

# Industrial Outreach Program in Mexico 2014

Council of Science and Technology of the State of Querétaro

## Self – Cleaning Dryer Lint Filter



mabe



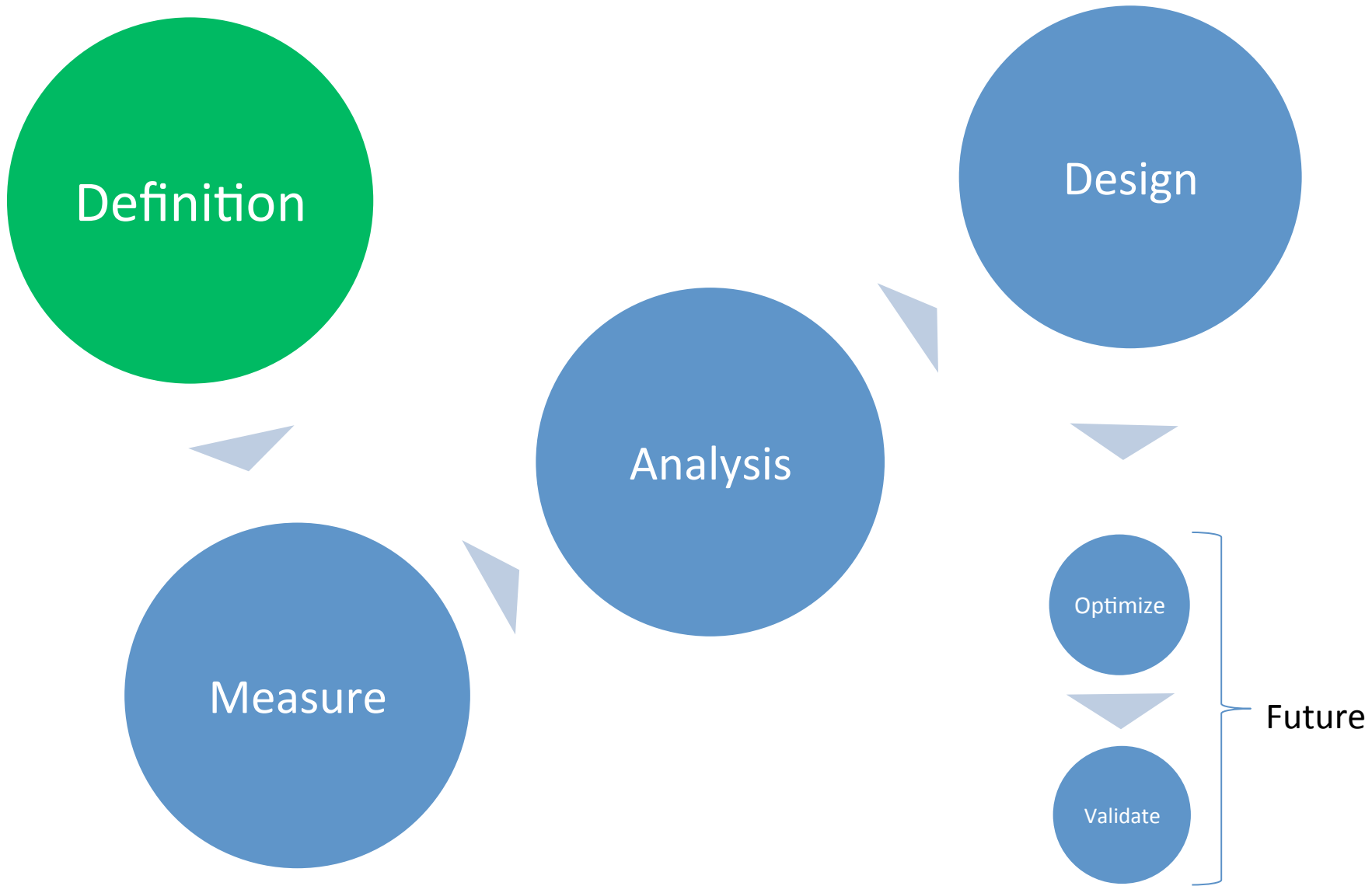
### Team members:

Carlos Daniel Pizano Gómez

José Octavio Trejo Guzmán

### Advisor:

Raúl Santillán Galván



# Introduction:



# Objective

Propose a low cost self – cleaning system, capable of removing the lint from the filter

## Expected Benefits and Results

Diagram of a functional prototype capable of solving the lint problem on the filter.

# Customer Needs

Customer	Review	Model	Rating
Carolnyc	The only thing I can't get is <b>why any clothes dryer designers can't figure out a way to either dispose of lint automatically or compact it to dispose every month or so</b> . Get on that, folks!	Wed86hebw	Recommended to buy

## Summary:

1. Filter is too small and fragile
2. The location of the filter is not ergonomic. It is not good for people with back problems.
3. When you take out the filter from its place, lint falls back inside of the drum or remove to outside to the floor.
4. The filter is hard to clean

# Impact of Lint in the Dryer (Time)

Restriction (in)	Average Negative Pressure (inH2O)	Time (min)	Time (%)	Condition
1.650	0.025	82.00	186%	Reference
<b>1.808</b>	<b>0.036</b>	<b>74.83</b>	<b>170%</b>	<b>Filter Clogged (LINT)</b>
3.125	0.125	52.80	120%	Reference
3.750	0.186	44.00	100%	Ideal Conditions

Based on a 12 lbs mix load

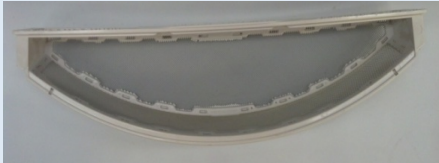





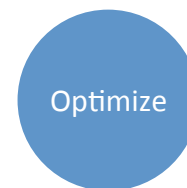
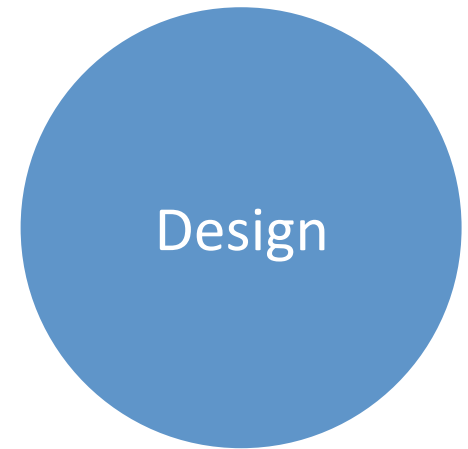
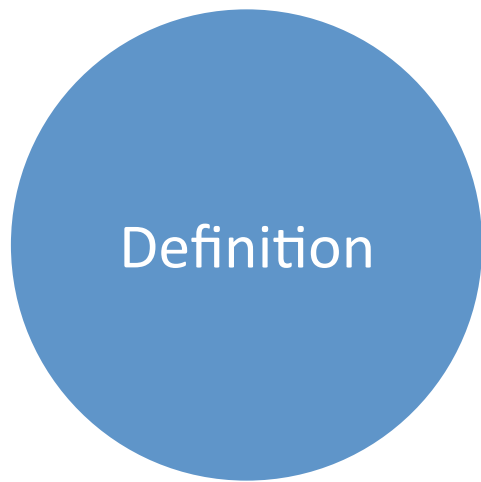
Clogged Filter

When the filter is clogged, the dryer takes 70% more time to finish a cycle.

# Scope

- Mabe counts with different dryer filter models

Product:	Filter Model:	Condition:
Laundry Center		It is an economic product and adding an overprice will show a negative effect on sales.
Leadership		Dryer 2015 will replace this product
HALC		The size of these two models is the only difference. -HA filter takes 3 cycles to be fully saturated. -Viper filter takes 5 cycles to be fully saturated.
Viper		Dryer 2015 will have the same HA filter model. <u>We will work with HALC filter model.</u>



Future



# Patents

Patent	Name	Owner
US4700492 A	Air actuated automatic lint screen cleaning system for dryer	Whirlpool Corporation
US6016610 A	Self-cleaning lint trap and gravity assisted lint trap	Maytag Corporation
EP1098028 A3	Laundry dryer with self-cleaning lint filter	BSH Bosch und Siemens Hausgeräte GmbH
US 3069785 A	Clothes dryer with lint burner	Gen Motors Corp
US 4669199 A	Clothes dryer with a lint incinerator	Raytheon Company

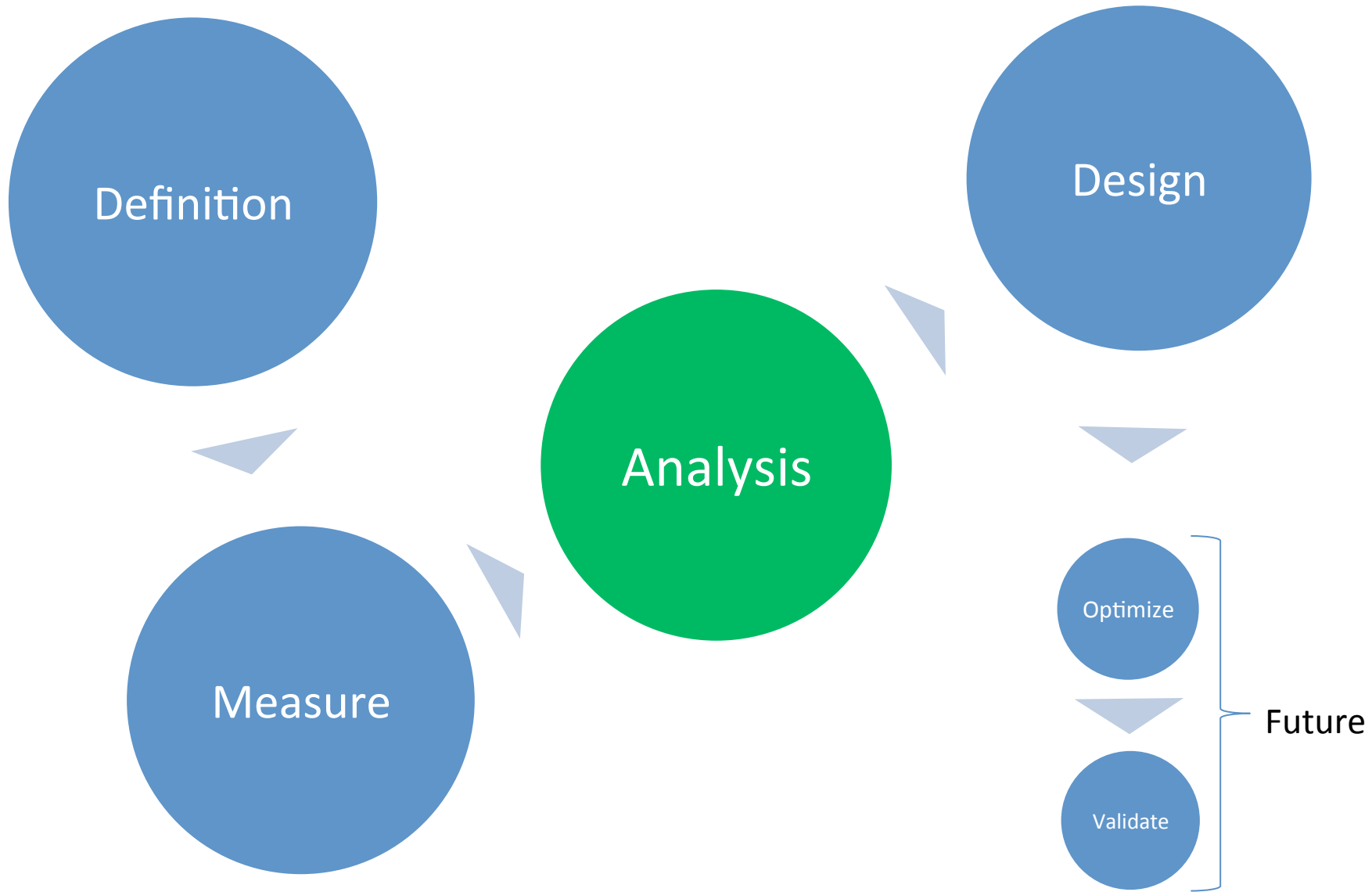
## Summary

1. Designs are complex and they seem to be hard to build
2. There is not enough available space inside of the dryer.
3. Most of them do not look like they can really work.

# Workplace



We have a limited workplace, so applying different concepts to the system is complicated and therefore the difficulty of the project increases.



# MABE Innovation System

N°	Name	Idea	Description
7	Mabe Innovation	Sticky baffle	Special cleaning cycle where the sticky baffles will take off the lint from the clothes
8	Leonardo Urbiola	Built in vacuum	Filter will have a vacuum in front of it which will clean the filter.
9	Leonardo Urbiola	Electric Resistance Mesh	Self – cleaning cycle (airfluff + cooldown), electricity will heat up the mesh and will burn the lint

## 7 ways

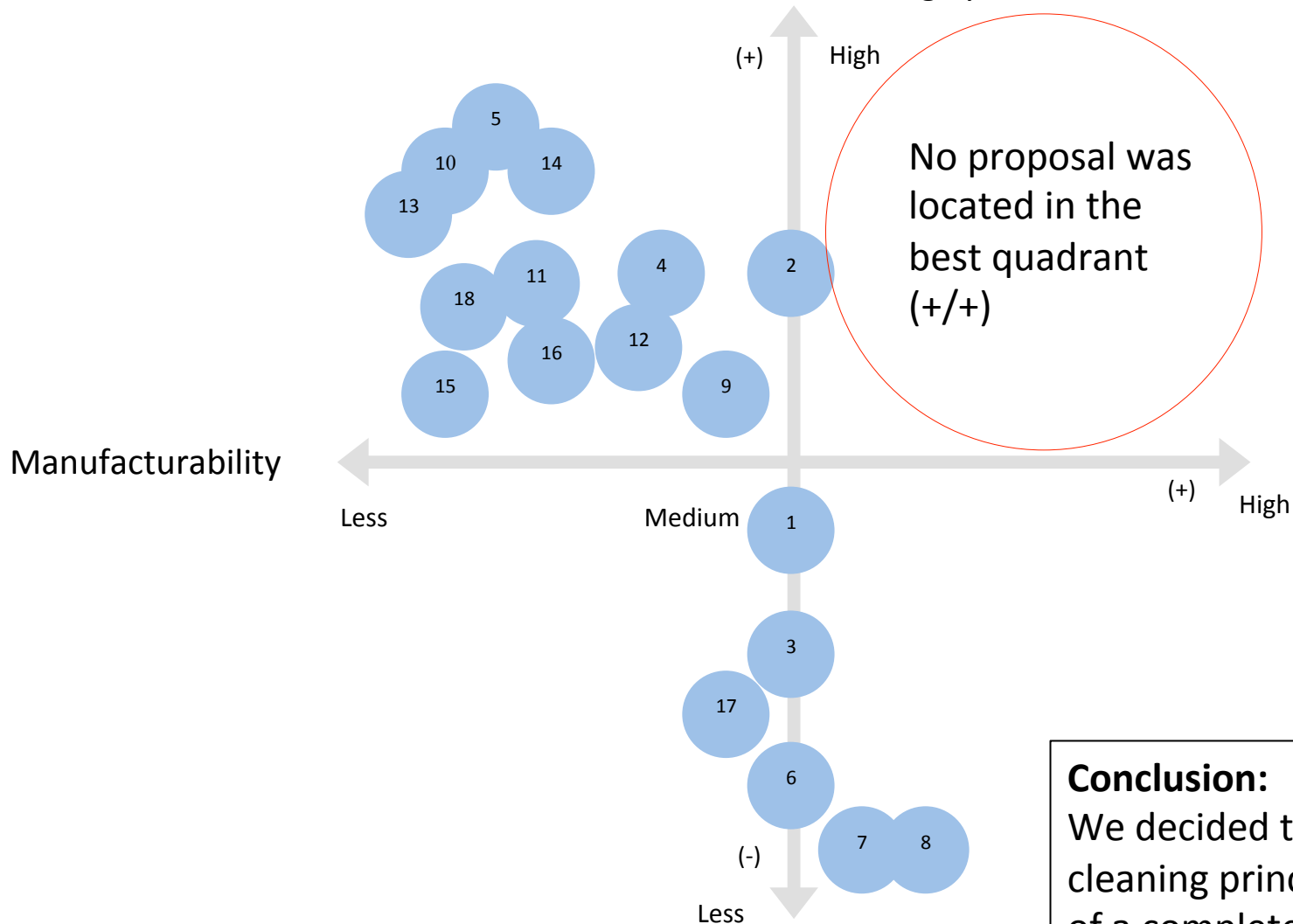
N°	Name	Idea	Description
1	Raúl Santillán	Electric cable burners	Electricity will pass through the cables creating heat and lint will burn and be disposed to the outside as ashes
2	Raúl Santillán	Water spray (Mist)	Spraying water to the lint will make it fall because of gravity
3	Raúl Santillán	Sliding item	A material capable of preventing lint from sticking to it
4	Octavio Trejo	Pressured water	Water will wash down lint from the filter
5	Carlos Pizano	Brush	Brush will drag the lint from the filter and the blower will vacuum the lint to an outside container
6	Carlos Pizano	Spark burners	Sparks created around the filter will burn the lint in the filter

# 7 ways

N°	Name	Idea	Description
10	Carlos Pizano	Filter Band	The filter will be a band turning and cleaning itself by passing close to a brush which will wipe the band and lint will be disposed in an outside container
11	Carlos Pizano	Condenser Sprayer	Water sprayed to the filter will wipe the lint; the water with lint will be disposed with the same washer duct.
12	Carlos Pizano	Change design	The filter will be moved to a different angle which will help the lint to fall by gravity and blower will vacuum helping the lint to fall
13	Carlos Pizano	Sweep and collector	A turning brush will swipe the filter and a collector located under the filter will gather the lint
14	Carlos Pizano	Vacuum brushes	A brush with a built in vacuum will sweep the filter and suck the lint to an outside container
15	Octavio Trejo	Sweeping lint	Uses a band and tube collector to catch the lint
16	Octavio Trejo	Sprinkler	Pressured water cleans out the filter and removes lint
17	Octavio Trejo	Sliding Filter	Lint won't get stuck in the filter and will fall to a container
18	Octavio Trejo	Inclined filter	Water will pass through the filter cleaning it and the filter will have an angle so the water can run easily to the outside

# Proposals Evaluation

Function: Self – Cleaning System



## Conclusion:

We decided to work on cleaning principles instead of a complete system

# Cleaning Principles

- **Mist**

Lint will get wet and increasing its density it will fall by itself.

- **Non – Sticky Material (Plastic):**

A plastic filter won't let lint to get glued to it.

- **Electric Mesh:**

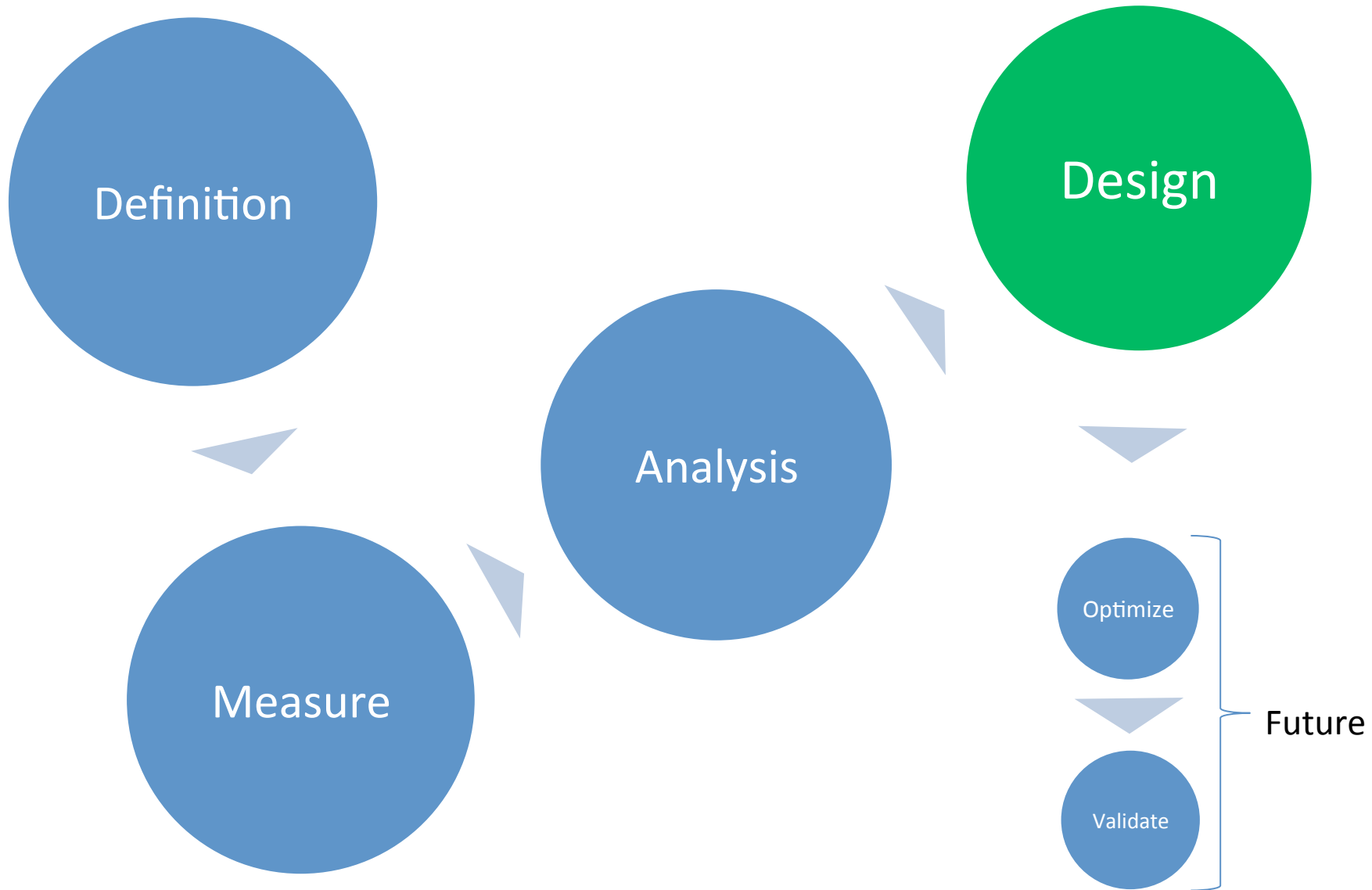
Wrap a resistive wire all across the filter mesh, warm it up and burn lint.

- **Air curtain:**

Using positive pressure from the blower wheel, pushing lint off the filter.

- **Brush:**

A brush will be used to clean the lint from the filter.

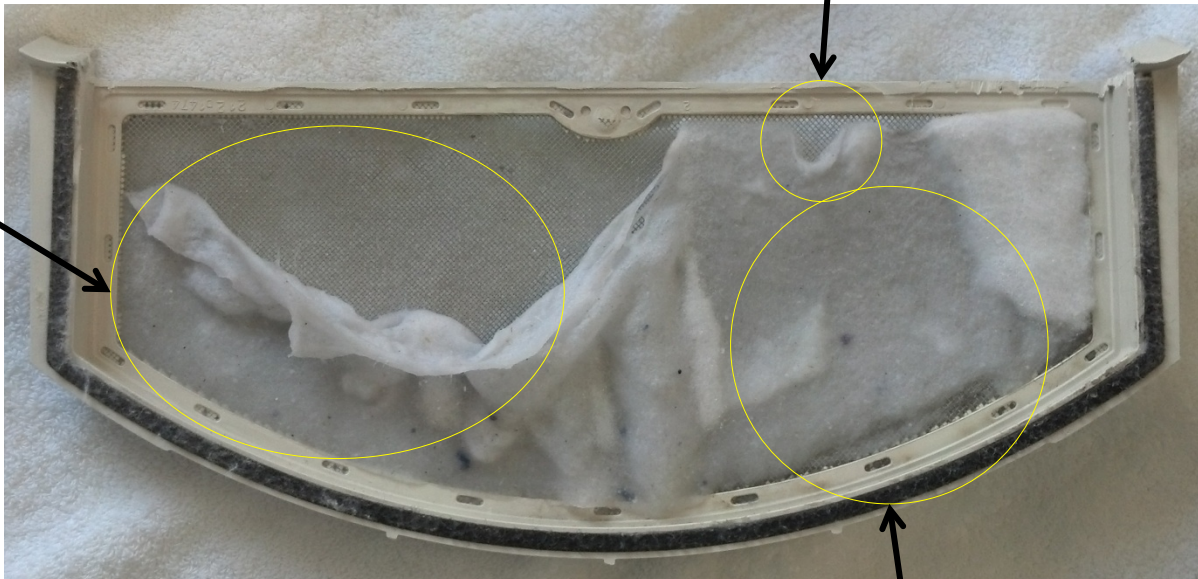




# Mist

Direct sprays from above

Sprays from behind the filter



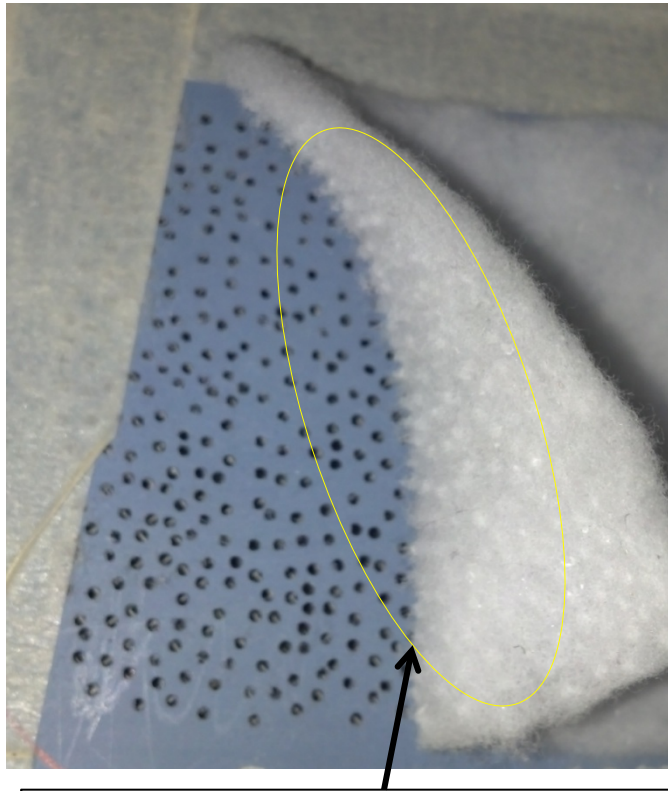
Sprayer

Lint did not absorb water easily, we needed a lot of water to start having any results.

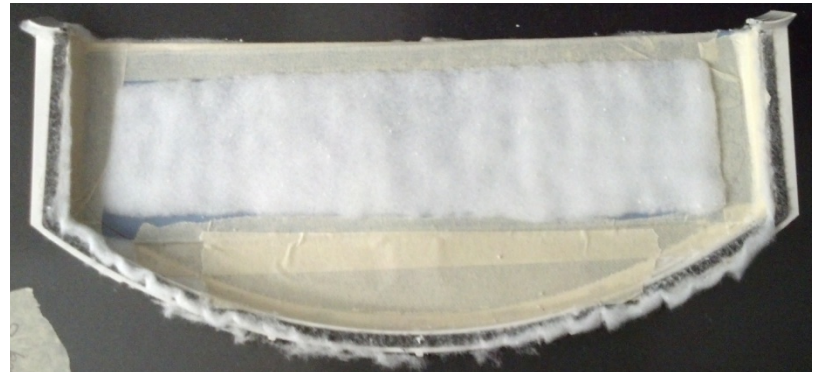
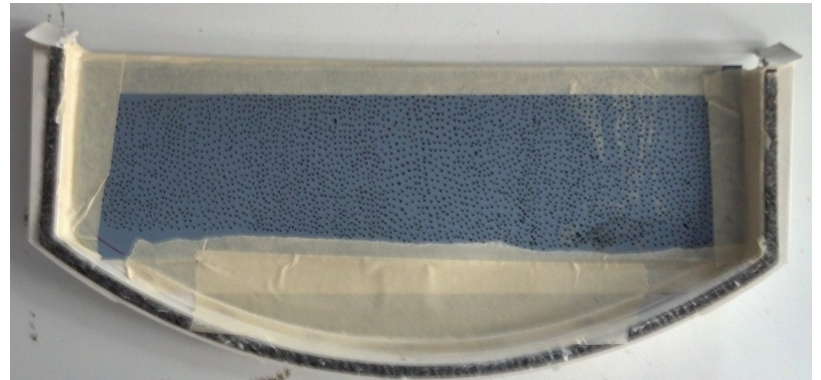
Sprays from the front by a distance of 10" away



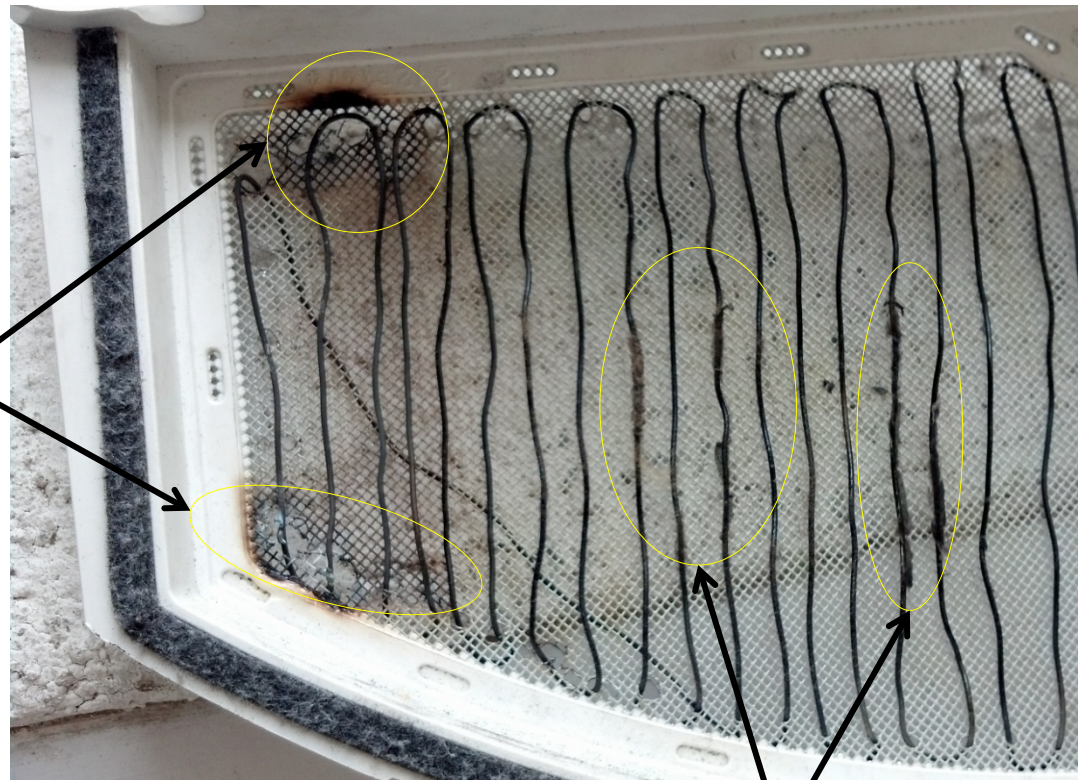
# Non – Sticky Material (Plastic)



We got the same effect than with the normal metal mesh. It was really hard to clean



# Electric Mesh



Hot spots

The filter mesh could not handle the power and temperature from the wire, it created hot spots. It was a risk for the customer's safety.

Lint glued to the resistive wire



# Air Curtain



Aire is taken from the exhaust and guided towards the trap-duct, in order to be placed behind the filter

When using smaller diameter hoses, the air pressure increased in a way where it did not cause any effect on the lint, making this concept a failure.



# Brush



- We built the first prototype:
  - Flexible and thin spikes.
  - Hard frame



- Concept Validation: (0.7 grams of lint)



Assembly completed



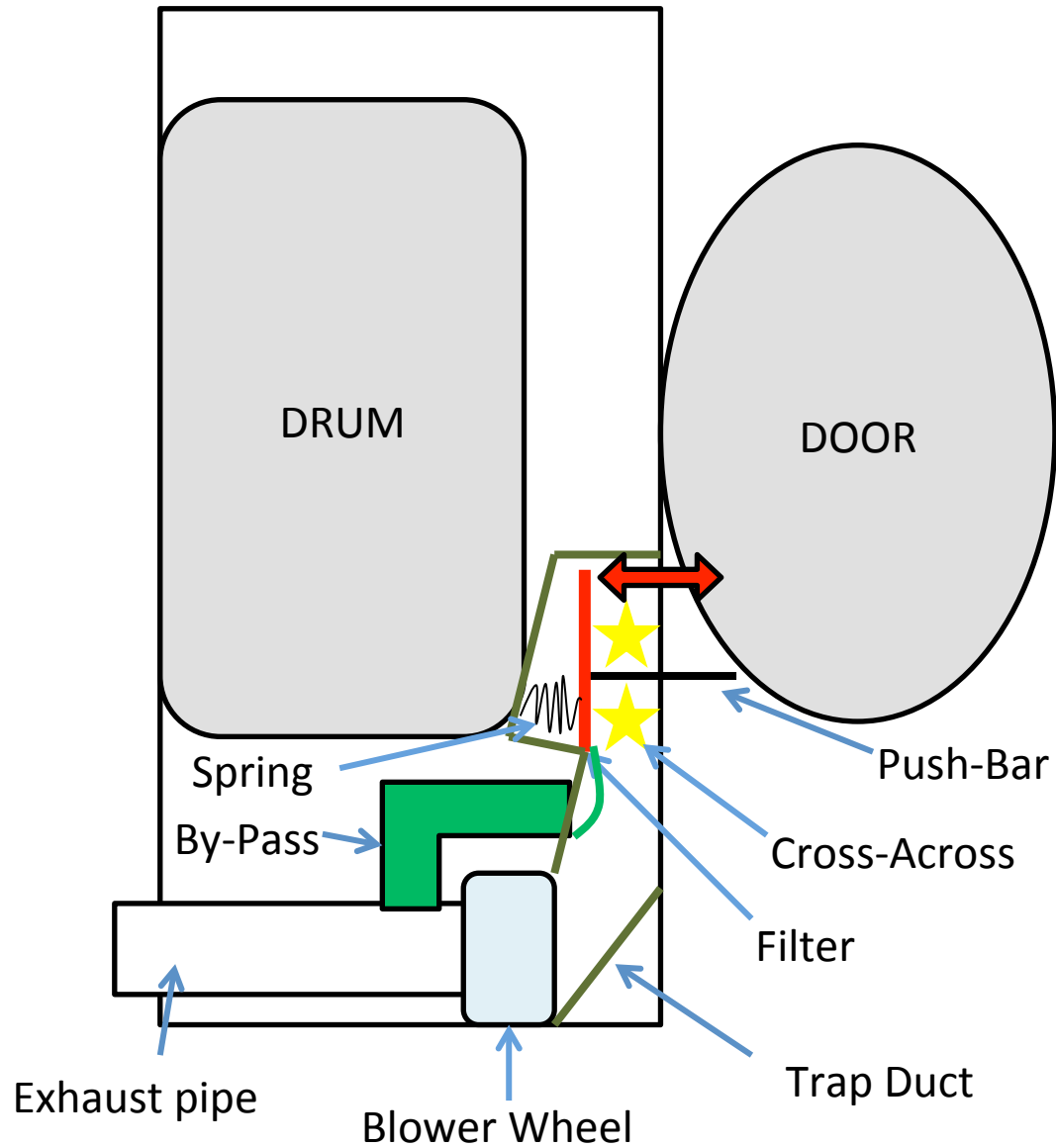
# Negative Pressure Test

- Knowing that a restriction to the system will be added because of the brush, we estimate the impact that this one will cause.

Restriction (in)	Average Negative Pressure (inH2O)	Time (min)	Time (%)	Condition
1.650	0.025	82.00	186%	Reference
<b>1.808</b>	<b>0.036</b>	<b>74.83</b>	<b>170%</b>	<b>Filter Clogged (LINT)</b>
3.125	0.125	52.80	120%	Reference
<b>3.478</b>	<b>0.159</b>	<b>47.448</b>	<b>108%</b>	<b>BRUSH (ESTIMADO)</b>
3.750	0.186	44.00	100%	Ideal Conditions

# **SELF-CLEANING SYSTEM**

# Functional Diagram





# Conclusions

- 4 cleaning proposals validated and discarded
- 1 proposal with high chances of probability
- Complete conceptual self-cleaning system sketch

# Next Steps

- Robust Design
- Real prototype
- Validation of the prototype
- What to do with the lint that has been taken out of the dryer?

# Acknowledgements

- MABE T&P
- Raúl Santillán Galván
- Guillermo Astorga
- Octavio Solís

# Programa Bicultural de Alcance Industrial 2014

Consejo de Ciencia y Tecnología del Estado de Querétaro (CONCyTEQ)

## Self – Cleaning Lint Filter Dryer



mabe



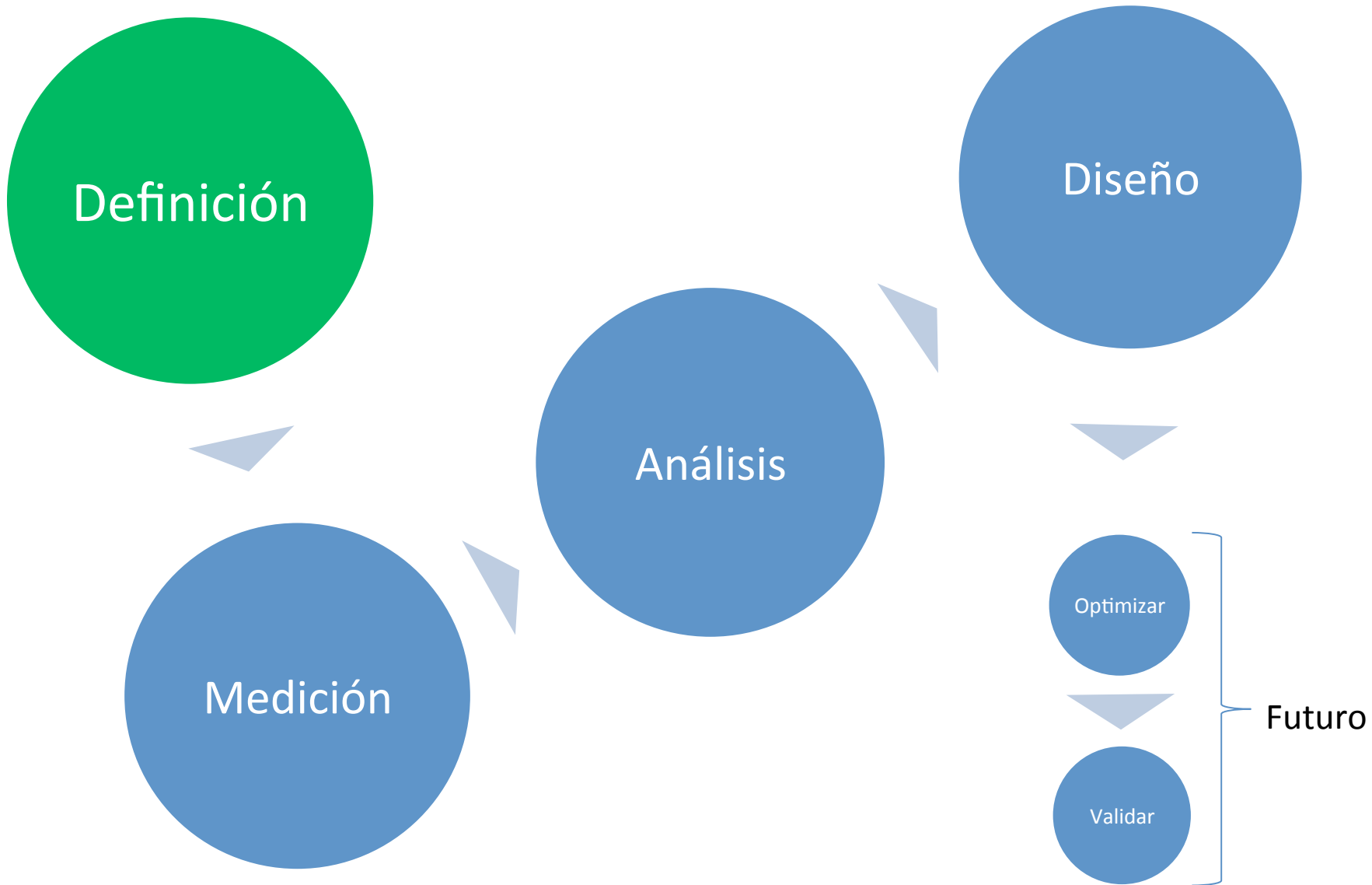
### Integrantes:

Carlos Daniel Pizano Gómez

José Octavio Trejo Guzmán

### Asesor:

Raúl Santillán Galván



# Introducción



# Objetivo

Proponer un sistema de autolimpieza del filtro a bajo costo, capaz de remover la pelusa del filtro.

## Beneficios y Resultados Esperados

Bosquejo de un prototipo funcional capaz de resolver el problema de la pelusa en el filtro

# Necesidades del Cliente

Customer	Review	Model	Rating
Carolnyc	The only thing I can't get is <b>why any clothes dryer designers can't figure out a way to either dispose of lint automatically or compact it to dispose every month or so</b> . Get on that, folks!	Wed86hebw	Recommended to buy

## Resumen:

1. El filtro es muy pequeño y frágil
2. La ubicación del filtro no es ergonómica, no apto para personas con problema de espalda.
3. Cuando se retira el filtro de su lugar, la pelusa cae dentro y/o fuera de la secadora, siendo una incomodidad para el cliente.
4. El filtro es difícil de limpiar.

# Impacto en tiempo de la pelusa en la Secadora

Restriction (in)	Average Negative Pressure (inH2O)	Time (min)	Time (%)	Condition
1.650	0.025	82.00	186%	Reference
<b>1.808</b>	<b>0.036</b>	<b>74.83</b>	<b>170%</b>	<b>Filter Clogged (LINT)</b>
3.125	0.125	52.80	120%	Reference
3.750	0.186	44.00	100%	Ideal Conditions

Basado en una carga de 12 lbs mixta



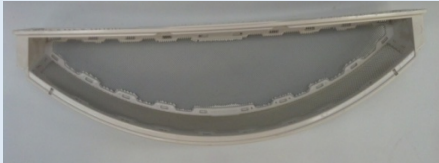



Filtro Saturado

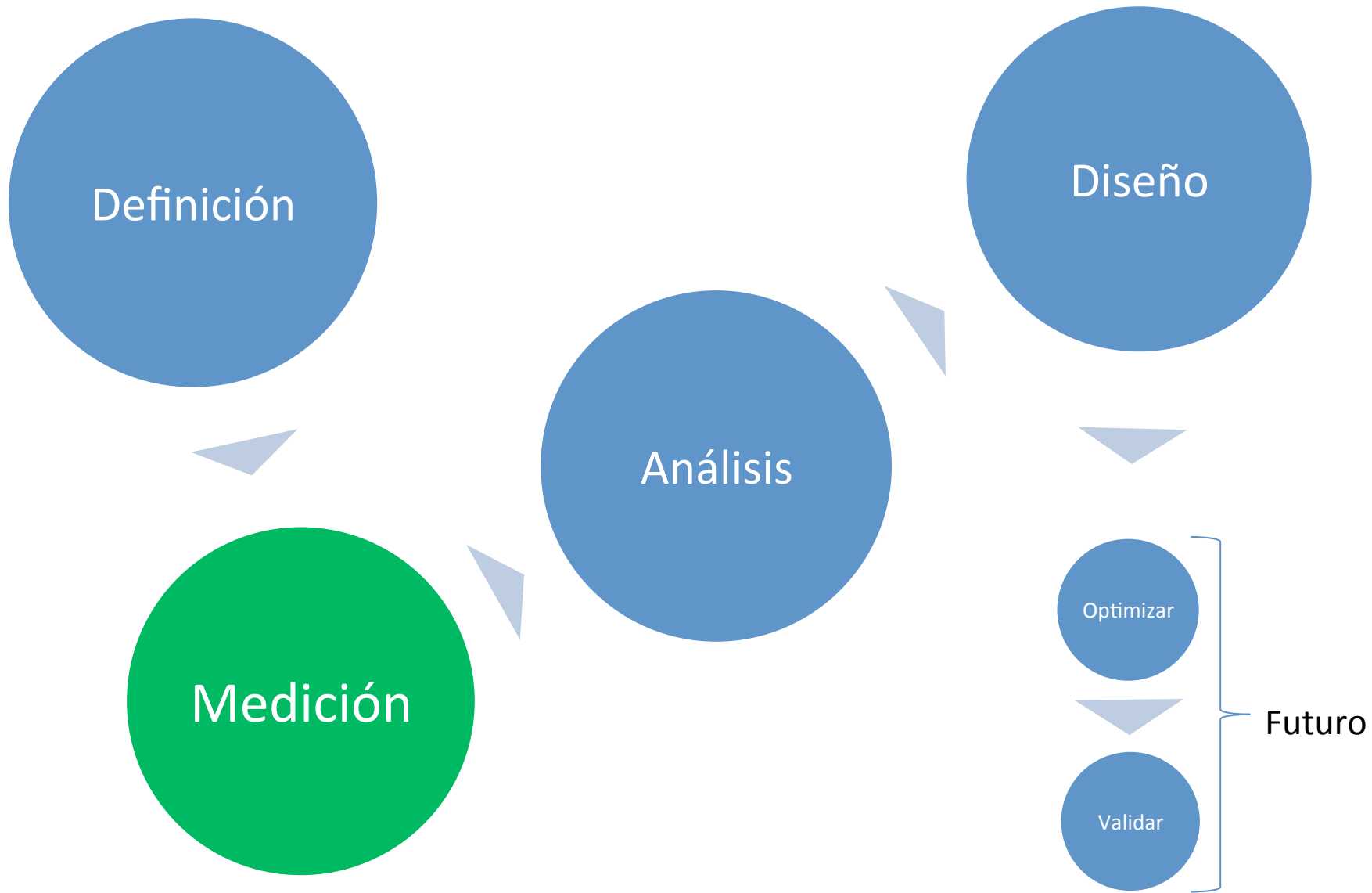
Cuando el filtro está saturado, el tiempo de ciclo de secado aumenta en un 70%.



# Alcance

- Mabe cuenta con distintos modelos de filtros de acuerdo a los productos que oferta.

Producto:	Modelo:	Condición
Laundry Center		Es un producto económica y agregarle un sobre costo, las ventas se verían afectadas.
Leadership		Dryer 2015 reemplazará este producto
HALC		El tamaño es la única diferencia entre ambos: -HA necesita 3 ciclos para saturar el filtro. -Viper necesita 5 ciclos para saturar el filtro.
Viper		<u>Se trabajará con el filtro de HA.</u> Dryer 2015 tendrá un filtro similar a HA.



# Patentes

N° de Patente	Nombre	Dueño
US4700492 A	Air actuated automatic lint screen cleaning system for dryer	Whirlpool Corporation
US6016610 A	Self-cleaning lint trap and gravity assisted lint trap	Maytag Corporation
EP1098028 A3	Laundry dryer with self-cleaning lint filter	BSH Bosch und Siemens Hausgeräte GmbH
US 3069785 A	Clothes dryer with lint burner	Gen Motors Corp
US 4669199 A	Clothes dryer with a lint incinerator	Raytheon Company

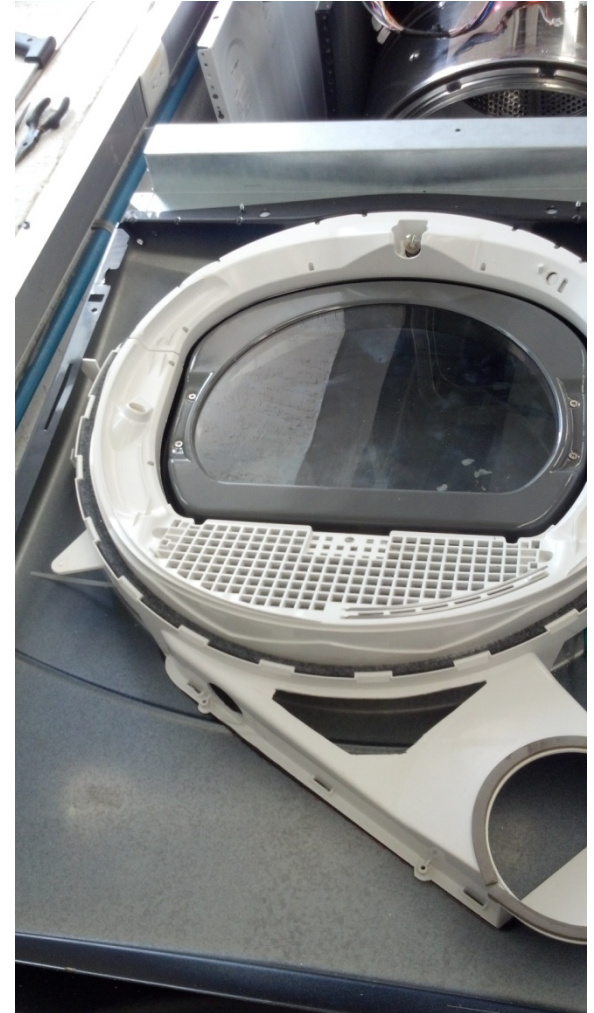
## Puntos a destacar

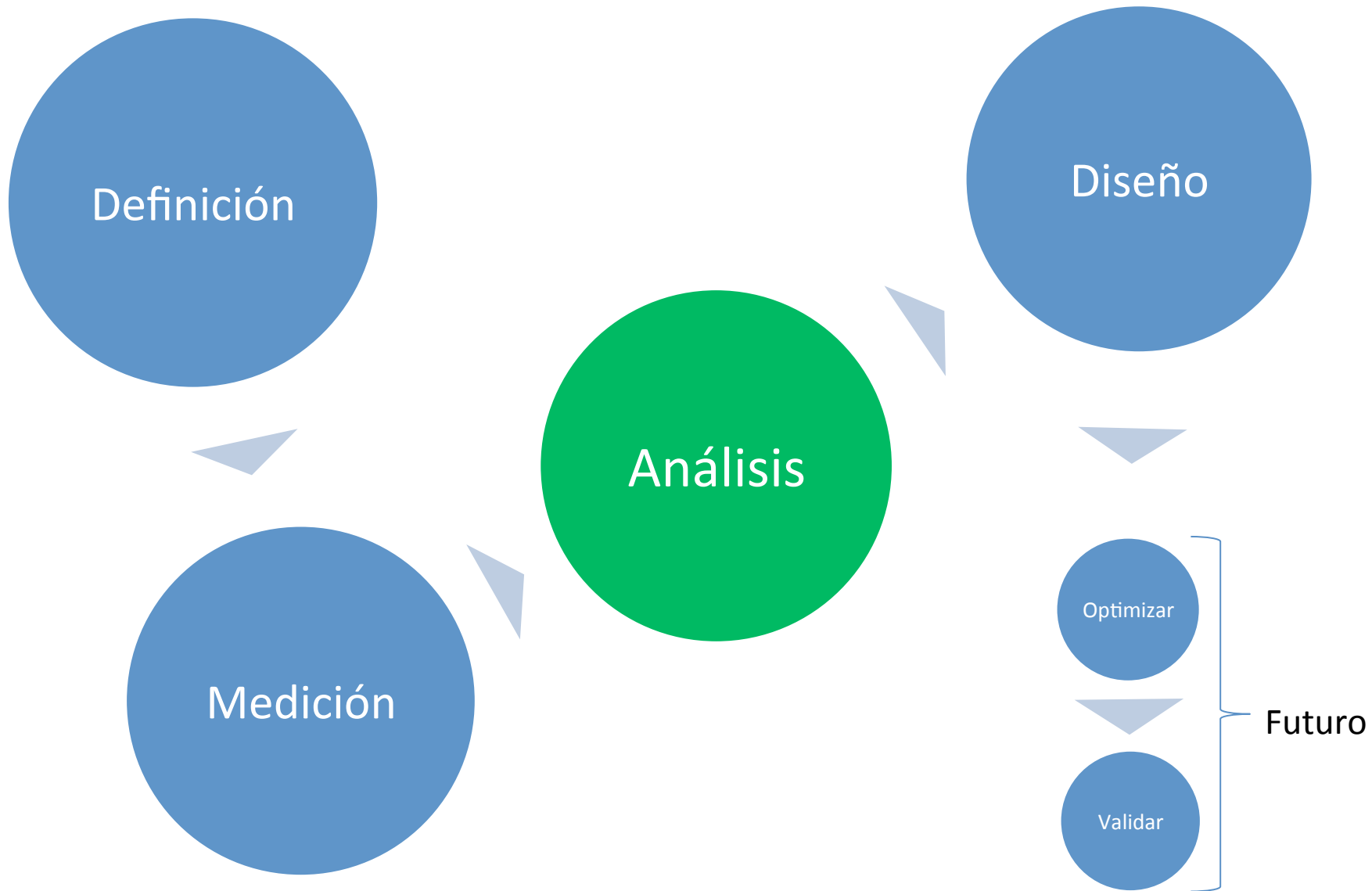
1. Los diseños son complejos y difíciles de manufacturar
2. No existe suficiente espacio libre dentro de la secadora en caso de querer implementar alguno.
3. Algunos de ellos parecen no funcionar en la realidad.

# Espacio de Trabajo



Se cuenta con un espacio muy limitado, por lo tanto, aumenta la dificultad del proyecto de acuerdo a propuestas e implementaciones al sistema.





# Sistema de Innovación Mabe

N°	Nombre	Idea	Descripción
7	Mabe Innovation	Sticky baffle	Special cleaning cycle where the sticky baffles will take off the lint from the clothes
8	Leonardo Urbiola	Built in vacuum	Filter will have a vacuum in front of it which will clean the filter.
9	Leonardo Urbiola	Electric Resistance Mesh	Self – cleaning cycle (airfluff + cooldown), electricity will heat up the mesh and will burn the lint

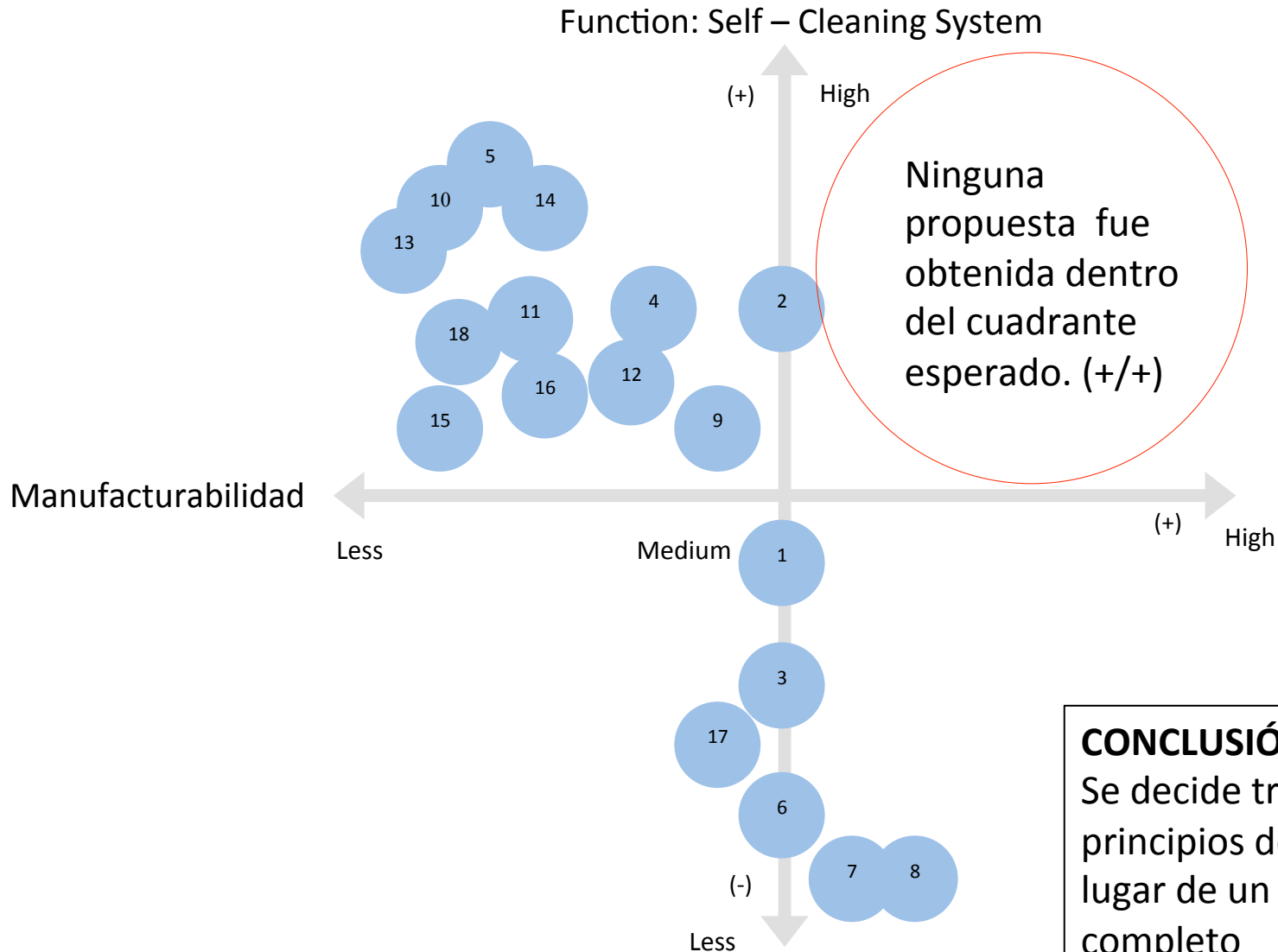
## 7 ways

N°	Nombre	Idea	Descripción
1	Raúl Santillán	Electric cable burners	Electricity will pass through the cables creating heat and lint will burn and be disposed to the outside as ashes
2	Raúl Santillán	Water spray (Mist)	Spraying water to the lint will make it fall by gravity cause
3	Raúl Santillán	Sliding item	A material capable to repel lint from sticking to it
4	Octavio Trejo	Pressured water	Water will wash down lint from the filter
5	Carlos Pizano	Brush	Brush will drag the lint from the filter and the blower will vacuum the lint to an outside container
6	Carlos Pizano	Spark burners	Sparks created around the filter will burn the lint in the filter

# 7 ways

N°	Name	Idea	Description
10	Carlos Pizano	Filter Band	The filter will be a band turning and cleaning itself by passing close to a brush which will wipe the band and lint will be disposed in an outside container
11	Carlos Pizano	Condenser Sprayer	Water sprayed to the filter will wipe the lint; the water with lint will be disposed with the same washer duct.
12	Carlos Pizano	Change design	The filter will be moved to a different angle which will help the lint to fall by gravity and blower will vacuum helping the lint to fall
13	Carlos Pizano	Sweep and collector	A turning brush will swipe the filter and a collector located under the filter will gather the lint
14	Carlos Pizano	Vacuum brushes	A brush with a built in vacuum will sweep the filter and suck the lint to an outside container
15	Octavio Trejo	Sweeping lint	Uses a band and tube collector to catch the lint
16	Octavio Trejo	Sprinkler	Pressured water cleaning out the filter and removes lint
17	Octavio Trejo	Sliding Filter	Lint won't get stuck in the filter and will fall to a container
18	Octavio Trejo	Inclined filter	Water will pass through the filter cleaning it and the filter will have an angle so the water can run easily to the outside

# Evaluación de Propuestas





# Principios de Limpieza

- **Mist**

La pelusa al mojarse aumentará su densidad y caerá por medio de la gravedad

- **Material Resbaladizo (Plástico):**

Un filtro de plástico que no dejará que la pelusa se adhiera a él.

- **Malla Electrificada:**

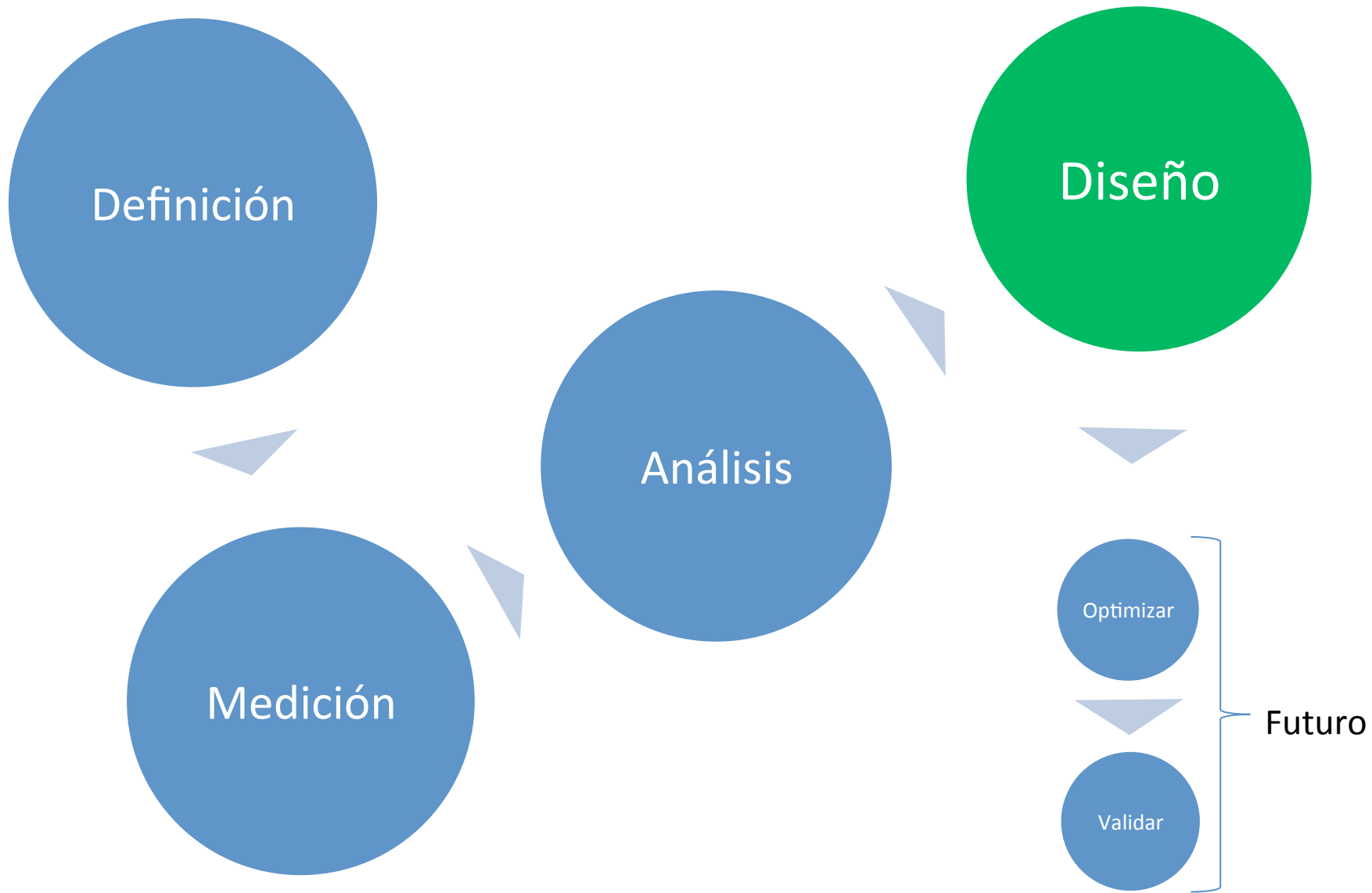
Alambre resistivo que al calentarse convertirá la pelusa en ceniza.

- **Cortina de aire:**

Presión positiva se aplicará detrás del filtro para realizar la limpieza.

- **Cepillo:**

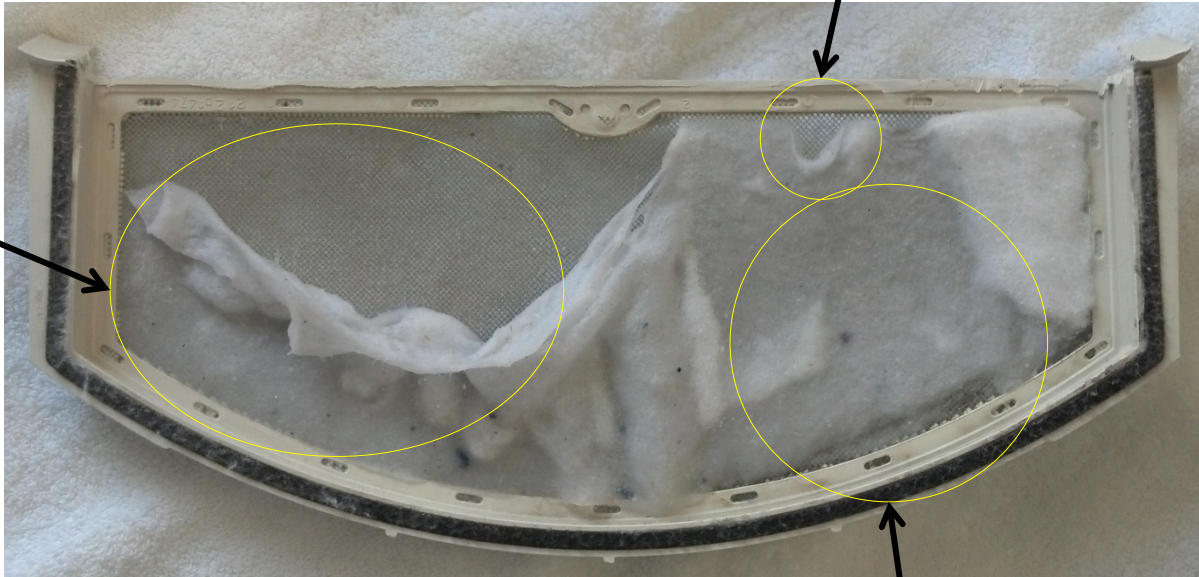
Uso de cerdas para realizar la limpieza del filtro.



# MIST

Descargas  
directas desde  
arriba

Descargas  
directas  
desde atrás  
del filtro



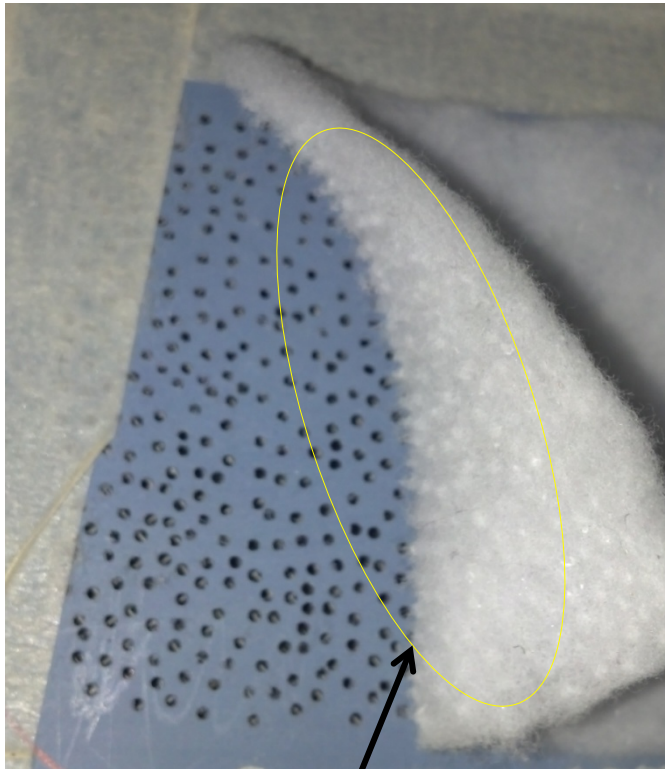
Objeto de  
prueba

La pelusa no absorbió el agua, se  
necesito una gran cantidad de agua para  
comenzar a observar algún cambio.

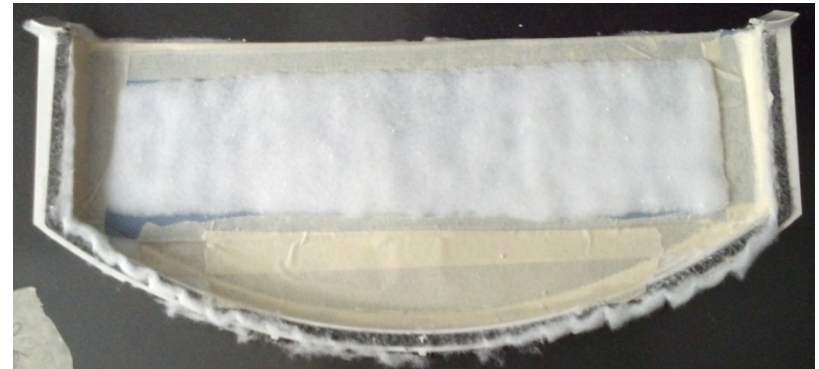
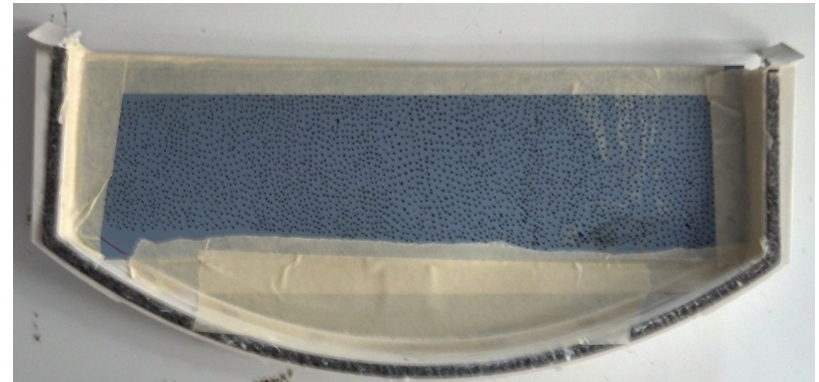
Descargas frontales  
por frente del filtro  
a una distancia de  
20 cm.



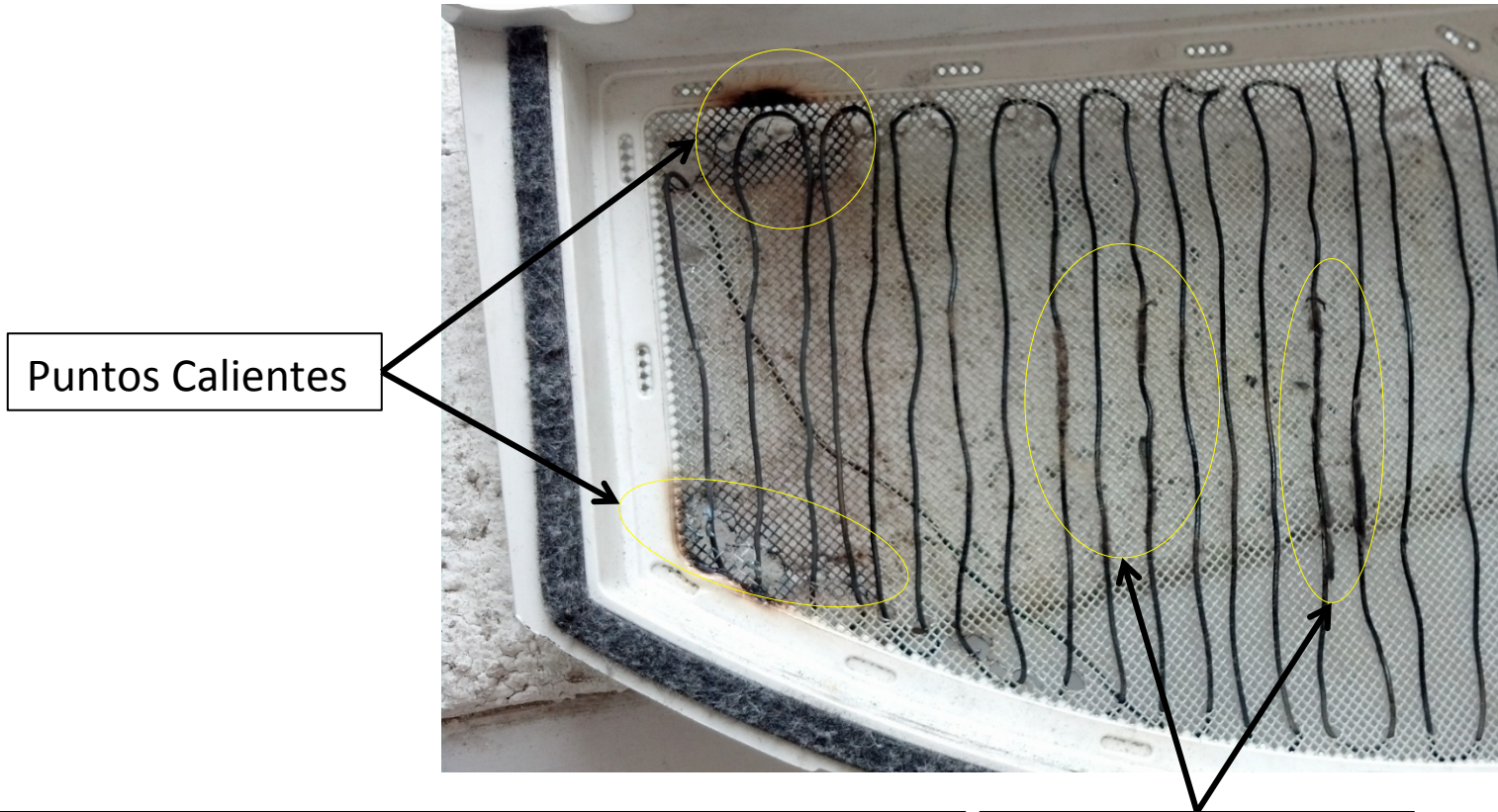
# Material Resbaladizo (Plástico)



Se obtuvo el mismo efecto que con la malla metálica, a pelusa se adhirió con fuerza en los agujeros del plástico



# Malla Electrificada



Puntos Calientes

La malla del filtro no soportó la energía que pasaba a través del alambre resistivo, creando puntos calientes que ponían en riesgo la seguridad del cliente y del producto.

Pelusa carbonizada adherida al alambre resistivo



# Cortina de Aire



Aire tomado desde el exhaust y dirigido hacia el trap-duct para colocarse detrás del filtro

Al usarse mangueras de diámetros pequeños, la presión de aire disminuían considerablemente, donde la presión negativa era más grande que la positiva aplicada, no causando efecto en la pelusa.



# Cepillo



- Prototipo
  - Cerdas flexibles y delgadas
  - Marco sólido



- Validación de Concepto: (0.7 gramos de pelusa)



Ensamble completo



# Prueba de Presión Negativa

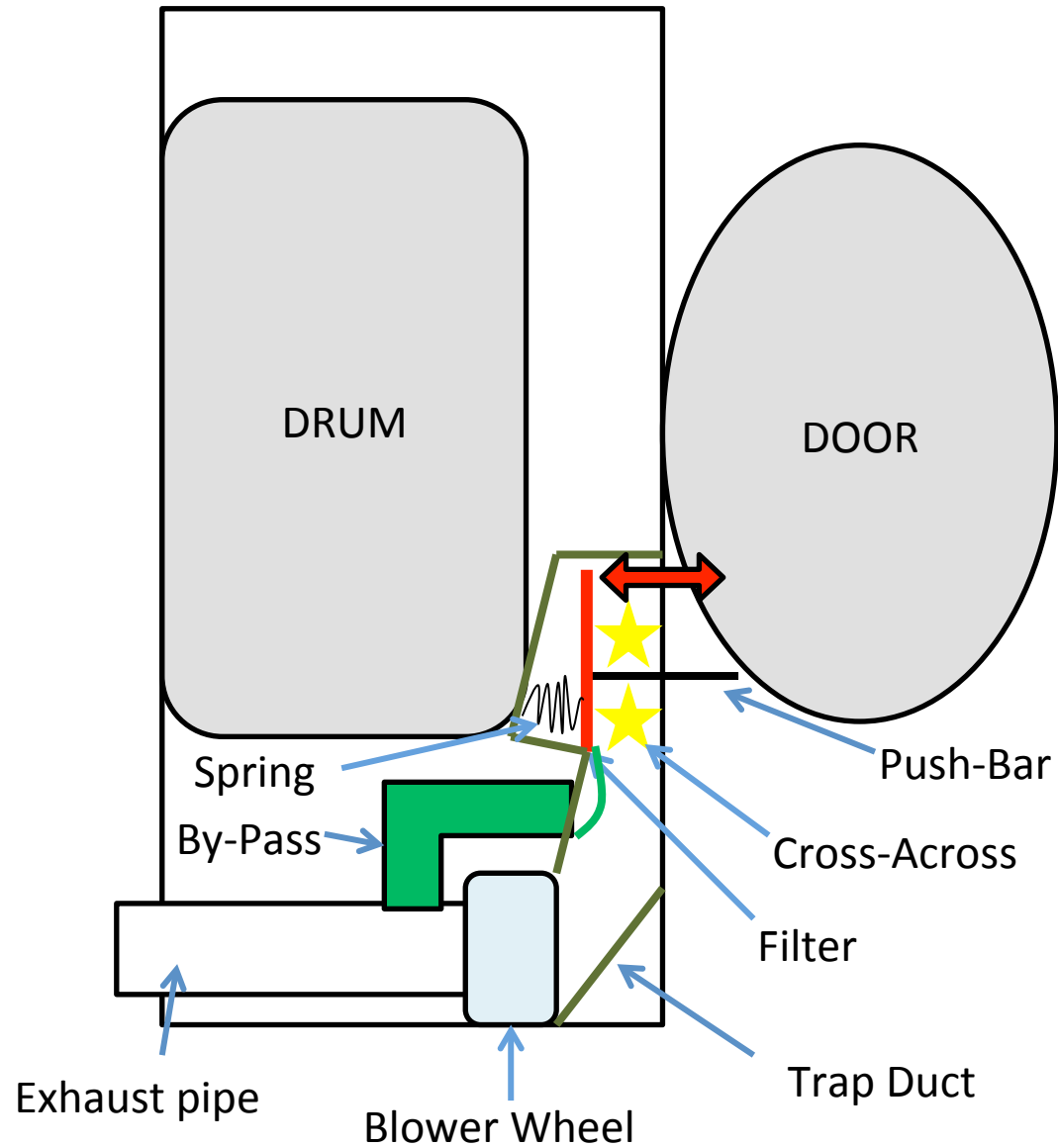
- A sabiendas que se causará una restricción al sistema con la implementación del cepillo, se realiza una estimación del impacto al sistema.

Restriction (in)	Average Negative Pressure (inH2O)	Time (min)	Time (%)	Condition
1.650	0.025	82.00	186%	Reference
<b>1.808</b>	<b>0.036</b>	<b>74.83</b>	<b>170%</b>	<b>Filter Clogged (LINT)</b>
3.125	0.125	52.80	120%	Reference
<b>3.478</b>	<b>0.159</b>	<b>47.448</b>	<b>108%</b>	<b>BRUSH (ESTIMADO)</b>
3.750	0.186	44.00	100%	Ideal Conditions



# **SISTEMA DE AUTOLIMPIEZA**

# Diagrama Funcional



# Conclusiones

- 4 Propuestas de limpieza validadas y descartadas
- 1 Propuesta con alta probabilidad de funcionalidad
- Bosquejo del sistema de auto-limpieza completo conceptual
- Prototipo conceptual del sistema

## Siguientes Pasos

- Robustez del diseño
- Prototipo Manufacturable
- Validación del sistema mediante pruebas
- ¿Qué hacer con la pelusa expulsada?

# Agradecimientos

- MABE TyP
- Raúl Santillán Galván
- Guillermo Astorga
- Octavio Solís