Design of water catchment device for boost of the sustainability in Atlixco

Colaboración
Luz Verónica Rosas Velazquez, Instituto Tecnológico Superior de Atlixco; David Méndez Amaro, Asesor Externo; Lizzeth Hernández Carnalla; Fabiola Olvera Torres, Instituto Tecnológico Superior de Atlixco

ABSTRACT: The availability of drinking water is a worldwide problem, as use of this resource is increasing due to population growth.

A number of global studies have already been demonstrated future projections in which resources will be insufficient for the population.

In Atlixco, the available water has been running out in the last years; this is a serious problem. Sustainable development has several relations with other factors, it should be addressed in an integrated way using strategies to help the environment.

If the system is implemented in the 31198 housing units in Atlixco, it is possible to obtain 10.16% of not extracting water from the wells, equivalent to 1.5 months on average of turning off pumps, generating savings electricity and economic savings in the region.

KEY WORDS: Water catchment, APQP, Sustainability.

RESUMEN: La disponibilidad de agua potable es un problema mundial, ya que el uso de este recurso está aumentando debido al crecimiento de la población. Diversos estudios mundiales demuestran proyecciones futuras en las cuales los recursos serán insuficientes para la población.

En Atlixco, el agua disponible se ha estado agotando en los últimos años; este es un problema serio. El desarrollo sostenible tiene varias relaciones con otros factores, por lo que debe abordarse de manera integrada utilizando estrategias para ayudar al medio ambiente.

Si el sistema es implementado en las 31198 Viviendas en Atlixco, se puede obtener el 10.16 % de no extracción de agua de los pozos, lo equivalente a un mes y medio en promedio de apagado de bombas, generando así mismo un ahorro eléctrico y económico en la región.

Palabras clave: Captación de agua, APQP, Sustentabilidad.

INTRODUCTION

Atlixco has great natural resources including water, the region is in great industrial growth, so companies demand large quantities of water, as a effect, new wells will be drilled to supply all the industries.

Existing water wells have a reduction of 5.82% on average, creating a disadvantage in the region, as this decline increases every year and the estimated consumption is 250 L per day, per person.

The system that we propose to implement in the region is intended to control the decline, to give another input and a second utility to the resource.

The functionality of the system will be carried out by collecting water on the roofs of houses, buildings, greenhouses among others, it will pass through a filtering system carrying the water to a Tlaloque which has as its objective the separation of clean and dirty water, making clean water reach a cistern or a Rotoplas, to be later used in toilets, plant irrigation, washing clothes, washing cars among others.

The project is intended to have an approach in which government, school and business have a share of responsibility towards the environment, working hand in hand.

Having as competitive advantages the adaptation of the design depending on the surface.

Aim.
Design a Water Catchment System by using the Advanced Product Quality Planning (APQP).

The specific aims included the following:

- Identify activities to be developed for the incorporation of the catchment system.
- Design the product using quantitative (annual precipitation statistics) and qualitative characteristics (SWOT analysis and simulation).
- Carry out design and plans in SolidWorks™ 2018.
- Define characteristics for obtaining materials, marketing strategies and cost analysis integrating a CANVAS model, for your production.

MATERIAL AND METHODS

Methodology

Part of the methodology is based Core Tools, which are mainly used to give solutions to the development of new projects, processes or services, among others, provide competent results focused on the project to be carried out.

The methodology APQP is one of the few that shows the development of new products and emphasizes the requirements for the product [1]. It consists of 5 steps:

1. Planning: Determine the needs and expectations of the client, define a work plan.
2. Product design: Planning elements, characteristics and properties.
3. Process development: Development of the production system.
4. Process and product validation: A test production is performed, evaluated and fed back.
5. Production: A production control plan is carried out.

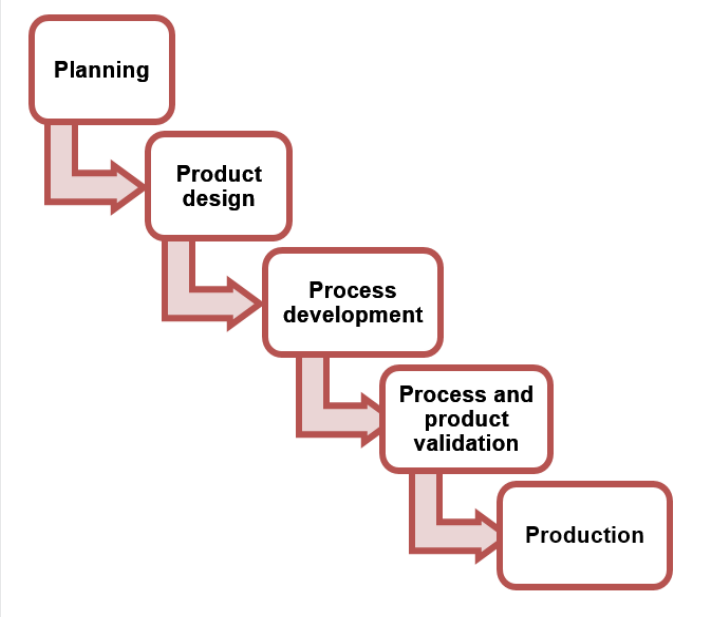

Figure 1. Methodology APQP used (Advanced Product Quality Planning)

RESULTS

A list of key activities, essential for the development of the activities carried out, was drawn up.

Key Activities:
- ✔ Rainfall study
- ✔ Design of the water catchment in the SolidWorks software
- ✔ Design of rotomolding
- ✔ Definition of the material
- ✔ Test production.
- ✔ Improvement of the design

The first step begins with inputs to the planning, it is necessary to establish activities in time and form in order to be able to monitor and advance in the results.

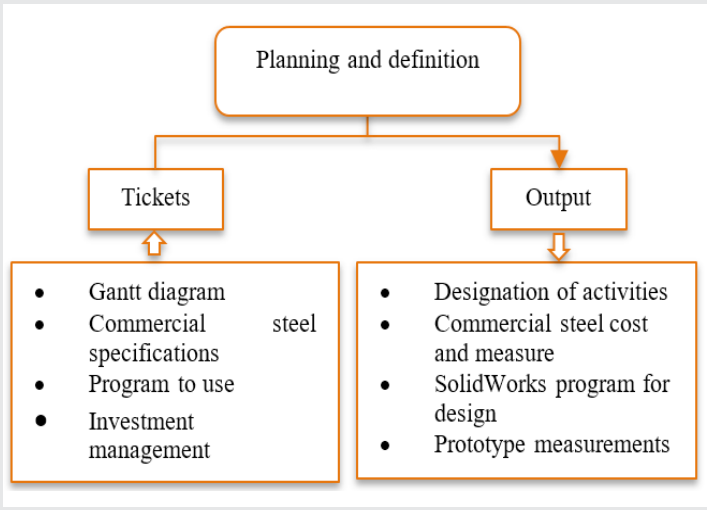

Figure 2. Planning and definition of Project

It is important to investigate the properties of steels in order to identify the material that will be best used in the prototype construction. In order to obtain the process in which the prototype will be developed, is necessary to design the water catchment in a way that meets the specifications and measures that we need.

Is necessary annual precipitation survey of the region, is required to estimate the capacity of the product. An important point is to have the domain of the software SolidWorks™ where the plans will be made.

Population and sample.

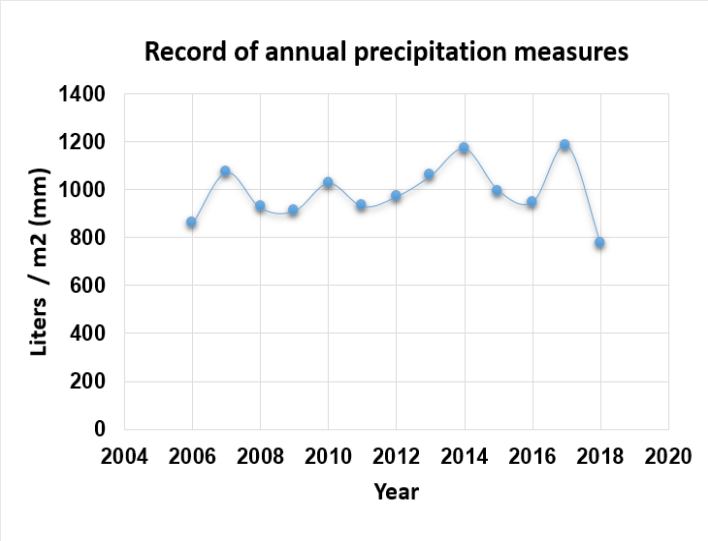

Figure 3. Record of annual precipitation measures

- Population region of Atlixco 134,364 [2].
- Sample: 31,198 homes in the region.

With the rainfall data collected in 16 years, the capacity of the water catchment is estimated at 200L.

SWOT ANALYSIS. (Strengths, Weaknesses, Opportunities and Threats)

ATZINTLI stemmed from the need to postpone the water shortage, generated by demographic increasing and industrial development in the region. Atlixco has experienced considerable increase of shopping centers.

Through data acquisition, we identified a significant problem with the water resource that has resulted in considerable aquifer decrement. It would be beneficial for Atlixco to obtain a certification of "CORPORATE SOCIAL RESPONSIBILITY (CSR) [3]. The implementation of the proposed water catchment system may also facilitate obtaining ISO 14000 certification, for any company that is willing to collaborate in that system [4].

Figure 4. SWOT

SWOT was made the hierarchy of all characteristics for each one of the four factors and this is showed in Figure 4.

From SWOT analysis we have as a result a global analysis [4, 5].

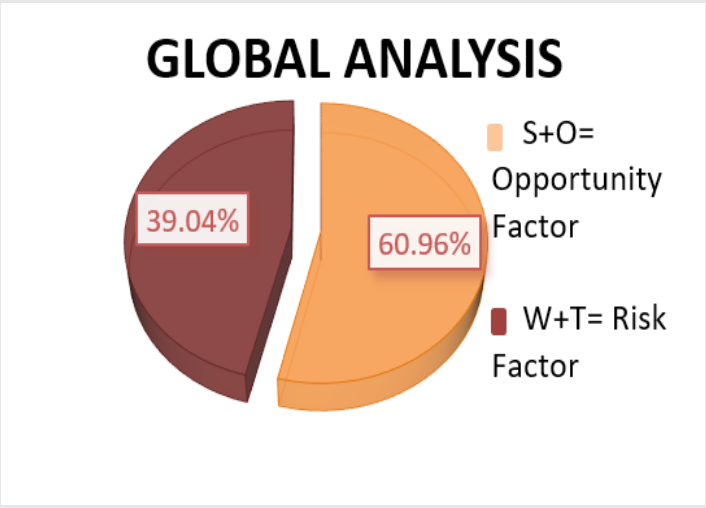

Figure 5. Global Analysis

According to our SWOT analysis, we can observe a main threat and weakness, they are the restrictions imposed by the local government. However, our projections resulted in a 39% failure and a 61% opportunity [5].

The next step is the design process, the tests and the improvements that can be made.

ROTOMOLDING PROCESS.

Once the design process has been obtained with the help of Solidworks™ software the plans for the prototype were developed the simulation of rotomoulding was carried out, where some of the faults that could occurred during the process can be observed. As part of the AQPQ methodology, the corresponding design and process AMEF will be carried out, verifying safety.

For the realization of the AMEF design, the center of gravity, the rotation of the tubes, among other aspects, must be taken into account.

For the AMEF process, it is necessary to analyze the function temperature, rate of rotation and time of exposure to heat.

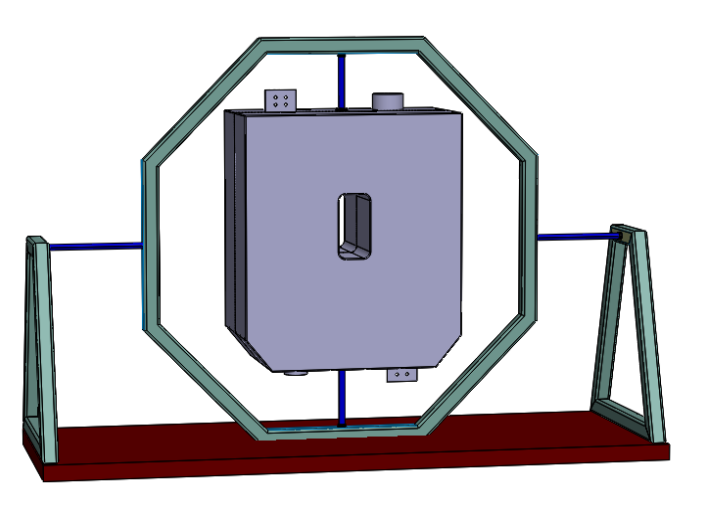

Figure 6. Rotomolding process

Figure 6 shows the simulation performed, with the greatest use of material, so that the polymer to be used generates a homogeneous layer during the process within the mould.

Having the complete SWOT analysis and the rotomolding process, we proceeded to the CANVAS model, will allow us to observe the best areas of opportunity [6, 7].

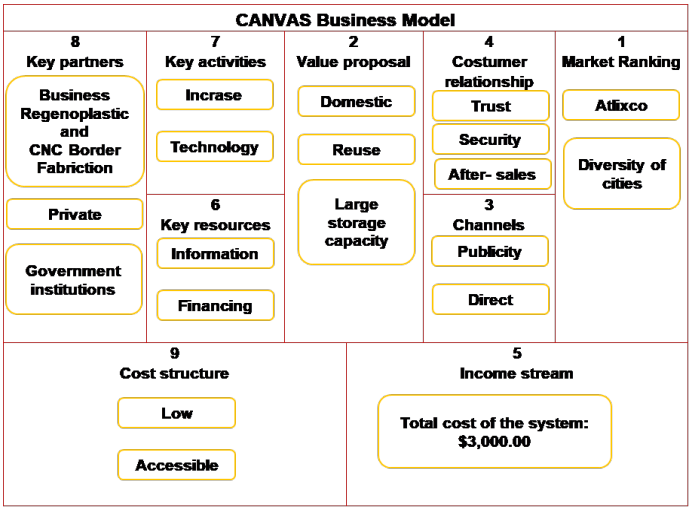

Figure 8. CANVAS model

In the model, the main raw material suppliers are described to develop the product, the total cost, taking into account the various resources found in the manufacturing process and the main channels for its distribution. [8]

Catchment Water Devices

There are various uses for the water collected, for example: for the toilet, washing clothes, washing the car or watering the garden [9]. The benefits of the system are:

- Water purification filter with accumulative system of compartments, ecological, long-lasting and easy to regenerate and clean.
- Portable rain water collection device.
- Automatic rainwater selection system.

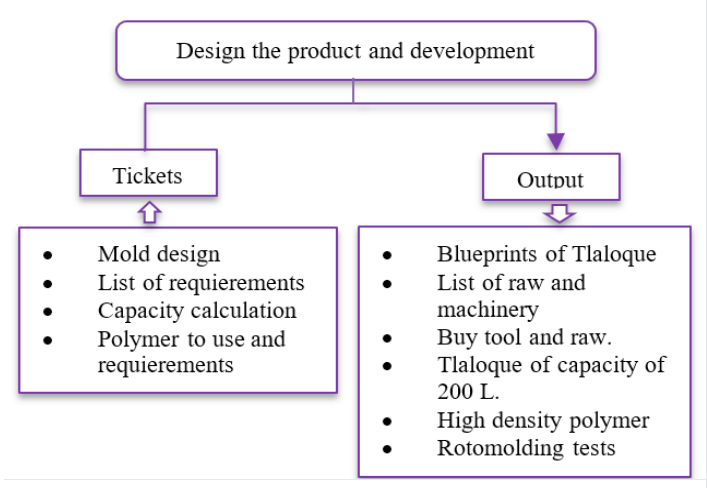

Figure 7. Design the product and development

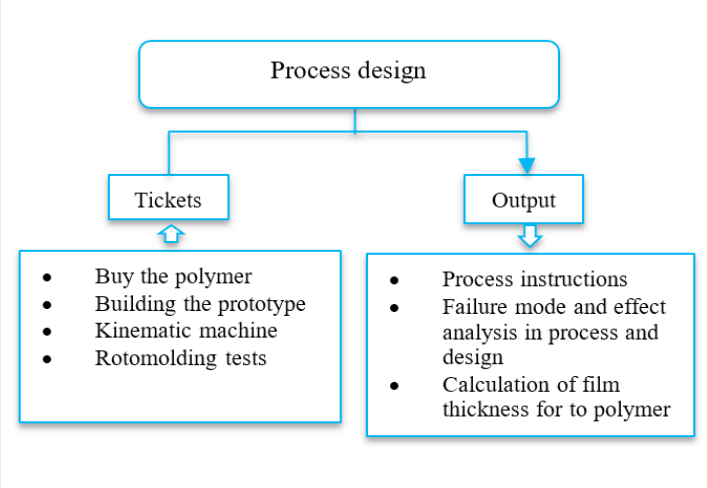

Figure 9. Process design

CONCLUTIONS

Regarding the process and according to the methodology, we are in the process development and in the product design improvements.

According to the activities proposed, only 60% of them have been completed, since various feedbacks have yet to be carried out.

The design, dimensions and capacity of the collector were taken according to the precipitation of water in the region shown in Figure 3.

One of the advantages is the ability to adjust the design and storage capacity.

With the help of the SWOT, we were able to identify qualitative characteristics of the product and in general part of the benefits it generates for the region.

The CANVAS model allowed us to have a projection of what we can generate in the future, in addition to making better strategic decisions to further develop the project, until its conclusion.

ACKNOWLEDGMENTS

Thanks to the Instituto Tecnológico Superior de Atlixco, by providing the space to work and technical support the program. And to the organization of SOAPAMA, for the data provided.

REFERENCES

[1] P. Reyes, «APQP,» 2003. [En línea]. Available: https://www.icicm.com/files/CurAPQP.pdf.

[2] E. y. D. R. Secretria de Planeación, «Informe anual,» 2015. [En línea]. Available: http://diariooficial.gob.mx/SEDESOL/2017/Puebla_019.pdf.

[3] «Busines News Daily,» [En línea]. Available: https://www.businessnewsdaily.com/4679-corporatesocial-responsibility.html.

[4] «International Organization for Standardization,» ISO, [En línea]. Available: https://www.iso.org/iso-14001-.

[5] M. C. &. P. G. E. L¨uftenegger, The Service-Dominant Ecosystem: Mapping a Service Dominant Strategy to a Product-Service Ecosystem. School of Industrial Enginnering, Eindhoven University of Technology, Eindhoven Netherlands, 2013.

[6] H. Ponce, The SWOT matrix: an alternative for making diagnoses and determining intervention strategies in productive and social organizations, Contribution tothe Economy, 2006.

[7] J. Rojas, «Process for the preparation of an FODA alisis as a tool,» 2009.

[8] K. F. &. M. C. O. Gassmann, The Bussines Model Navigator: 55 models that will Revolution your Bussines., UK: Ed. Pearson., 2014.

[9] I. A. Costa, «agua%ambiente,» 2018. [En línea]. Available: https://www.aguambiente.com/,.