

AISLATE PANELS

by THE CHILENSIS

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SOLUTION SUMMARY

Overcrowding is a serious problem for most cities and Santiago of Chile is not the exception. This problem has increased exponentially during the pandemic, where all the family members have to be in the same place 24/7. We believe that people deserve some privacy and we could give it to them, creating the “Aislate” sound isolators from old palm leaves.

2. Context

In Chile there are several types of palm trees, especially the Chilean palm tree *Jubaea Chilensis* and the palm tree *Brahea armata*, known as the blue palm. Nowadays discarded palm leaves are treated as a waste. These palm trees are used as decorative plants throughout the country. Specifically in private condominiums, municipal parks and houses.

Although there is only a cadaster of the Chilean palm, existing more than 2 and a half million throughout the country, palm trees of all types are abundant in all regions of Chile due to their great resistance to the different types of climate. Additionally, Palm trees need constant maintenance, especially the blue palm whose palm leaves are shed more frequently and must be removed.

On the other hand, Chile is a country with a high rate of inequity, which is reflected in the existence of neighborhoods with higher and lower income. Santiago de Chile, the capital, has more than 7 million people and 32 communes, which are neighborhoods governed by their own municipality. These municipalities are in charge of maintaining their green areas and pruning the dry leaves of the palm trees. People who work cutting the palm leaves in private houses, condominiums and green public areas often dump the waste in illegal landfills.

Chilean household problems

In our country there are several difficulties in becoming a homeowner. According to the Property Prices Index Rate (PIR), it is almost impossible for close to 80% of the population (Cox, W., Pavletich, H., and Hartwich, O.,2019). They will need three years of their complete salary to buy an average home at the formal market. The first quintile, being the poorest segment, will need 28 years paying each month their complete salary to finish a house debt (TECHO-Chile, 2019). Besides, paying rent is also difficult. The average home costs correspond to a 48,23% of the total income, where the average for the OECD countries is 22,3% (Centro de Estudios de Ciudad y Territorio, 2020).

This situation leads people to take poor options such as living in camps, renting illegal apartments that exceed their capacity or living with other family members.

Each scenery leads to several problems of overcrowding, where 47% of households are in that position. Overcrowding negatively affects life quality and people development, a situation that has increased now because of the pandemic, one of the biggest problems carried with that is the lack of privacy that affects simple routines for most people. In addition, during the pandemic more than 4000 complaints of annoying noise were registered only in buildings in Santiago, June (2020).



Informal gardener throwing fresh-cut palm leaves in an illegal landfill.



Jubaea Chilensis in a private condominium.



Typical crowded apartments built with low quality materials.

Environmental scenario in Chile

On average, each inhabitant generates more than 400 kg of waste annually and it is estimated that only 10% of industrial and residential waste is recycled. REP law (Extended Producer Responsibility) was introduced to encourage recycling for the next few years, focusing on glass, plastic and used tires. Still, there are no major initiatives to deal with organic waste. Besides, the environment ministry's goals for 2040 are to generate 180,000 jobs related to the circular economy, increase the recycling rate of municipal waste and eliminate illegal landfills, among others.

3. Solution Overview

After discovering that palm leaf waste is present in different cities in our country, we decided to use its sound insulating properties to contribute to a latent problem; excessive noise that comes from overcrowding, developing sound isolators based on palm leaves waste. Thus, our eco-panels that we named "Aíslate", a word that means "isolate yourself" in spanish, also contains the word "Isla" that means Islands, a geographical place that people associate with palms. Our solution aims to improve people's quality of life by giving them something fundamental to their well-being: more privacy.

Using a Material Driven Design strategy we are allowed to find prospect solutions and benefits being guided from the **natural properties of our material**:

- Low-cost production
- Great sound isolation
- Contamination-free manufacturing
- Biodegradable material
- Low degradation time

We intend to be pioneers in the industry, considering that other sound isolators in the market are made of plastic or wood, generating waste that will not degrade in hundreds of years, while our product will take less than a year to degrade in a suitable humid environment.

palm fiber > plastic & wood

How does it work?

- 1 We obtained the palm leaves waste from private condominiums, houses or municipalities that are in charge of pruning their palm trees.
- 2 We start producing our sound isolator panels, then people can buy them at low price on online channels, and finally, after its useful life, people can cut it and bury it in their plants, exposed to moisture, and expect them to degrade in a short period of time.
- 3 After its useful life, people can cut it and bury it in their backyards, exposed to moisture, and expect them to degrade in a short period of time.

Competitive price

In addition, the market price of sound isolators ranges between USD 25 and USD 85 for each panel or block, while, as we save a significant percentage of investment due to the natural properties of palm leaves, we could be in the market with a competitive price of 20 USD. This price contributes to our goal of bringing middle-income families into the market that do not yet have access to this technology.

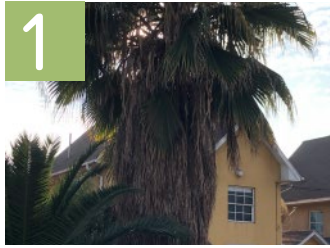
\$20 vs \$25-85

We believe that the innovative ideas of Circular Economy are the open door for people and businesses to become familiar with this economic model and to encourage them to start adapting to this consumption model in their daily lives. In this way, we will work with educational institutions that seek to involve students, citizens and communities, to increase their awareness and invite them to join us in this economic revolution.

Our business model is explained on the following diagram:

Sound Isolators Flow Diagram

Blue and Chilean palms are the most common species in Chile.



People can contact us to collect the leaves



The Chilensis produce acoustic panels



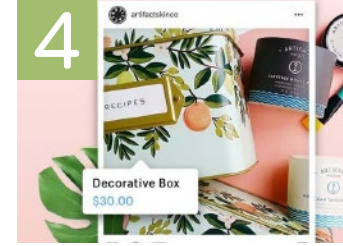
Panels can be composted after its useful life



The main function of the product is to insulate sound within homes



Sales through website and markets



4. Detailed Material Analysis

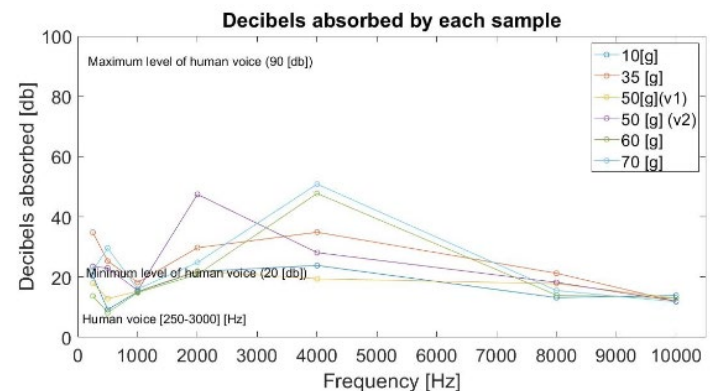
Panels are made of discarded leaves of the two most common palm species in Chile. To provide shine, hydrophobicity and antifungal protection we use linseed oil on the outer surface. For hanging the panels, we add biodegradable yarns and wood pallets. Regarding the manufacturing process, we do not produce carbon emissions or pollutants of particulate matter, since it is a handmade process. Besides, we will recycle wood pallets that are discarded in food markets.

The life expectancy of our product based on the life expectancy of a palm leaf vegetable fiber is 50 years on average in a dry ambient, taking into consideration that the dry palm fronds has been used for the construction principally on roofs from the antiquity (Johnson & FAO, 2010). However, the final product has a natural linseed oil layer to protect the palm from moisture and aging, increasing the life expectancy.

The filling inside the insulation it's 100% organic and without any chemical additives, therefore, at the end of its useful life, the material can be composted. The idea is to shred the panel into little pieces, so that the people can add these pieces to the nearest compost location, or if they

have a little garden, bury them in the soil and start the biodegradation process. As for the pallets, these are made of organic material, and the same type of sealant would be applied to them.

To improve our prototype and study its absorption properties, we used the physics laboratory of the University Santiago of Chile. We carried out an experimental setup that consisted of evaluating the relative decibel absorption of our prototypes against different sounds. Specifically, we used a microphone and a speaker in a closed tube, in which we emitted a range of sounds through our panels.



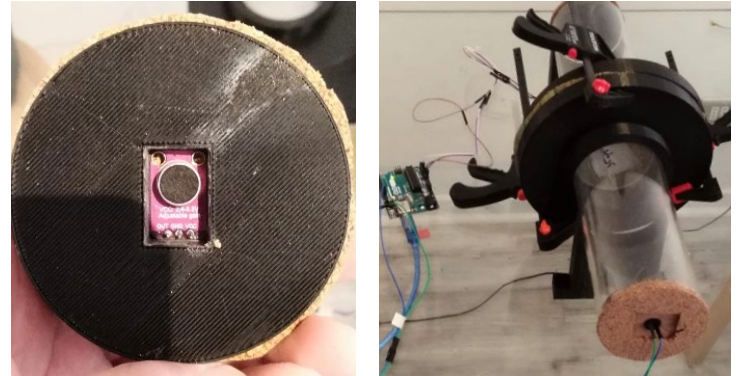
Graphic 1: Decibels absorbed by the panel samples. Each curve corresponds to a different amount of filling (in grams) in the panels. For the 50 grams, we experimented with 2 different designs of panels.

The speaker emitted sound waves of the same frequency as the human voice, to simulate the noise of a normal conversation.

Based on our experiments, a circular panel of 16 [cm] diameter, with 70g of filler, and at emission distance of approximately 30 [cm], absorbs between 30-40 [db] which suggest that our product contains great sound absorption if we compared to panels available in the market, that absorbs in the range of 30-70 [db] (Azkorra et al., 2015).

It's important to mention that the propagation of sound inside a closed space depends on many factors, like the dimensions of the room, the type of sound, the intensity of the sound, the construction material of the room and so more.

Still, under normal conditions, the greater the thickness and irregularity of the panel, the better the absorption. Therefore, the necessary quantity that each person will need will depend on the specific function for which they will occupy the panel and where they want to place it. Our first prototype is available for standard room doors.



Setup for experimental test: microphone, speaker, acrylic cylinder and 3D printed panel holder.

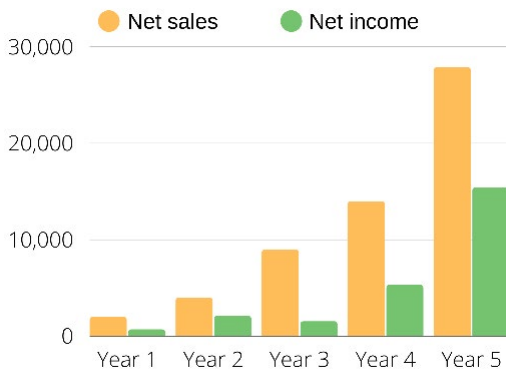
5. Detailed Economic Analysis

Business Model Canvas

Key Partners University Municipality Recyclers Government Delivery companies	Key activities Production Resources collection R&D Design	Value proposition Sound isolation Life's quality improvement Accesible Price Newness Design	Customer relationships Customer service Markets & fairs Workshops	Customer segments Upper & middle class Adults between 20-50 years Musicians
	Key resources Engineering & design Employees & knowledge Recycling culture		Channels Website Mercado Libre Instagram Facebook Marketplace	
Cost structure Manufacturing cost R&D cost Material cost			Revenue streams Acoustic panel sales Workshops Government funds	

Some of our key partners are universities and municipalities that provide us the opportunity to participate in fairs open to the communities that help us to promote our panels. In addition, we have access to university facilities to carry out our experiments. Besides, we will have as a partner some delivery companies, such as Shipit, Blue express, Chilexpress, in case of having shipments outside of Santiago.

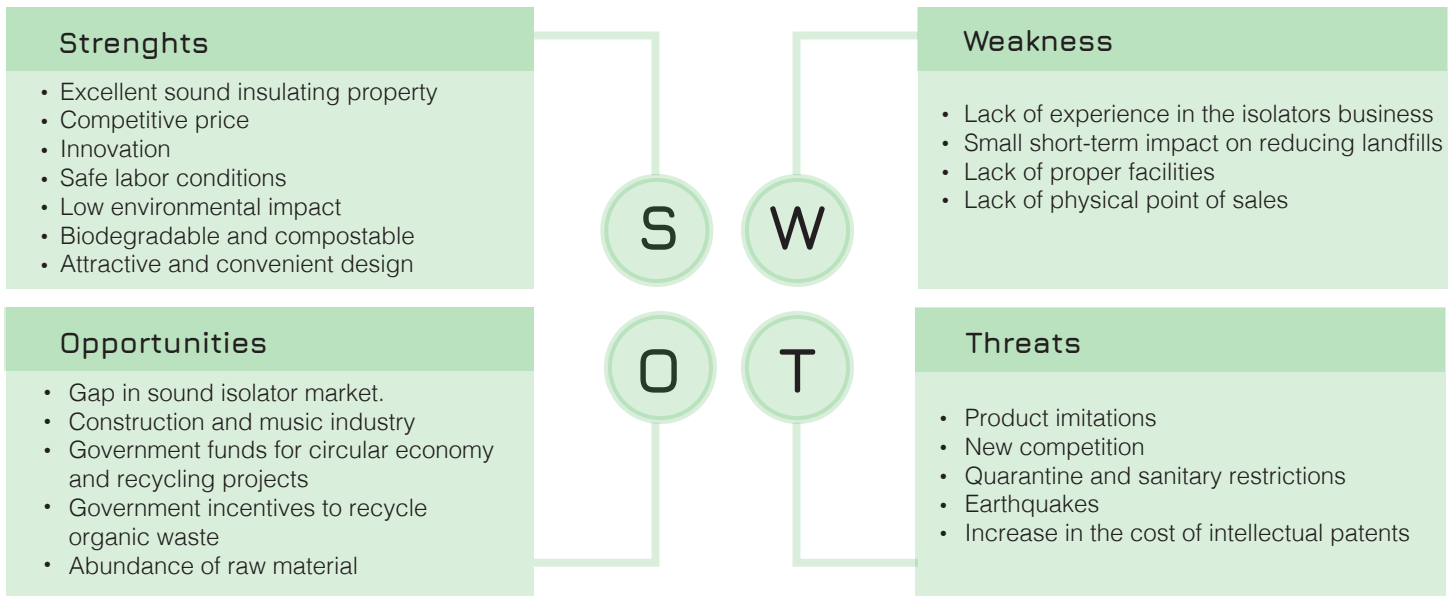
Sales will be made mainly through our website and initially the start product will have the size of a standard doors size panel launched at a very competitive price of \$20 dollars (45% less than the average market price). In addition, people can place **customized orders** depending on where they want to use the panel and how much they want to cover. Based on this information, we will recommend specific size, quantity and thickness of the panels.



Projected Income Statement (USD)	Year 1	Year 2	Year 3	Year 4	Year 5
Net sales	1.989	3.978	8.952	13.925	27.849
Cost of sales	836	1.120	2.071	2.332	3.835
Gross margin	1.153	2.858	6.880	11.593	24.014
Research and development	111	138	138	207	207
Selling, general and administrative	207	207	4.973	4.973	4.973
Operating income	835	2.513	1.769	6.413	18.834
Other income	28	83	138	166	193
Income before taxes	863	2.596	1.907	6.578	19.028
Taxes	164	493	362	1.250	3.615
Net income	699	2.103	1.545	5.328	15.412

After applying a survey to 200 people. We discovered that 72% have presented annoying noises problems during this pandemic, and more than 70% are very interested in acquiring our panels, where most of these were in the age range between 20 and 50 years. Moreover, 20% of our respondents had experience using isolating panels.

About our forecasts, this was made considering a small-scale production because we intend to continue carrying out the project ourselves on a part-time basis, and we considered making an investment in the third year in machinery to streamline the manufacturing process. Further, we intend to create specific panels for the music industry (recording studios).



Risk Analysis

People will not find us on a established point of sales.

Our main sales channel will be online but we will also participate in fairs, municipal activities and workshops to give people the chance to get to know our products. We plan to be active in social media to increase awareness.

A decrease in the economic solvency of our national consumers due to the pandemic and automation.

We would sell at a significantly lower price than our competition to reach our clients even in recessions.

Our new technology could be used by our competitor.

We will continue working on refining our product to make it more sophisticated. We will focus on researching new materials and diversifying our portfolio of products that meet the needs of society.

6. Impact Assessment

Aislate panels is project that has many advantages and benefits compared to the existing solutions.

- 1 The primary material that we use does not have a high cost associated with the obtention because it comes from residues of palm trees, therefore we have lower production costs.
- 2 The palm fiber panels have sound absorption properties that can compete with the usual non eco-friendly available in the market. For example, compared to cork boards, palm fibers absorb 46% more at 4000 [hz] frequency than this material, and 16% more when the frequency is 1000 [hz]. And in the case of Woodwool Slabs, the palm absorbs 53% more than this material at a frequency of 1000 [hz] (Elwaleed et al., 2013,p.12027; Acoustic Materials & Technologies Ltd., 2020).
- 3 The decomposition time of palm fibers with linseed oil varnish has a life expectancy of approximately one decade indoors, which is a great characteristic compared to other materials. On the other hand, our product after its useful life can be cut and thrown into the garden to be composted. Adding moisture and fertilizers like alfalfa flour is recommended to improve composting.

Since we use the complete palm residue, we would not be producing any by-product, such as CO2 emissions into the atmosphere, particulate matter, while we will generate no noise pollution and low energy consumption while we are helping with the reduction of illegal landfills, the most common destination for palm leaves that creates the perfect environment for rodents and insect nests. This gives the opportunity to create facilities for the management, distribution, and storage for some old palm leaves in the short term. Consequently, we expect that giving an important use to these residues, our initiative will encourage the communities to create health and environmental regulations within the same community, and more directly, create a culture of awareness of circular economy and how we can find multiple solutions with the materials that are already developed and discharged by nature.



Fresh-cut chilean palm leaves in residential area.

7. Prototyping

For the creation of the panel, the main goal was to create some type of (A) cover and (B) filling that would allow greater absorption of sound due to the properties of the fiber palm. This fiber fulfills a similar function to that of materials used in other types of insulators, such as glass wool or rockwool, since the agglomerate of this fiber absorbs the sound that is generated inside the room. In addition to the layer of palm leaves that will cover this agglomerate and give a better final look more suitable to home's decoration.

In order to keep the (A) process simple, we worked with the leaves just as they came to us, dried. Working with dried leaves makes the process easier but adds one necessary step: Clean the leaves, where we use UV treatment to avoid the proliferation of fungus. We placed them in order and did a series of step-by-steps processes. We sew it, fill the interior and cut the remaining excess of fibers which will be used in the next steps, no waste here. We finish the (A) process applying linseed oil to increase the durability and useful life of the panels up to 10 years.

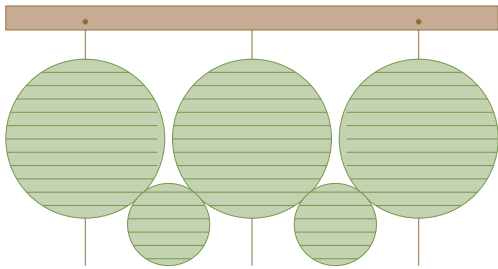


When it is necessary to work with the palm leaves moistened is to create the (B) filling. The goal is to mix the fibers in order to create some type of “nest” which will decrease sound waves intensity and by result, insulate the area.



Arranged fiber forming the “nest”

To completely cover the area we want to isolate, the panel design has two sizes of panels, one large and one smaller that covers the space between the large ones and also brings unevenness on the shape that results in better sound coverage. Furthermore, the curtain-shape arrangement makes it easy to install, no assembly needed and ready to use. We have the main version which is meant to be installed behind the doors because they are usually made of lightweight materials and non-insulating materials.



Full curtain-shape panel prototype behind a door

We experimented with different fixing methods and materials to come up with a shape that fits both the material and insulation requirements for the panel. What the material allows us to do with it and accomplish our insulation objective.

We have developed multiple prototypes looking for the cleanest process that in turn does not significantly affect the degradation point of the material properties, having major discoveries that will allow us to have a clean and low energy cost in the process. In relation to sustainability and environment, the raw material we use has low environmental impact, it is sustainable and retrievable.

Even though we initially developed a round shaped panel we are now working in another shape that can be more modular and cover better the area to insulate. The below image is a photoshop of it.



Triangular shaped panel mock-up

Finally, in the future we want to automate this process, including machines that can improve and make fast the processes. The machines we need for the first step is a shredding cutter for natural fibers for the fill and an automatic sewing machine that gives the circular forms to panels. Some processes would still need to be made manually by our ourselves.

8. Barrier acknowledgement

Our main barriers have to do with a logistical problem. Nowadays, the palm leaf extraction process does not have legal regulations on the treatment of their organic waste. After researching and consulting, we noticed that a common practice is for them to be disposed off in clandestine landfills. This situation difficulties the collection process since there is not a legal disposal for them. As a solution to this, we would start with a smaller impact working with the disposable leaves we find commonly in public areas close to our installations, paying the recyclers a fee to bring us the raw material. Then, we would like to propose an alliance with the municipalities to work with us after we start the production of our panels. We believe that this alliance has a great potential, given that Chile intends for the next 20 years to increase the involvement of municipalities in the recycling of their waste and the elimination of illegal landfills.

As a small addition, if we could access the prize money, we will be able to improve the characterization of our panels. Instead of determining relative decibel absorption, we will perform a description of the material with the acoustic absorption coefficient, which is a far more complete way to characterize the sound absorption properties (suggested by the International Standard ISO - 10534-2). However, to do this we will need specialized equipment, and therefore their price and implementation it's expensive, but it will allow us to significantly improve the quality of our panels.

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- Survey of 203 people with 16 questions. Some of these were about their demographic data, type of home, number of people they live with, noise problems, previous experience with acoustic isolators, and personal perception of our panels.