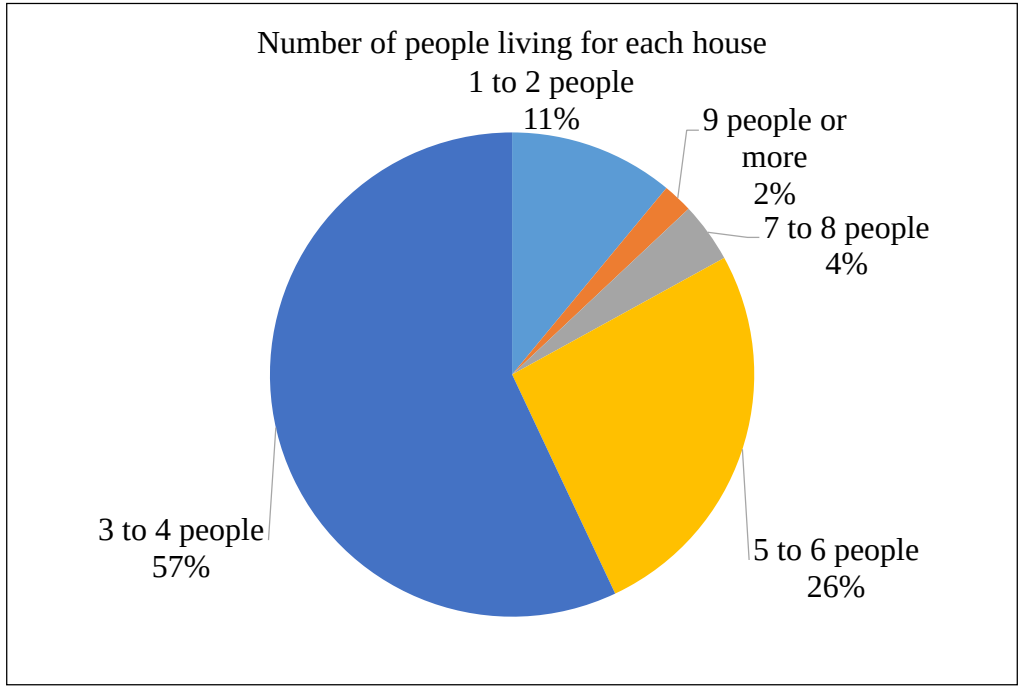
*Consultation Source: SEMARNAT*

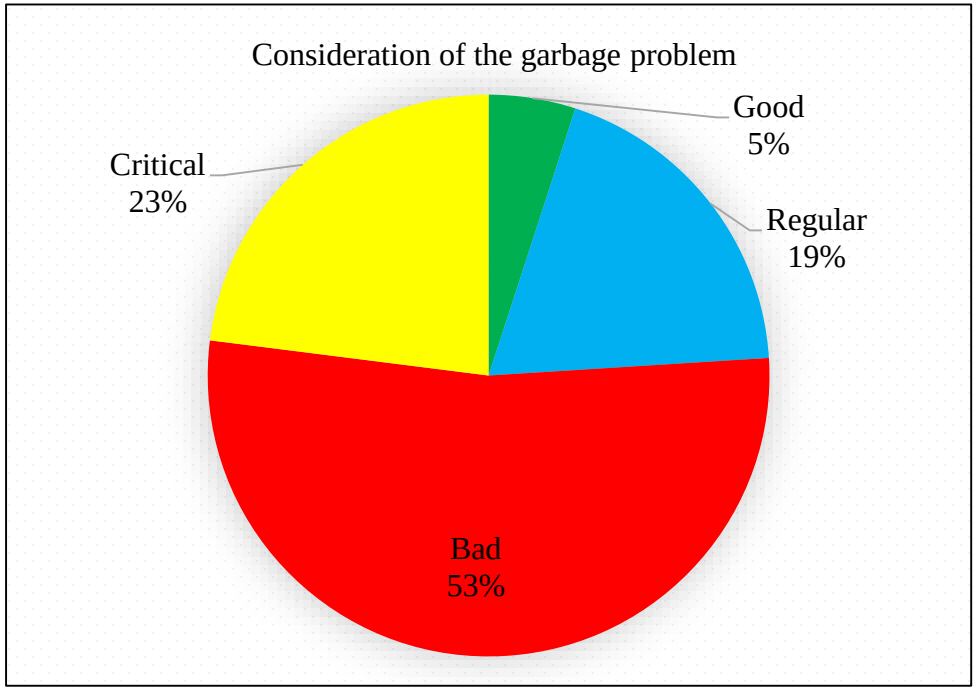
## Stage 3 Development and design of a recycling plant prototype

Considering what was obtained in the value chain mapping, in which the tools, limitations and procedures necessary for the optimal operation of a recycling plant are detailed, the design of the plant prototype will be carried out, this through the software SolidWorks design technology.

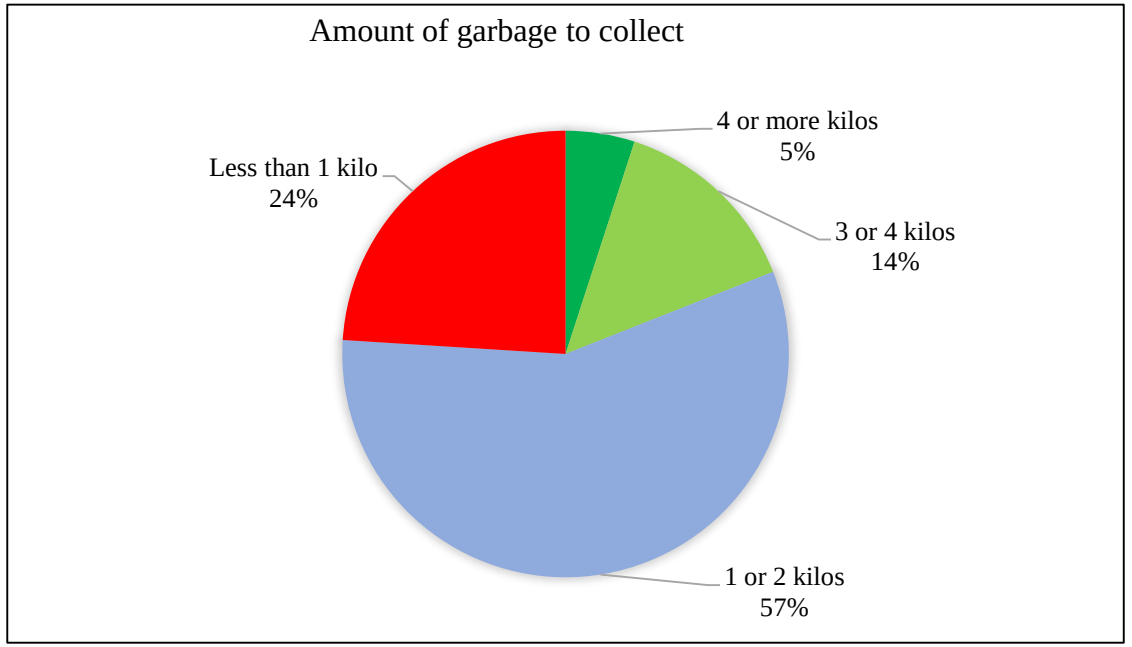
# Results

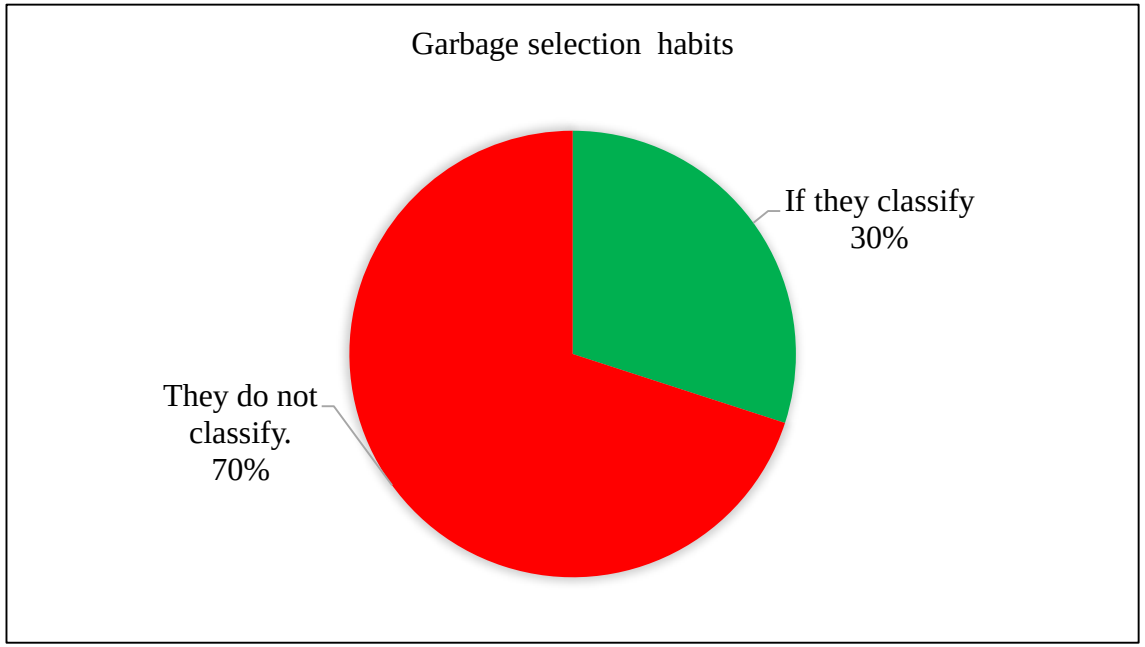
## Results of the surveys

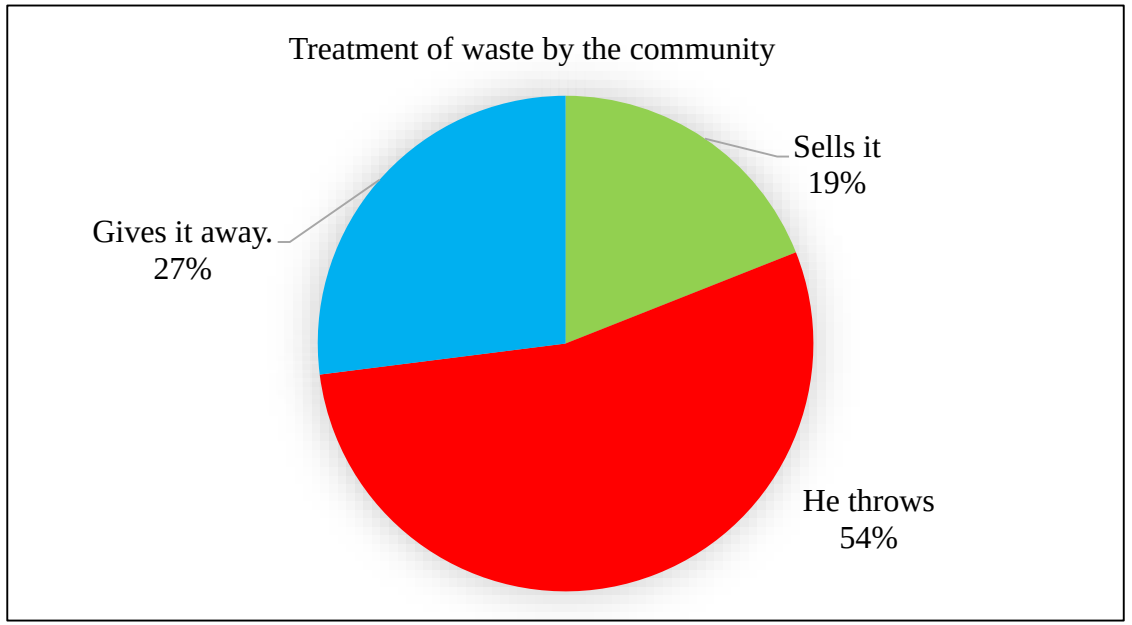


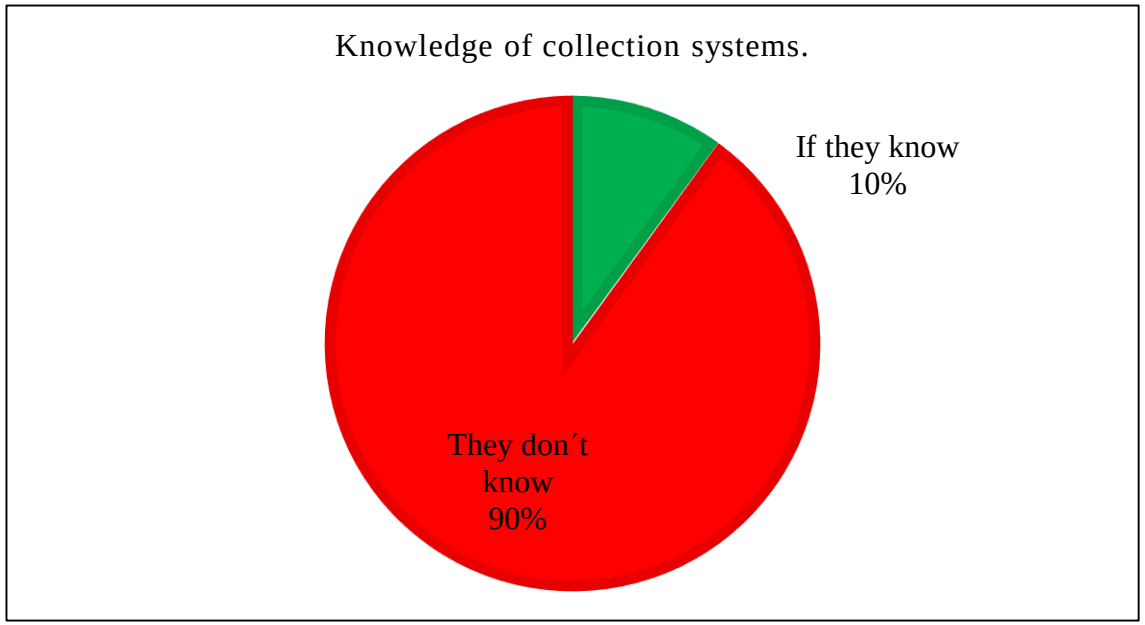




*Consultation Source: Own elaboration with data obtained from the survey*




Consultation Source: Own elaboration with data obtained from the survey

# Results of the value chain analysis
# Phase 1: Choice of a product family

**PRODUCT FAMILY**

PET

CARDBOARD

PAPER

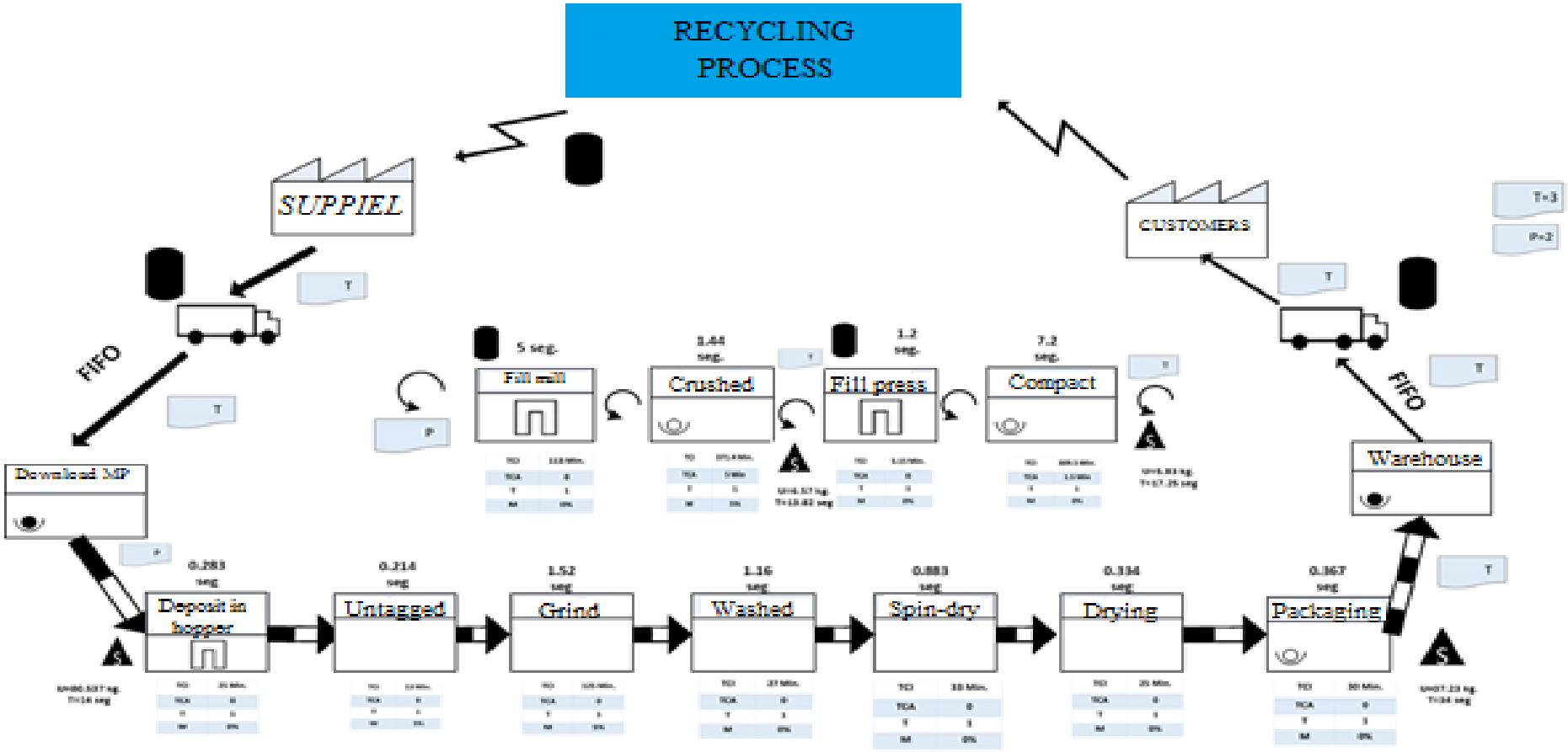
PET flakes.
Sale: Sacks of 60kg.

**Paper.**
Sale: Bales of 2 x 1 x 1 with a weight of 100kg.

**Cardboard**
Sale: Bales of 2 x 1 x 1 with a weight of 100kg.

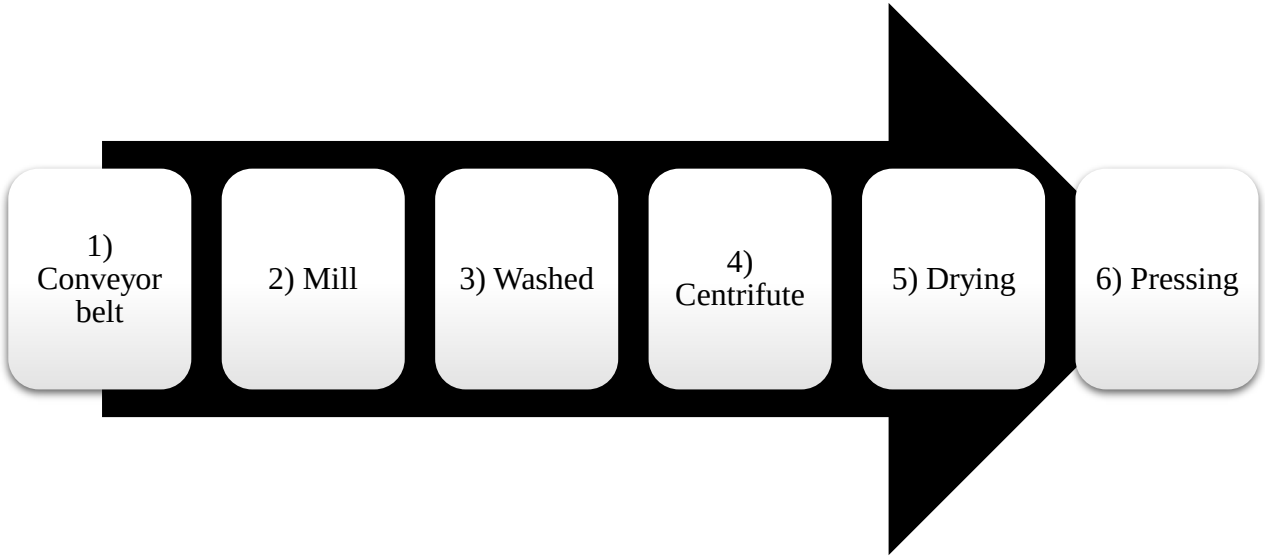
*Consultation Source: Own Elaboration*

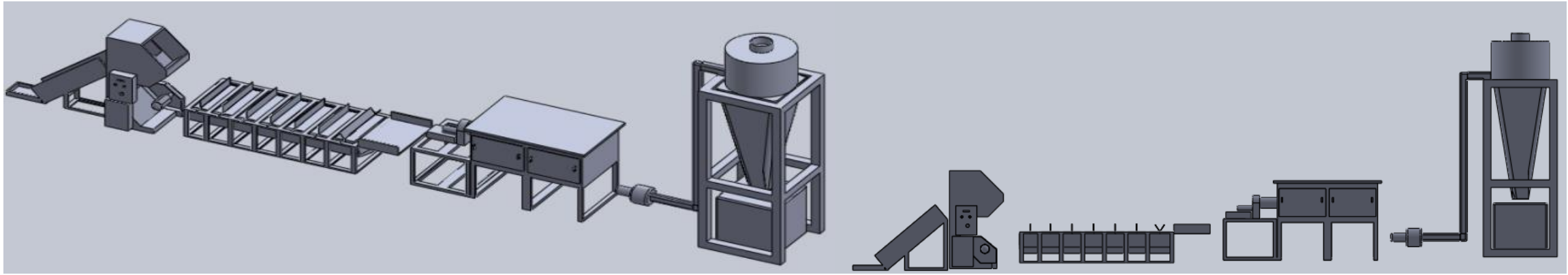
## Results of the value chain analysis
## Phase 2. Mapping the initial situation




*Consultation Source: Own Elaboration*

# Development and design of a recycling plant prototype



*Consultation Source: Own Elaboration, SolidWorks 2012*

# Conclusions

Fulfilling the objectives set at the beginning of this research and following the suggested methodology. A study of the value chain of the PET, cardboard and paper recycling process was carried out, in which the operations, machinery, and client suppliers that comprise it were identified. The potential MSW for the recycling process was determined, a projection was made to visualize the number of kilograms that are generated and are daily, in the same way the inhabitants of the two municipalities were involved through the application of a survey which was a guideline for determine the acceptance or rejection of the project; Subsequently, the optimal prototype was designed in SolidWorks technological software. What was described above allowed us to assess the proposal to open a recycling plant in the Sierra Norte of the State of Puebla.

The analysis presented is relevant, because it will guarantee a sustainable consumption and production modality through recycling; supporting the fulfillment of Sustainable Development Goal number 12 of the 2030 Agenda, the establishment of the recycling plant to serve the municipalities of Huauchinango and Xicotepec will promote the efficient use of MSW; The correct application of the designed production lines will contribute to the achievement of the municipal development plans that derive from the reduction of polluting sources for the environment, reducing the main problem of the effects produced by the consumption of products with PET, cardboard and paper, having economic, social but mainly environmental impacts.

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