Entrepreneurship as a Catalyzer of Housing Quality Enhancement in Colombia: Tervi

by

Alberto Cuéllar Cerón
Bachelor Of Science in Civil Engineering
Universidad de los Andes – Bogotá, 2015

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Authored By:	Alberto Cuéllar Cerón MIT Center For Real Estate and Department Of Urban Studies and Planning May 12, 2023
Certified By:	Professor Albert Saiz Daniel Rose Associate Professor of Urban Economics & Real Estate; Faculty Director, Urban Economics Lab Thesis Supervisor
Certified By:	Professor Justin Steil Associate Professor of Law and Urban Planning Thesis Supervisor
Accepted By:	Professor Siqi Zheng STL Champion Professor of Urban and Real Estate Sustainability MIT Center for Real Estate + Department of Urban Studies and Planning Faculty Director, MIT Center for Real Estate (CRE) Director, MIT Sustainable Urbanization Lab
	Ceasar McDowell Professor of Practice of Civic Design Department of Urban Studies and Planning Chair, MCP Committee

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ABSTRACT

The evolution of cities in Latin America has been shaped by a complex interplay of factors, including political history, informality, geography, and culture. With one of the highest rates of urbanization in the world, the region's urban centers have experienced a surge in makeshift settlements as governments struggle to meet demand and provide affordable housing. The result is a critical housing deficit, both in terms of quantity and quality, which requires innovative solutions from both the government and the private sector.

The narrative in this thesis unfolds exploring the housing deficit in the region, focusing specifically on Colombia's case and the implications of the existing social housing system on the market. By examining the actors involved, the policy framework, and the current status quo, I sought to reveal the potential for local governments, developers, entrepreneurship, and technology to play a more influential role in addressing the quality gap. In 2021, I co-founded Tervi, a platform designed to provide low- and mid-income homeowners in Colombia access to design, financing, and construction services to improve their substandard dwellings and dignify their living conditions. Drawing on my experiences in conceiving, developing, and engaging with families, communities, and stakeholders during the deployment of the minimum viable product and proof of concept, this thesis highlights the potential of tech-enabled solutions to have a direct impact on life quality through home improvements. Furthermore, the thesis explores potential alternatives to address housing quality deficiencies and challenges the notion of the qualitative deficit as a fixed threshold for classifying the complex concept of home. It argues that factors such as livability and well-being are equally important in the creation of just and comfortable living conditions, and that policies must take these factors into account to avoid perpetuating substandard housing.

The outcome of the process outlined in this thesis is a digital platform that aims to bridge the gap between much of the homeowner population in Colombia and access to high-quality standard homes. In essence, a platform that provides *home improvement as a service* supporting social housing homeowners in transforming their incomplete dwellings by using technology to optimize their resources and unlock the full potential of their equity. Ultimately, stating that developing prop-tech platforms in the service of communities can augment their opportunities to progress and contribute to the creation of healthier, more comfortable, and just living conditions.

Thesis supervisor: Professor Albert Saiz

Title: Daniel Rose Associate Professor of Urban Economics & Real Estate with tenure; Faculty Director, Urban Economics Lab

Thesis supervisor: Professor Justin Steil

Title: Associate Professor of Law and Urban Planning

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1. Introduction

1.1 Housing, a Fundamental Right

Beyond being a fundamental right established in the Universal Declaration of Human Rights, housing has proven to be an avenue for the progress, wellbeing and development of individuals and communities across geographies. Homeownership continues to demonstrate its capacity to be a driver of personal, health, and economic welfare as an effective instrument in combating poverty. Several social benefits result from owning a home. Positive homeownership experiences result in greater participation in social and political activities, improved psychological health, financial stability, wealth creation, and even higher high school and post-secondary school completion rates (Rohe & Lindblad, 2013).

Moreover, the quality of housing has a significant effect on health outcomes. The National Health System in the United Kingdom has conducted thorough research on the impacts that enhancements to social housing may create on individual health. Studies were undertaken between January 2005 and March 2015 with a pool of over 32,000 residents living in social housing and subject to improvements ranging from heating systems to insulation, kitchens, and bathrooms. After cross-referencing this data with hospital visits, the study revealed that meeting housing quality standards via home-improvements generated a substantial reduction in emergency hospital admissions. Conclusions surpassed expectations in a randomized controlled design. For instance, people of all ages living in homes in which electrical systems were upgraded – resulting in more efficient heating and ventilation systems – had 34% fewer combined admissions than those in the reference group. Similar results were found with door, window, and wall insulation upgrades (Rodgers, et al., 2018).

Studies such as the one portrayed above underscore the urgency that improvements and access to adequate housing represent, particularly to vulnerable populations who often lack adequate living conditions. Evidently, housing is fundamental as a vehicle to provide comfort, security, and dignity. Hence, having a common ground to classify when it does not meet these standards is necessary to identify where efforts must be concentrated. The concept of housing deficit has been widely used to refer to the housing shortage from a quality and quantity approach. The UN has characterized it as the set of unsatisfied housing needs of a population, including: (i) the absolute lack of housing; (ii) the lack of housing for exclusive use of a household and under secure conditions of

tenure; and, (iii) the inability to access adequate or quality housing (ONU-HÁBITAT, 2015). Figure 1 depicts these different typologies of basic housing needs. Herein, the third concept is broken down into dwellings that don´t guarantee minimum livability conditions and those with deficiencies or problems that can be repaired.

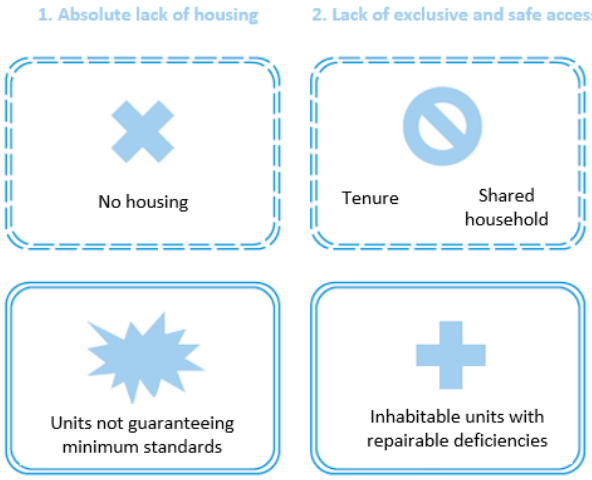

Figure 1- Categories of unsatisfied housing needs (ONU-HÁBITAT, 2015)

In order to facilitate the characterization of the housing deficit, two major concepts are salient – the notion of a required dwelling unit and the adequacy of the dwelling itself. This has enabled policymakers and multilateral entities to bifurcate the categorization into quantitative and qualitative deficits. Although both are equally urgent, it is worth distinguishing them separately as they usually require different modes of analysis and subsequent policy. They are regularly used to describe the lack of suitable housing in a country, and it is useful to understand their specific definition for the objectives framed throughout this thesis.

Quantitative housing deficit refers to the absolute shortage of dwelling units in an area, measured in terms of the number of households that do not have access to adequate housing. This deficit stems from the aggregation of various indicators such as the shortage of housing units to fulfill market demand, number of households that are overcrowded, homelessness, and units in risk of collapsing that require full replacement. Saiz et al. (2022) describe it as the need to completely replace fractions of the existing stock due to its extremely low quality. The study further highlights that this deficit tends to expand moving forward if new housing construction falls below expected household

formation requirements. The quantitative deficit is that which governments aim to tackle by enabling instruments to facilitate a more accelerated and affordable access to housing as an absoulte number. Possible strategies include strengthening the mortgage market, subsidizing demand and supply, or via affordable housing legislation.

Given the essence of this document, however, I will primarily focus on the concept of qualitative deficit, which refers to the inadequacy of quality within the existing housing stock. This is predominantly expressed as the percentage of homes in a country or region that would require major improvements to be at minimum standards for habitability (Saiz, Cuellar, Ganitsky , & Rodriguez, 2022). Specifically, this may include dwellings in substandard conditions that lack floors, natural lighting, proper insulation, or basic utilities and demand some kind of enhancement. Many of the homes classified under this category are the result of poor quality construction materials and workmanship – a phenomenon common across makeshift and informal settlements. Structures frequently made of mud, thatch, or corrugated iron sheets prone to deterioration and collapse, thus jeopardizing their occupants' wellbeing. The CEPAL (Economic Commission for Latin America and the Caribbean, in Spanish) categorizes the qualitative deficit across three primary dimensions: (i) materiality, (ii) inhabitable space, and (iii) basic utility services (ONU-HÁBITAT, 2015).

Furthermore, sometimes this quality shortage can also be classified as dwellings that lack access to jobs, schools, services, or transportation networks. Even if not necessarily a housing problem per se, this categorization is reasonable as livability impairments resulting from limited service accessibility may be resolved through new job location, transportation policies, and investments in public facilities or infrastructure. (Saiz, Cuellar, Ganitsky , & Rodriguez, 2022). As opposed to the quantitative deficit, which poses a plainer definition, drawing the line to qualitatively categorize a house is more cumbersome. Defining quality is a subjective construct; as such, more variables are often factored into the equation and vary depending on individual needs or household composition. This makes it complicated to account for all considerations that can also be influential beyond quantified basic standards. For example, although existing metrics amalgamate most of the parameters mentioned above, they completely disregard livability, usability, layout, and architecture which are usually fundamental in the daily people-space interaction. In Chapter 2, some of the policy and market implications of obviating this concept will be further examined.

Clearly, both quantitative and qualitative deficits require aligned efforts to eventually guarantee housing as a fundamental right. In Latin America specifically, the challenge of providing quality housing for the population has come with ample debate across the private and public spheres. For governments, policymakers, real estate developers, and entrepreneurs who sit at the intersection of these issues, it is worth benchmarking the region's current situation as a means to understanding the scale, complexity and nature that the implementation of meaningful solutions will come with.

1.2 The Latin American Context

Historically, Latin America has struggled to provide quality housing – an ongoing challenge further exacerbated by climate change, income disparity, and ineffective efforts to mitigate informality. High urbanization rates due to violence, displacement, and lack of opportunities in rural areas pose demographic and infrastructure pressure to major cities, which often cannot react fast enough to embrace this phenomenon in an ordered fashion. The result is rampant informal housing across virtually every major city in the region, i.e., structures built without an official permit, often without official title or deed, and spanning over a large area. This phenomenon is usually an unfortunate necessity for low-income communities to access urban shelter in most Latin American countries and occurs at the expense of settling in areas at risk of environmental hazards not suitable for inhabiting (Saiz, Cuellar, Ganitsky , & Rodriguez, 2022).

For the past fifty years, major urban centers have witnessed increasing migration from rural populations, and the region now has one of the highest urban population rates in the world (Murray, Monetti, & Ween, 2018). In some countries, urban populations have been growing at staggering rates oscillating between 4% and 10% annually (Adler & Vera, 2018). This growth has resulted in unregulated urban sprawling and normalization of precarious settlements in the urban periphery (ONU-HÁBITAT, 2015). Table 1 lists the recorded data comparing spatial and economic informality of South American countries. The second column in the table categorizes ranges of informal economy share by the OECD. Excluding Guyana as an outlier, the region is highly urbanized and there seems to be a correlation between urbanization rate and economic informality, as well as the informal housing patterns manifested as slums.

	OECD categories (CEPLAN, 2016)	Percentage urban	% of population living in slums
Uruguay	30–45%	95.2	no data ever recorded
Argentina	30–45%	91.6	16.7
Chile	30–45%	89.4	low proportion of slum dwellers
Brazil	30–45%	85.4	22.3
Guyana	30–45%	28.5	33.1
Venezuela	above 45%	88.9	high proportion of slum dwellers
Peru	above 45%	78.3	34.2
Colombia	above 45%	76.2	13.1
Bolivia	above 45%	68.1	43.5
Ecuador	above 45%	63.5	36
Paraguay	above 45%	59.4	moderate proportion of slum dwellers
Suriname	n/a	66.1	7.3

Table 1 - Informal economy, urbanization, and slums in South America (Murray, Monetti, & Ween, 2018)

Colombia's case particularly stands out as still having room for urbanization and a considerably low percentage of its population living in slums compared to its neighbors. This is potentially explained by Colombia's economic growth, its technocratic and effective housing policy (to be analyzed in Chapter 2), and the country's relative ability to tackle violence over the past two decades. Nevertheless, continued urbanization tending to balance the trend with countries in the region should be expected and will demand efforts from local authorities, planners, and government to control the increasing probability of urban population falling into slums and informality.

Beyond urbanization rates, the informal economy appears ubiquitous across the continent and deeply rooted to the proliferation of slums. Table 2, shown below, portrays its significance among South American countries. Except for Uruguay, informality has increased over time across every Latin American country, thus highlighting the challenges caused by a rapidly growing population and the need for regional housing improvement. Fifty percent of the region (Bolivia, Colombia, Ecuador, Paraguay, Peru and Venezuela) has astounding informality rates above 45%. As long as informality as a share of the total economy is not mitigated, pivoting from informal housing (an accessible and often exclusive avenue to shelter) will remain a thorny avenue.

	% for 2008	%	year	2017 (average)	OECD categories (CEPLAN, 2016)
Argentina	32.9	n/a	n/a	32.9	30–45%
Bolivia	n/a	71.8	2009	71.8	above 45%
Brazil	28.4	36.9	2013	32.65	30–45%
Chile	32.1	n/a	n/a	32.1	30–45%
Colombia	43.5	60.2	2014	51.85	above 45%
Ecuador	50.7	40.4	2015	45.55	above 45%
Guyana	36.7	n/a	n/a	36.7	30–45%
Paraguay	68.2	64.5	2013	66.35	above 45%
Peru	38.1	74.3	2012	56.2	above 45%
Suriname	n/a	n/a	n/a	n/a	n/a
Uruguay	36.2	24.7	2015	30.45	30–45%
Venezuela	43	47.5	2009	45.25	above 45%

Table 2 - The Informal Economy in South America (Murray, Monetti, & Ween, 2018)

As is perhaps expected, enacting robust policy to enable housing opportunities for the poor must be simultaneously coupled with steady macroeconomic trends and GDP growth. The effects are connected: unless affordable housing opportunities improve and informality is mitigated, low-income housing opportunities will remain limited. Unless per capita income increases, it is likely going to constrain residents' willingness and ability to access improved living conditions. Only together with focalized policy and economic stability will individuals be able to overcome informality and access formal and quality homes. For example, it is no mystery that access to mortgages for new housing and credit for home-improvements in Latin America are usually inaccessible for informal households. In fact, within several countries in the region job informality results in high unbanked populations; only 30% to 50% of adults have bank accounts as opposed to a 90% share in countries like the US (Baquerizo, Cubria, Marchi, & Sawaya, 2019) Consequently, this friction to join the banking system usually limits access to a mortgage and other financial services for a substantial portion of the population.

Governments' and financial entities' role in battling the informal status quo is crucial, as will be explored in Chapter 2. Beyond policy targeting informality and macroeconomic stability, incentives to simplify access to credit and mortgages will be essential in tackling the quantitative deficit. Today, a still young secondary mortgage market, high interest rate environments, and a stringent financial system create barriers that are difficult to overcome by those who are self-employed or with unstable and non-recurring income. There has been some progress in countries like Brazil, Mexico, and Colombia to enact the required legislation to integrate capital and mortgage markets via securitization, to bring liquidity to the market, and thus allow for longer-term mortgages.

Nevertheless, today only six countries (Argentina, Brazil, Chile, Colombia, México and Panamá) register issuance of mortgage-backed securities (Gonzales, 2005).

Indeed, more thorough financialization of mortgages to aid low-income homeowners to access the formal market will require both public and private efforts; the secondary market will need to assume a fundamental responsibility in augmenting access to housing. Saiz et. al. boldly state that "we need much more financialization in Latin American housing markets, with a focus on improving the living conditions of the middle working classes and those currently excluded or at the margins of their economies." (Saiz, Cuellar, Ganitsky , & Rodriguez, 2022) Today the region is still full of credit invisible individuals with limited or no financial record. Hence, private initiatives aiming to address this underserved market have a great potential for impact.

All of the above forces, in addition to local authorities' limited capacity to enact policy and provide infrastructure, promptly has aggravated both qualitative and quantitative deficits in the region. Of the more than 600 million inhabitants in Latin America, over 120 million live in informal and inadequate housing. This represents 20% of the total population (Urban Housing Practitioners Hub, 2020). The region faces an enormous challenge, as mitigating the formal housing deficit must be bolstered by reducing income inequality and poverty. To facilitate access on the demand-side, the government must concurrently stimulate a stable macroeconomic environment and encourage affordable housing supply policies. Some progress has been made in this space and since 1990 the proportion of the population living in slums has been reduced from 33% to 21% (Adler & Vera, 2018), however there's still a considerable shortage that needs to be addressed and in some cities and countries this figure has even escalated over time.

Table 3 aggregates qualitative and quantitative deficits in number of households for countries that reported data to UN Habitat. The table compares the results based on the year 2000 census or closest vs the year 2010 census or closest). Although the information is not fully available for every country, the exercise does exemplify the sheer size of the problem, and the presence of underlying drivers as discussed through this chapter. This again represents another regional challenge, which is the availability and quality of information, a factor highly correlated to the quality of effected policy. Of course, the volume of the figures presented is proportional to each country's population and size, which makes Mexico and Brazil particularly stand out.

	Year 2000 or Closest measure Available			Year 2010 or Closest measure Available		
Country	**Estimated Qualitative Deficit**	**Estimated Quantitative Deficit**	**Source**	**Estimated Qualitative Deficit**	**Estimated Quantitative Deficit**	**Source**
Brazil	12,000,000	7,200,000	2000 Census	13,000,000	6,900,000	2010 Census
Argentina	2,126,233	926,047	2001 Census	2,156,658	1,255,817	2010 Census
Chile	677,556	543,542	2002 Census	n/d	495,390	CASEN Survey 2011
Colombia	n/d	n/d		2,520,298	1,307,757	2005 Census
Costa Rica	146,378	24,809	2000 Census	145,099	25,017	2011 Census
El Salvador	n/d	n/d		416,648	61,260	2007 Census
Guatemala	611,495	410,907	2002 Census	1,061,900	712,100	Habitat for humanity Guatemala
Mexico	24,845,481	8,783,336	CONAVI 2001	21,526,675	9,675,005	CONAVI 2010
Paraguay	705,298	98,719	2002 Census	n/d	n/d	
Peru	n/d	n/d		1,470,947	1,860,692	2007 Census
Dominican Republic	480,000	320,000	National Office of Statistics	540,000	360,000	National Office of Statistics
Uruguay	245,769	83,000	1996 Census	213,954	51,889	2011 Census

Table 3 – Quantitative and Qualitative deficit Latin America (ONU-HÁBITAT, 2015)

The region evidently shares common traits and challenges. Particularly on the qualitative shortage, overcoming the deficit appears as a particularly large feat, most likely triggered again by informality as a catalyzer of low-quality housing. Raising the quality bar will require major investment in materials, utility infrastructure, and securing tenure, among others. An investment of over $30 billion USD or $3,000 USD per household, is estimated to be required to bridge the quality material gap alone. Likewise, narrowing the infrastructure gap the figure is even more concerning: this will demand an investment of over $5,000 USD per household in deficit, i.e., $107 billion USD (Adler & Vera, 2018). Normalizing the data to account for total population helps better understand the context and challenges of each country. Thus, Figure 2 describes the share of households in qualitative deficit

as a percentage over country's total housing stock. Unlike Table 3, when accounting for population size, Bolivia, Nicaragua, and Ecuador appear to be the most critical nations in the region.

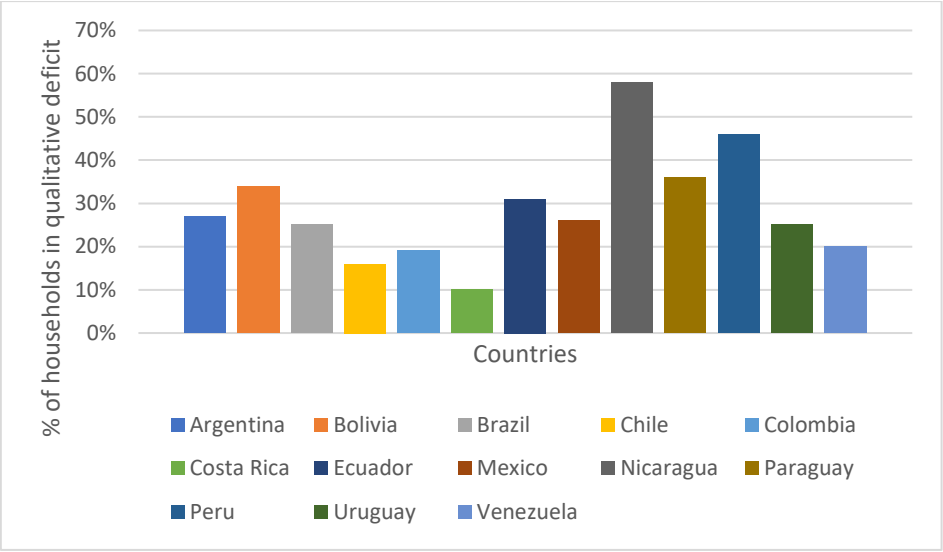

Figure 2 - Qualitative urban housing deficit Latin America (Adler & Vera, 2018)

Colombia – with almost 20% of its households falling under the qualitative threshold – also has plenty of margin for improvement. As the country of this thesis' primary case study, the next chapter analyzes in detail how Colombia's context, demographic trends, and other forces, are shaping its housing market. The analysis breaks down the existing Colombian policy framework and highlights its recent successes and shortcomings.

Finally, Chapter 3 and 4 focus on the conception of Tervi as a service-oriented platform that aggregates different housing services required for low-income home enhancements. These sections outline the initial personal motivation as a side job, highlight the existing gap and Tervi's ability to bridge it, and finally use a detailed customer identification for the service to tie Tervi back to how the housing market is operating and some remaining challenges. Ultimately, this thesis hopes to illustrate the potential of tech-enabled solutions to disrupt the space and contribute to overall housing improvements. Beyond governmental action, entrepreneurship and innovation, Tervi tries to emphasize technology's penetration potential in our communities, and how it may be designed and implemented to ease access of previously unavailable services for low- and mid-income Colombian residents.

2. Colombia´s Case, Subsidized Social Housing

2.1 Fundamentals & Demographics

Over the past two decades, Colombia has witnessed unprecedented economic growth, including some of the most positive trends across the Latin American region. The following section depicts some of the country's fundamental demographics, and how these shape housing markets and conducted policy. In total, Colombia has a population of over 48 million people, with an average of 3.1 people per household, of which 77.1% live in urban areas (DANE, 2023). Figure 3 below depicts the most updated demographics of the country, including sex and age distribution. It is worth noting the graph on the bottom right corner, which indicates the demographic shift happening between the last two recorded census (red bars 2018, blue bars 2005). The trend reveals a rapidly aging population with a reduction of its youngest members, partially due to falling fertility rates and continued downsizing of families. Together, smaller household composition eventually sets more pressure on the housing markets in the long run as it demands more units to fit the increasing population.

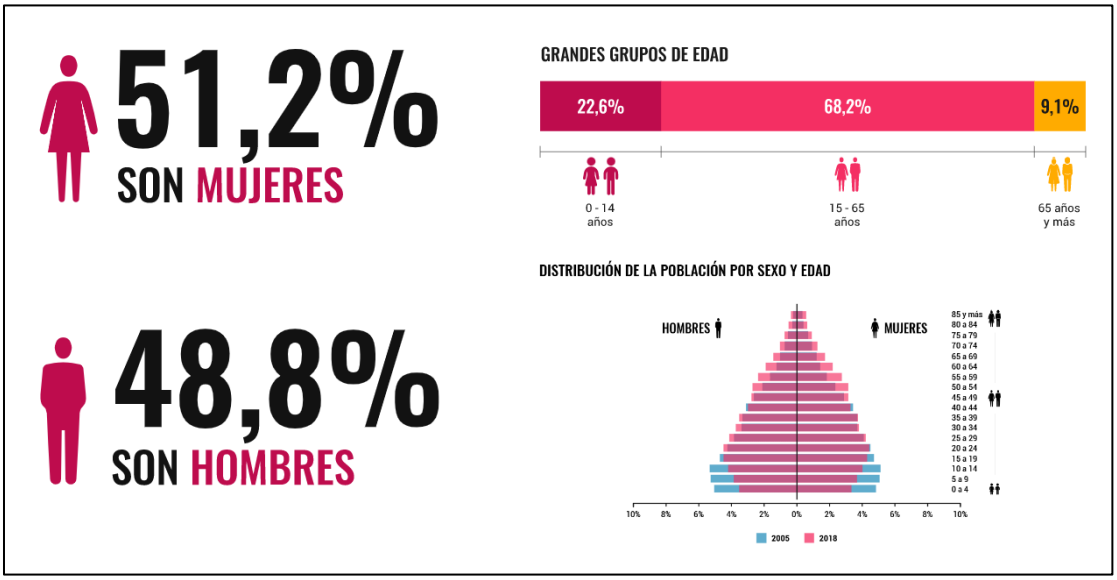

Figure 3 - Demographic distribution by age and sex (DANE, 2023)

With a GDP per capita of $6,131 USD (World Bank, 2022), the economy relies heavily on services, mining, oil, minerals, manufacturing, and increasingly construction and infrastructure. If compared to its regional peers, the country ranks fifth in terms of GDP and exhibits steady positive growth.

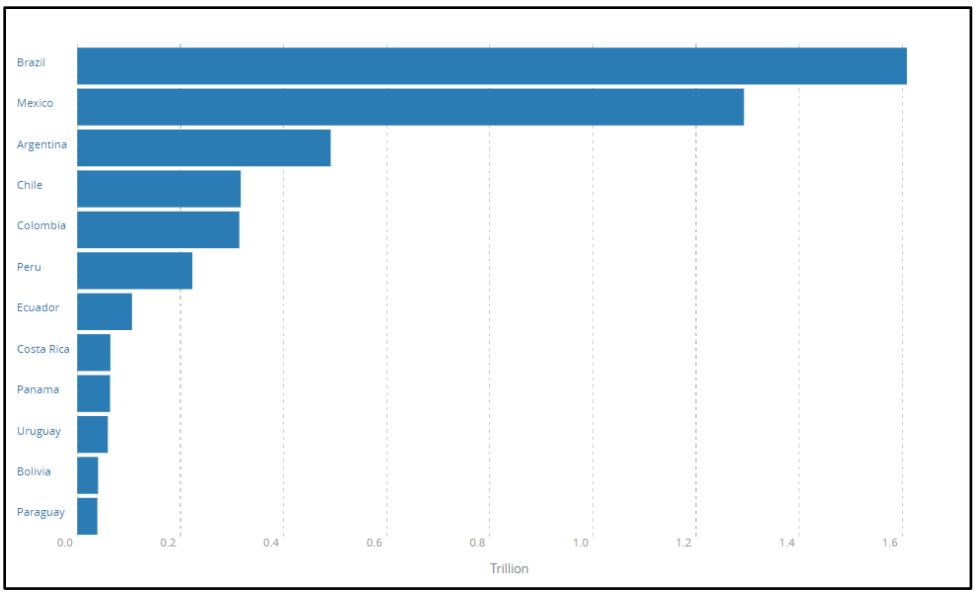

Figure 4 - 2021 GDP-USD Trillions Latin America (World Bank, 2022)

Excluding the Covid 2020 downturn, GDP growth has averaged 4% over the past 20 years, and inflation has remained on average at 3.8% over the past decade (World Bank, 2022). This stable evolution of inflation rates if compared to the region´s standards, is a key element that has contributed to the steadiness of interest rates to achieve further financialization and a broader access to mortgage for lower-income families. Both factors, added to the shifting demographics, unemployment, and poverty reduction, have ultimately enabled the proper conditions to develop a robust housing policy framework. Despite political turnover in government administrations, a rigorous monetary policy spearheaded by a technocratic and apolitical Central Bank has established the foundations that reinforce these steady indicators over time relative to Colombia´s neighbors. As the violence, political turmoil, and poverty continues to decline, an emerging middle class and other demographics have become major economic drivers particularly in primary urban areas.

Nonetheless, there is still ample room for improvement. Although poverty has been mitigated to some extent, 2022 registered a high informality and self-employment rate of 58.3% across the country and 44% in central cities (DANE, 2023). With over 50 percent of the population relying on the informal economy, the obstacles to accessing home ownership are further exacerbated. It is not uncommon for informality to be associated with unstable income, indicating poor to nonexistent credit scores when pursuing a loan. Furthermore, persistent double-digit unemployment rates tend to perpetuate the dire living conditions of individuals already under the housing deficit threshold. While the country

appears to see a continued reduction of unemployment from 2020 levels and stabilize at pre-pandemic rates, the lack of employment (formal or informal) exacerbates the challenge for private and public initiatives when it comes to housing.

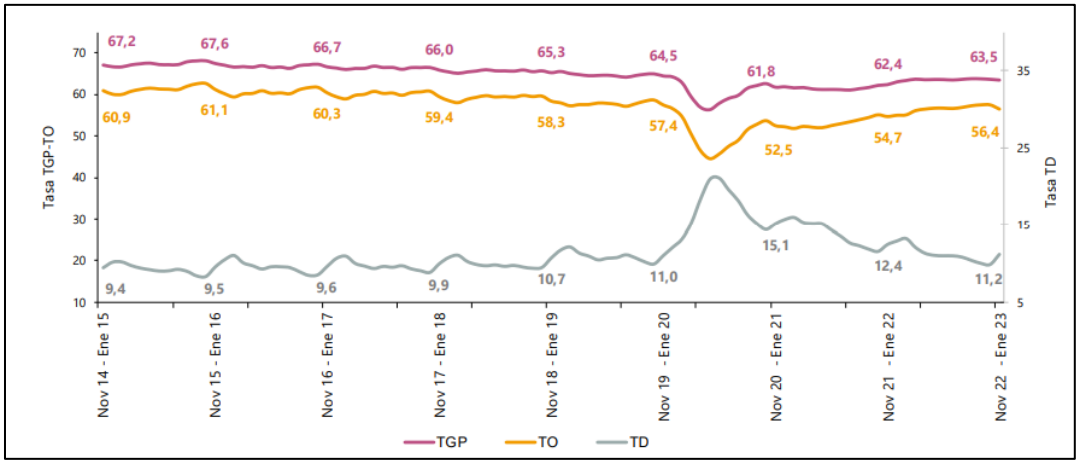

Figure 5 - Unemployment and total employment evolution (DANE, 2023)

Figure 4 shows this tendency in the grey line (TD) as unemployment rate compared to employment rate in yellow (TO) and the global employment participation (TGP) rate in red. Note that TGP is calculated as the ratio between the existing workforce or employed individuals and the available population of working age (DANE, 2023). Unemployment throughout 2022 oscillated around 10%. As in Latin America's broader context, for Colombia to eradicate both qualitative and quantitative deficits, government policy and private investment in the housing sector need to be complemented with continued economic growth, macroeconomic stability, and steady mitigation of informality and unemployment. This will help pave the way for broader financialization, expanding potential homeowner's purchasing power and driving more private investment to flow into the affordable housing space. The latter, combined with the efficient deployment of government resources via a proven successful policy framework, should make the goal of combating the housing shortage achievable. Hence, it is worth analyzing the current state of Colombia's housing market as a leading example, particularly following a series of its innovative and sustained initiatives that have spearheaded its progress over the past decade.

2.2 The Housing and Mortgage Market

In line with the positive economic trends mentioned above, the housing market in Colombia has experienced significant growth and development, with several notable characteristics worth outlining before delving into the policies guiding it. According to the National Department of Statistics (DANE), the real estate and construction industry has maintained an average share of 3.15% of the nation's GDP over the last decade. The growth rate of this share was 11.8% in 2022, and it is expected to be 9.8% in 2023 (CAMACOL, 2022). This impressive growth can be attributed to government policies aimed at addressing the quantitative housing shortage across the country by incentivizing developers to focus on building social housing. Moreover, the housing sector has created a source of income for thousands of families and is responsible for generating 7% of the total jobs in the country (CAMACOL, 2022).

The driving forces behind the growing demand in the sector include population growth, quantitative deficit catchup, stock replacement, and household downsizing. Notably, over 65% of the units being demanded are the result of natural downsizing of households, a trend that has been ongoing for several decades (Saiz, Cuellar, Ganitsky , & Rodriguez, 2022). This trend, however, is not new and has set the boundary for the market to grow substantially over the past decades. Figure 6 provides a visual representation of the growing trend in yearly sold formal units.

Figure 6 - Formal Housing Sales Colombia (Malagón & Duque, Libertad y Equidad, 2022)

The growth in supply to meet burgeoning demand did not happen by chance. Rather, it was the result of a series of governmental policies that catalyzed access to housing via three major premises: (i) broadening populations' access to mortgage via subsidies, (ii) creating the legal and fiscal structure for an affordable ownership product, and (iii) leveraging the private sector's capacity to scale. At the state level, one notable measure was the formalization of a specialized housing financing system through Law 546 in 1999. This law promoted instruments to pivot public policy from direct government-led housing construction towards incentivizing supply and demand through targeted subsidies. Essentially, this law allowed banks and housing developers to play a more influential role in the process by modifying the framework that rules amortization, duration, and other conditions to modify or finalize a mortgage.

This was further encouraged by the creation of the Ministry of Housing, City and Territory as an independent entity via Ordinance 3571 in 2011 (Malagón & Duque, 2022). This ordinance created a single entity to manage and disburse resources related to housing, which triggered several innovative subsidy initiatives to be created in a short period of time. Since this milestone, Colombia's housing policy has become a world reference to the point where it yields one of the highest sales per million inhabitants index in the world, with over 4,763 units/million inhabitants sold per year (Malagón, 2022). Figure 7 illustrates the housing boom in Colombia relative to other countries across the world. The result is reflected in the 730,000 Colombians who have become homeowners in the past decade.

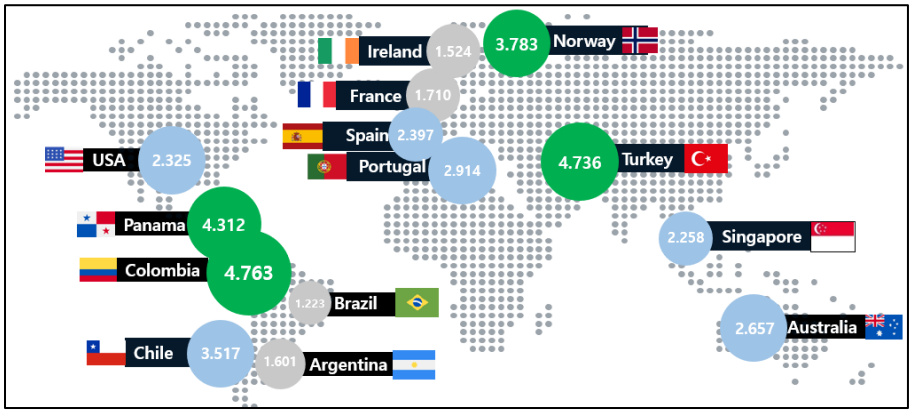

Figure 7 - Yearly Housing Sales Per Million Inhabitants (Malagón, 2022)

However, despite the substantial progress made in addressing the housing deficit and meeting market demand, further efforts will be required to maintain momentum. According to research

conducted by the MIT Urban Economics Lab, Colombia will need to build more than 350,000 new dwellings per year over the next two decades to keep pace with demand (Saiz, Cuellar, Ganitsky , & Rodriguez, 2022). Figure 8 provides a breakdown of the total demand, with the dark red representing the units required to accommodate the growing number of households, the red representing the units needed to address the current deficit, and the grey representing the units required for stock replacement. Despite the impressive growth illustrated in Figure 6, the country will still fall short of fully meeting its housing needs without additional efforts.

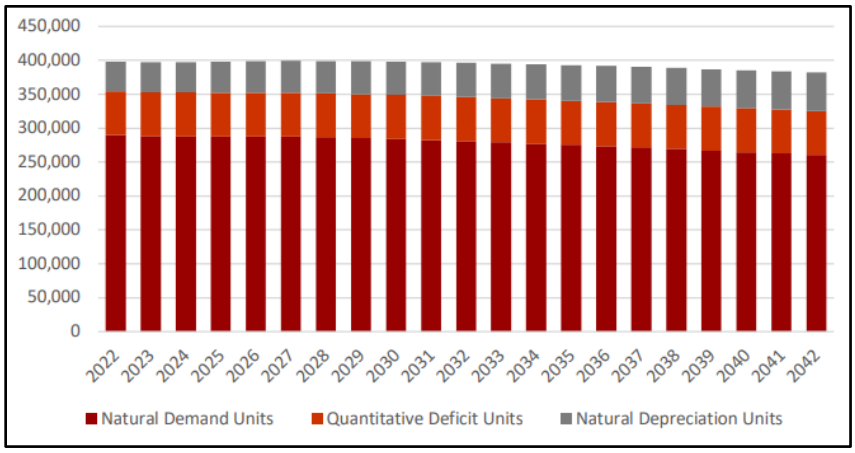

Figure 8 - Housing Demand Projections (Saiz, Cuellar, Ganitsky , & Rodriguez, 2022)

Financialization through a more robust mortgage market has the potential to hinge the gap between the units coming into the market and the actual housing needs. Since acquiring a house is a durable good that often represents a household's primary source of equity, its price far exceeds the family's income. This means that for most families, buying a house is only possible through long-term debt that reduces the asset's price pressure. Moving towards a country of homeowners will require strengthening access to mortgages, which will primarily depend on macroeconomic stability and a financial system supported by regulations that streamline the process of accessing credit for both lenders and borrowers.

Some regulatory actions have been taken to strengthen the mortgage market. Law 1819 modified the tax statute since 2016 to exempt financial institutions from paying taxes on profits from mortgages intended for social housing projects (Función Pública, 2016). This benefit has stimulated financial entities to provide more housing loans for low- and mid-income individuals, increasing their social housing mortgage portfolio share. Furthermore, in 2021, the 2079 Habitat and Housing Law extended

the maximum loan term from 30 to 40 years (Malagón & Duque, Libertad y Equidad, 2022). This measure allows families in the lowest income bracket to meet the credit scoring requirements of financial entities and access a mortgage as their monthly installments to service the debt are reduced when deferred over a longer term. Similarly, the debt service coverage ratio relative to household income for social housing homeowners was increased from 30% to 40%, which balances the cost proportion of a mortgage relative to the average cost of rent across the country (Malagón & Duque, Libertad y Equidad, 2022).

Housing credit has seen significant growth in Colombia, particularly since 2007 when positive trends began to emerge following the 1998 financial crisis. By 2018, over $17.5 trillion COP had been disbursed for mortgages, and the balance of the portfolio exceeded $60 trillion COP. Since 2010, the number of financed dwellings has been over 100,000 (CAMACOL, 2018). However, there is still a lot of ground to cover in this matter. Colombia's mortgage portfolio as a share of GDP is only 6.3%, which is lower relative to its peers in the region, such as Chile, Panama, Mexico, and Brazil (See Figure 9), This may partially explain why there is still such a high demand for housing and why 40% of the population still rents (CAMACOL, 2018). Countries such as Chile, Panama, Mexico, and Brazil outshine Colombia substantially. To catch up with the region and further deepen the mortgage market in the country, two additional efforts need to be undertaken.

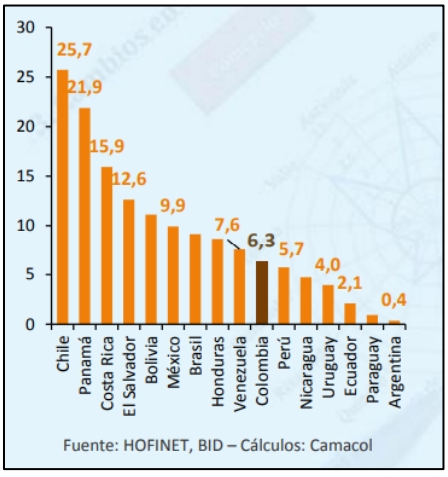

Figure 9 - Mortgage Portfolio as a Share of GDP (CAMACOL, 2018)

The first effort involves an assessment of the loan-to-value (LTV) ratio regulations, which are currently capped at 70% in Colombia, with the national average even lower at 53% (Roth, 2017). A

more favorable LTV ratio, which implies lower down payments, would contribute to a stronger housing financial system. With lower down payments, more homeowners would be able to overcome the hurdle of accessing a mortgage, which is currently one of the main constraints. The second avenue involves securitization or a better-established secondary mortgage market. Credit growth tends to be stronger in economies where securitization plays a major role than in those where bond financing is the primary source of financing. In Colombia, there is still a gap that must be bridged in this regard, as banks commonly use retail deposits as a primary source of financing (Roth, 2017). The development of capital markets will result in a deeper housing financial market with more liquidity, which will increase competition and accessibility.

Other government initiatives have also proven successful in increasing access to mortgages and housing. The social housing policy, which includes several different aid packages for low-income families, is a clear example of public policy contributing to this endeavor.

2.3 Housing Policy Framework

To further emphasize the impact of government policies on the housing market, it is worth noting that in 2021, out of the total 230,000 dwellings sold in Colombia, a staggering 183,000 were classified as social housing or VIS (Vivienda de Interés Social). Figure 10 illustrates the market's size over the past five years, including yearly sold units (in grey), units that started construction (orange), and new releases for incoming projects. Today, social housing comprises over 70% of the overall housing market in the country.

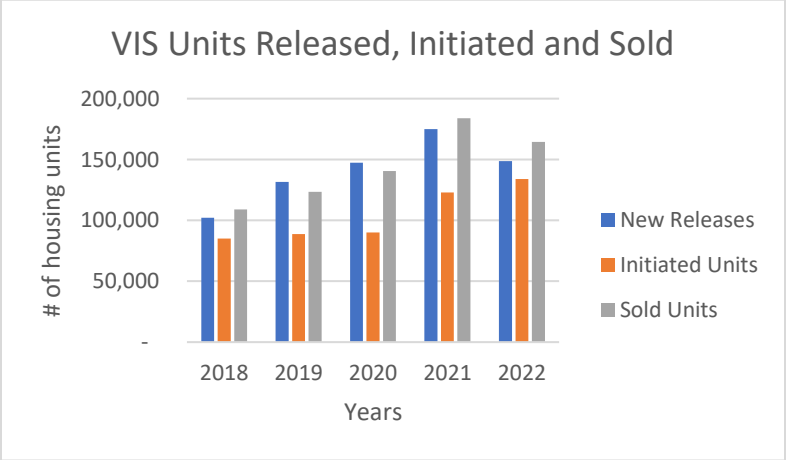

Figure 10 - VIS Units Released, Initiated and Sold 2018- 2022 (CAMACOL, 2023)

Law 388 from 1997 defines this housing typology as intended destined to serve households on the lowest income bracket. VIS dwellings have two different categories and are capped at a sales price indexed to monthly minimum wages or MMW VIS dwellings are divided into two categories and are subject to a price cap indexed to the monthly minimum wage (MMW). The lowest cap range, known as "Vivienda de Interés Prioritario" (VIP), is capped at 70 MMW in small and medium cities and 90 MMW in larger cities, while the higher VIS cap range is set at 135 MMW for intermediate cities and 150 MMW in larger cities (DIAN , 2022)[1]. Existing programs and regulations have aimed to promote VIP and VIS homeownership through subsidies as a means of combating inequality and removing barriers to accessibility by increasing access to formal housing. The capped price, in addition to these subsidies, helps to increase the probability of low-income households being eligible for a mortgage when the subsidy is applied.

On the supply side, to encourage the construction of VIS projects, the existing tax statute dictates that developers who build projects that meet the criteria for this category are eligible for tax exemptions on profit and may recover up to 4% of the total proceeds of the project spent on value-added tax (VAT) paid for construction materials. This incentive has been the most significant driver of social housing supply in recent years, attracting developers to the social housing niche that has become the driving force behind the housing market in Colombia. Moreover, the government has also led initiatives such as the Free Housing Program or "Proyecto de Vivienda Gratuita" (PVG), which provides fully subsidized supply, enabling poor families who would otherwise have no access to mortgages or housing to gain homeownership for free. However, this program has been costly and energy-intensive, and efforts on the demand side have proven to have a more efficient and broad impact on the market.

2.3.1 Mi Casa Ya Program

Undoubtedly, subsidizing demand has been one of the main pillars of the VIS policy, specifically championed by the "Mi Casa Ya" program. Over the past years, Mi Casa Ya has become the most recognized housing program in Colombia, both in terms of scale and the number of families that have benefited from it. This subsidy is designed as an instrument to co-finance the investment of households earning less than 4 MMW. The program provides a cash subsidy for the families' down

[1] Note that when referring to VIS housing and market through the rest of this document, both VIP and VIS are included.

payment, which is directly disbursed to the developer of the project selected by the family. This subsidy represents up to 20 MMW for families with earnings between 2 to 4 MMW and up to 30 MMW for families with income under 2 MMW. This has helped thousands of families to break the accessibility barrier and access a mortgage through an accredited financial institution, ultimately achieving ownership, which has proven to have several positive impacts on beneficiaries. In some cases, as shown in Table 4, over 40% of the total unit's value can be covered, which eases the down payment families must commit to and their monthly installments by reducing the outstanding balance of the mortgage.

Household Income	***0-2 MMW***	***2-4 MMW***
Down Payment Aid	30 MMW	20 MMW
Discount % for a VIP Dwelling (70 MMW)	42%	NA[2]
Discount % for a VIP Dwelling (90 MMW)	33%	NA
Discount % for a VIS Dwelling (135 MMW)	22%	15%
Discount % for a VIS Dwelling (150 MMW)	20%	13%

Table 4 - Discount % for a VIP Dwelling (70 MMW – 150MMW)

Over the past four years, Mi Casa Ya has single-handedly assisted over 165,000 families in purchasing a new home (Malagón & Duque, 2022). The National Department of Planning (DNP) has researched the impact of the program's beneficiaries, revealing the outstanding progress that comes from accessing homeownership. Individuals who accessed Mi Casa Ya demonstrated a 46% and 13% less probability of falling into quantitative and qualitative deficits, respectively. Households involved in the program were also 30% less likely to fall below the poverty line and reduced their overall housing expenses by 30.5%. This means that the monthly installment paid is even more favorable than market rate rents paid previously. They additionally have a 58% higher chance of overcoming the poverty line or evolving from being vulnerable households. Other transformational outcomes of the program include a 20% increase in rooms per capita and a 51.5% increase in the probability of owning a computer (DNP , 2022). These metrics serve as irrefutable evidence of the program’s impact.

Furthermore, because the program is demand-oriented, beneficiaries decide in which project and with which developer to allocate the subsidy. This has resulted in competition on the supply side,

[2] Note that only households earning less than 2 MMW are eligible for VIP subsidies.

which has generated favorable outcomes regarding the quality of the projects to attract customers. As developers strive for creativity to attract customers, amenities such as pools and recreational areas have become increasingly common among these projects. This is remarkable, considering that in 2017, 82% of Mi Casa Ya subsidies targeted households in the 2 to 4 MMW income range, and by 2021, 75% of beneficiaries were below the 2 MMW threshold (Malagón & Duque, 2022). The program has improved its progressivity by reaching the most vulnerable families.

2.3.2 FRECH – Interest Rate Subsidy

In addition to Mi Casa Ya, other programs have sought to subsidize interest rates. As mentioned throughout this thesis, lack of access to mortgages is one of the greatest constraints on housing demand in developing countries. To address this reality and enable a more robust base eligible for a mortgage, the government introduced an interest coverage subsidy in 2009 to assist households earning less than 8 MMW and complement the financing of their purchase. The subsidy, colloquially known as FRECH (an acronym for the Mortgage Stabilization Reserve that funds it in Spanish), covers between 400 and 500 basis points of the interest generated during the first seven years (Malagón & Duque, 2022), reducing homeowners' monthly installment and ultimately enabling thousands of families to become eligible for a mortgage by facilitating their chances of overcoming the unstable and limited income hurdle. Like the tax statute benefits and the Mi Casa Ya program, this interest rate subsidy has helped spearhead the surge in demand over the past decade. It is crucial that initiatives like this continue to be prioritized to close the mortgage accessibility gap that prevents millions of families from becoming homeowners.

The DNP has conducted research to evaluate the impact of this program. The results indicate an undeniable improvement in various facets among beneficiaries. Families that accessed the subsidy increased their income by 7.34%, reduced their housing expenses by 30.5%, and had a 23% lower probability of falling below the poverty line (DNP , 2022). There is clear evidence of the underlying benefits. These tangible outcomes, in addition to the overall performance of the market, which has seen steady growth primarily because of these incentives, must continue to be bolstered by the government to continue democratizing access to formal housing.

2.3.3 Complementary Subsidies

Another significant catalyst for housing demand has been the possibility of deploying concurrent subsidies provided by different entities. These multiple subsidies ultimately broaden the scope of demand as more families with limited income become eligible to purchase a dwelling by accessing federal government subsidies such as Mi Casa Ya and FRECH, as well as regional or family welfare fund resources. Ordinance 1533, passed on August 26, 2019, established the legal framework to enable lowest income range families to access complementary subsidies to further support the purchase of their home. This means that individuals who accessed Mi Casa Ya and FRECH can be eligible for additional down payment assistance from the local city or department, as well as family welfare funds in some cases.

For example, depending on the location of the dwelling, households below the 2 MMW limit, who are eligible for down payment support of up to 30 MMW via Mi Casa Ya, can benefit from complementary additional subsidies, which, in cities like Bogotá, can represent an additional 10 MMW covered by the local government. Moreover, households that qualify for the family welfare fund subsidy can access another additional 20 MMW. This can add up to a total of 60 MMW in some cases, which represents even more than 50% of the equity of a unit that's being provided via subsidy from different entities depending on the dwelling's value (Malagón & Duque, 2022). Preserving the legal structure that allows for complementary subsidies will mostly benefit the lowest income percentile of the population that needs a higher share of their equity being subsidized to overcome the underwriting hurdle and access a mortgage.

2.4 An Efficient but Imperfect System

All of the aforementioned initiatives have created favorable conditions for the stabilization and optimization of programs that have proven to accelerate housing demand and foster supply competition by relying on efficient private sector deployment. Implemented policies have been effective in increasing access to formal housing and mortgages. In the last decade, unprecedented figures of VIS sales have been achieved and the population values the efforts made by the government in this regard. In 2022, 168,000 families accessed social housing, the majority with one of the government's aid packages. However, while these numbers provide a reliable indicator, particularly as a measure of quantitative deficit catch-up, the system has disregarded the quality in which most of

these units are delivered. Nine out of ten VIS dwellings are delivered completely unfinished as concrete and brick shells, lacking floors, paint, cabinets, and other necessary finishes. Although the structure is properly built with functioning utilities and basic elements that technically make it livable, the reality is dire, as evidenced in Figure 11.

Figure 11 - Unfinished VIS Housing Delivery State

As mentioned in chapter one when introducing the concepts of quantitative and qualitative shortages, categorizing the qualitative deficit as a reliable indicator is challenging because quality can be a subjective measure that often disregards several variables that contribute to the overall state of a dwelling. In Colombia's case, unfinished VIS and VIP units do not fall under the qualitative deficit threshold according to law 1077 of 2015, which sets the minimum standards required to sell a dwelling in the market. Along with law 388 of 1997, regulations establish general quality parameters, but overall, delegate the responsibility of defining specific minimum required standards such as finishes and space designation to local municipalities. Local regulators, trying to attract development to their regions, try to maintain these standards as low as possible to foster more development.

While quality regulations remain general and flexible to give room for the developer to build an affordable product that suits the target customer's purchasing power, the concept of qualitative deficit fails to gauge the reality of how people inhabit these unfinished spaces. By no means am I disparaging a successful system that has improved the living conditions of thousands of families across the Colombian geography, but rather highlighting that a holistic analysis around housing quality should assess additional variables thoroughly. This will require factoring in health, aesthetics,

comfortability, and well-being to better understand the implications of quality on homeowners' lives and act accordingly by building upon existing frameworks.

This shortcoming occurs due to various factors, including price caps, market forces, and urban economics, which impact the underwriting process of every project. On the policy side, the sales price cap is set to ensure that the product remains affordable and accessible to the lowest-income individuals who are most vulnerable to poor housing conditions. However, as developers leverage their cost structure, which consists of fixed land, sales, and construction prices, the scope of delivery becomes the only variable that can be adjusted. Therefore, most developers choose to build to minimum standards and deliver unfinished units, particularly in main cities where land costs are high and construction costs have skyrocketed due to disruptions in the supply chain. Although some developers have opted to provide smaller areas and finished dwellings, the market has shown that people prefer unfinished units and more square footage. Since all the fiscal benefits that a developer receives for building VIS are subject to not surpassing the sales price cap, they don't get involved in the finishing process to avoid jeopardizing their upside.

Although living conditions may improve for some families, the result is an incomplete system that creates additional accessibility and financial barriers for these families to live more comfortably. Unfortunately, most homeowners lack the financial resources to undertake the build-out, and even those who do have savings find the process of finishing their units highly informal, inaccessible, and fragmented across several intermediaries with elevated levels of uncertainty and quality underperformance. Hence upon delivery it is not uncommon to see homeowners lack the cashflows to undertake the build out and thus usually move in to live in their new-builds in an unfinished state. Overall, the lack of awareness throughout the construction and sales process to help homeowners prepare for the finishing step exacerbates the problem.

Accessing a core and shell unit is undoubtedly an important milestone for first-time homeowners in Colombia. However, enhancing the unit to not just make it livable but also add value to the underlying asset is a challenge that calls for urgent action. In order to bridge the quality gap that this problem poses, innovative solutions that challenge the status quo and understand the homeowners' needs and ethos are paramount. With this premise in mind, my co-founder and I have spent the past two years developing Tervi, a technology-enabled service that aims to improve the living standards of

VIS homeowners by streamlining home improvement services. Our platform operates within the existing policy framework to provide a convenient, accessible, and cost-effective solution for homeowners to finish their units. The following section will delve into the inception of Tervi, our framework, traction, and impact to date, as well as our roadmap for scaling the solution moving forward. date and analyzes the roadmap for scaling the solution moving forward.

3. Home Improvement as a Service: Tervi

3.1 Inception

Throughout my professional experience working in the design, entitlement, development, and construction of VIS housing master plans, I realized that the full potential for impact of these projects was limited due to the caveat outlined in the previous section. Unwilling to be a passive bystander, I decided to take action and started developing the concept of Tervi, a solution that leverages technology and my experience in the sector to facilitate homeowners in a more streamlined pathway to living with dignity and transforming their dwellings into real homes. As a project manager, I realized that after delivering VIS projects under my responsibility, construction was far from being concluded. Informal construction workers, usually self-employed and living day-to-day, or "Maestros" as we locally know them, clustered in front of our projects with construction materials to offer improvement and finishing services to incoming homeowners. I quickly identified problems across three different spheres.

First, from the homeowner's perspective, it is evident that the state in which developers deliver the unit demands additional effort and resources. Beyond the difficulties of gathering the capital to undertake the completion, it is challenging to find a trustworthy Maestro or contractor that provides an integral and quality service. Secondly, on the developer and HOA (homeowner association) side, lack of control over multiple buildouts simultaneously being executed across projects with up to 500 units becomes a source of disorder that is difficult to control, sometimes resulting in damages to the building's structure and MEP systems due to a lack of technical expertise. Thirdly, the informal nature of contractors restricts their capacity to scale, deliver an integral service, and access a broader market. These limitations further reinforce the existing affordability problem by constraining supply and elevating costs to homeowners.

It's clear that there is room for improvement for all parties involved in the VIS home improvement process. As a result, my co-founder Esteban Castro and I began brainstorming ways to address this issue and add value to the system. In order to better understand the process, we even took on some home improvement projects on the side, working with subcontractors on weekends. Through an 8-unit pilot program, we were able to identify the main challenges that homeowners faced, including unit economics and logistical issues. With a better understanding of the process and parties involved,

we decided to move forward with the idea, which eventually took shape through MIT's thriving entrepreneurial ecosystem. Over the past two years, we've worked diligently to shape the existing platform and its first version, considering the pains, needs, and stakes of each party involved in the process.

3.2 Understanding the Stakeholders

3.2.1 The Homeowner

Tervi's foundation lies in putting the homeowner at the center of its mission. The challenges that homeowners face in improving the standards of their homes inspired us to create a solution that would simplify and streamline the process. We quickly learned that home-improvement for homeowners was a complex and often daunting task, with limited accessibility, poor design and quality control, and high financial barriers. Renovations demand a significant investment of time and effort to find a designer, procure materials, source labor, and raise funds to cover the underlying costs, not to mention unforeseen expenses that may arise. In the case of VIS housing, the situation is more concerning as families often move into an unfinished unit. In order to create a solution that would truly serve homeowners and improve the status quo, we had to understand their pains, motivations, expectations, willingness, and capacity to pay. This understanding allowed us to develop a solution that was not just a nice-to-have, but a true painkiller in the process.

Recognizing the limited purchasing power of a substantial volume of potential customers was critical for designing an inclusive solution for Tervi. Through the process, two different types of homeowners were primarily identified. The first type includes individuals or families who have accessed one of the various government subsidies mentioned in section 2. According to data from the Ministry of Housing, 60% of VIS sales are possible due to government housing programs such as Mi Casa Ya and FRECH (Estrada, 2023). Therefore, 60% of VIS purchasers earn less than the 4 MMW threshold required to be eligible for these programs and are likely to struggle to pay upfront for a contractor or service to finish their unit. The remaining 40% are mid-income range households who purchase a VIS dwelling for location, preference, price, or even investment in some cases, but are not eligible for government aid and pay the full price with no subsidy. Identifying this was critical in outlining the go-to-market strategy. Initially, engaging with homeowners in the 40% pool proved to be easier given their higher purchasing power; however, several of the identified pains appeared to be ubiquitous regardless of income level.

As part of the MIT Design X accelerator program in 2022, during the primary market research prior to launching the minimum viable product (MVP), thirty interviews were conducted with VIS homeowners who had undertaken some form of improvement and were living in partially finished housing conditions (Category 1) and owners who had gone through the process of fully finishing their unit (Category 2). A fully finished unit was classified as one with paint, floors, finished bathrooms, doors, cabinets, and closets. The partially finished category included those that lacked one of the fully finished traits.

The objective was to uncover the priorities of households in the decision-making process, common pain points, and available alternatives to complete a unit. Among homeowners in Category 1, 96% indicated that their current living environment presented constraints in at least one of the following categories: cooking, cleanliness, privacy, sleeping, and overall comfort and happiness. All interviewees in this category agreed that making improvements such as painting, tiling floors, adding cabinets, storage space, and doors would improve their quality of life and reduce stress. Furthermore, homeowners in both categories acknowledged encountering some type of difficulty in the improvement process. Figure 12 illustrates the main barriers identified by both groups when asked to select from a list of difficulties faced in the home improvement process.

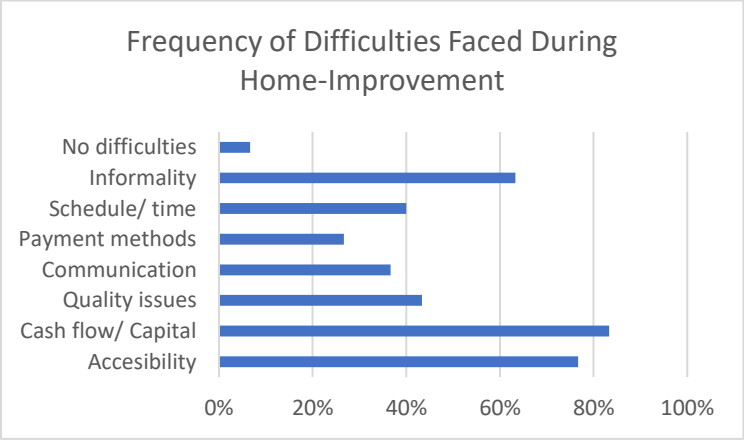

Figure 12 - Design X PMR Survey Results on Difficulties in the Home-Improvement Process

Several factors were identified as difficulties in the home-improvement process, but informality, accessibility, and cash flow were the three most frequently selected by homeowners. Given the

informal nature of the status quo, where Maestros usually engage in these types of jobs, it is not surprising that 63% of owners declared it to be a problem. Informality usually combines several of the listed difficulties, tying back to quality and schedule underperformance, lack of trust and communication throughout the transaction process, and, in some cases, even scams. Accessibility, with over 75% of the sample identifying it as an issue, is the result of a fragmented process that becomes inaccessible as it requires dealing with several intermediaries such as designers, home retailers to purchase material, and a contractor or labor provider. Most of the interviewed homeowners declared themselves unsophisticated in construction and struggled to find a trustworthy solution that met their requirements. As a more exogenous factor to the process itself, having the capital to cover the expenses involved in home-improvement ranked first on the list with 83%. Evidently, given the type of customer for this type of housing, purchasing power crystallizes a significant barrier for homeowners to enhance their units.

To understand homeowner priorities and expectations when undertaking home-improvement, we asked them to select from a varied list of features. 77% of surveyed households prioritized having design and material options, 97% claimed that cost and budget are paramount, and 73% said they prefer an alternative with ease of payment and financing features. Figure 13 frames the frequency at which surveyed homeowners selected priorities from the given list. Other salient items that concern homeowner expectations through the improvement process are customer service, quality, and delivery time, which again seem to constitute several of the latent issues.

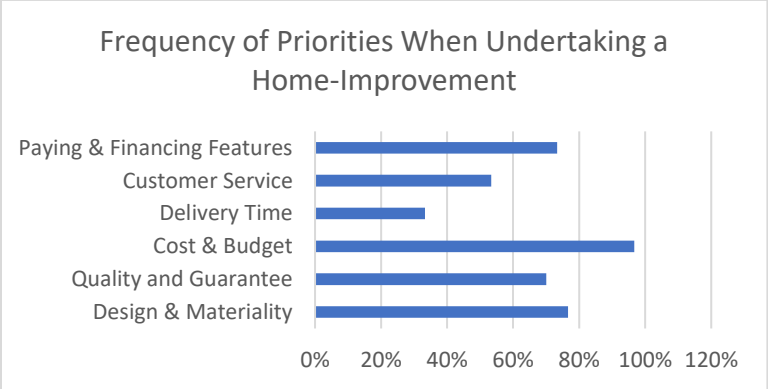

Figure 13 - Design X PMR Survey Results on Priorities When Undertaking the Home-Improvement Process

Acknowledging the VIS homeowner's perspective from both what historically has troubled them in the improvement process and what they expect and prioritize when decision-making, denoted

valuable data for designing the first version of the platform and prioritizing the features that where essential to solve their main needs and demolish the obstacles they were facing.

3.2.2 The Contractors and Maestros

To fully understand the needs of homeowners, a comprehensive analysis of their profile, concerns, and aspirations was necessary. However, it is also important to examine the available services in the market to identify the options that homeowners have for completing their units. Currently, housing enhancements in VIS are mostly handled by informal and self-employed Maestros or small and medium contractors. More sophisticated general contractors and designers tend to focus on higher-end segments with higher ticket prices, and due to regulatory constraints, developers are unable to capture this market. As a result, minor and informal players are able to obtain these smaller deals as they require less technical skills and upfront costs.

While this alternative may seem like a fast and affordable way to renovate, its informal nature often results in quality underperformance, hidden costs, delays, and a lack of transparency that requires a high level of involvement and supervision from the homeowner in an unfamiliar subject. Renovation jobs with Maestros are typically governed by spoken agreements or basic contracts, and determining the upfront fixed cost before the buildout is almost impossible. Warranties are non-existent, transactions are in cash only, and the scope of the fit-out is constrained by their limited technical skills and access to providers and materials. Since they work on several projects with modest volumes, they do not operate efficiently and have limited bargaining power with providers, making them more expensive and logistically clumsy. Additionally, their informal ethos restricts digitalization of processes, data collection, quality control, lead management, and construction efficiencies. While Maestros are skilled in labor, they usually lack design skills and working capital to offer an integral service, which hinders their ability to overcome informality and stagnation.

A more advanced player in the field, above the level of the Maestro, is the small and medium enterprise (SME) contractor. While they typically offer a more efficient and design-oriented experience to homeowners, they still face logistical and bargaining constraints. These contractors generally have better quality control procedures in place than Maestros, but their warranties are often limited, and they are more expensive, which limits their customer base to the higher income bracket of the VIS spectrum. Like the Maestros, they lack access to technical information about the

building, which can lead to interferences and improper practices that may even jeopardize the overall functioning of the building's structure and technical systems. Many of these SME contractors are former Maestros who have progressed over the years and now have established small businesses.

Both Maestros and contractors have room for improvement in customer engagement and the process of formalizing contracts, as well as in design, material procurement, construction, warranty, and communication throughout each stage. Additionally, they are both limited in their ability to access the full potential of the market due to purchasing power limitations of an important segment of their customer base. In the MIT Design X primary market research phase, we conducted surveys of 11 contractors and Maestros, gathering information on the main issues that trouble them in their day-to-day operations. Figure 14 presents their responses, with two particular pain points standing out.

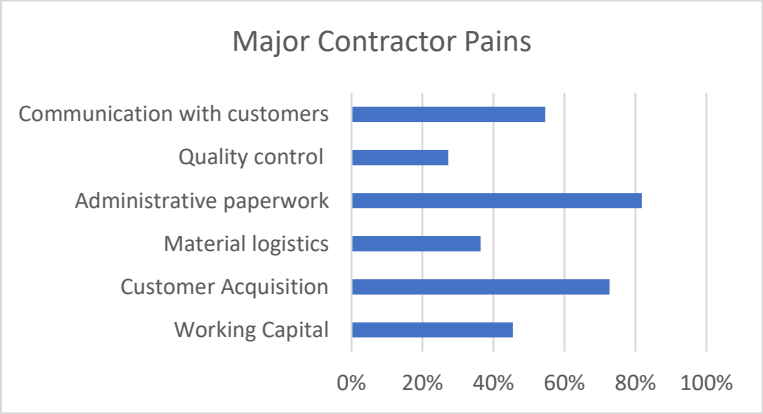

Figure 14 - Identified Contractor Pains in the Renovation Process

To begin with, it was clear that the customer interaction process needed significant improvement. Maestros and contractors heavily rely on traditional methods, such as business cards, physical presence at unfinished projects, and referrals, to acquire customers. They rarely utilize social media, and in most cases, WhatsApp is their most advanced communication tool. This severely limits their access to a broader market, where they could potentially have more leads and deals. Additionally, they struggle to communicate effectively with homeowners regarding payment arrangements, change orders, progress updates, and overall customer service. Their informal nature also makes paperwork and administrative processes a nightmare to deal with. In fact, 82% of the interviewees reported issues with providing formal estimates, managing contracts, and overall paperwork, classifying it as a time-consuming activity that distracts them from more valuable activities.

Furthermore, their capacity to maintain a steady workflow is hindered by working capital, material logistics, and quality control problems.

Therefore, in order to establish an equitable solution, it was crucial to consider SME contractors and Maestros as essential actors at the center of the system. Instead of viewing them as competitors, we aimed to create a platform that leveraged their experience and extensive knowledge of the industry to establish a sustainable framework that also improved their conditions and outcomes.

3.2.3 The Developers and HOA's

Acknowledging the role that developers and homeowner associations (HOAs) play has also proven to be valuable as part of the primary market research. VIS housing projects are structured as condominiums, and after 50% of the units in a project are delivered, a homeowner association or property management figure led by the homeowners is created to run the building operations and manage the property's common areas and budget. Before the first 50% is delivered, by law, the developer or promoter is responsible for the integrity of the property, which increases their interest in the project being taken care of and properly managed in addition to the overall guarantee of the structure.

Through my experience working for one of these major housing developers, I identified a latent risk and headache that both developers and HOAs were facing and could potentially be mitigated to an extent with our solution. Once the construction of a project is concluded on the developer side, a whole new universe of construction begins as homeowners, through Maestros and contractors, start to individually finish their dwellings, resulting in hundreds of renovations happening simultaneously. This entails a chaotic situation in which the overall state of the building is severely affected. It is not uncommon to see construction materials and residue across the common areas, malfunctioning and vandalized elevators, wrecked hallways, and sometimes even damages to the building's structure or MEP systems in periods as short as two months after the completion of the project. These circumstances not only pose a significant risk for the developer, jeopardizing the overall stability of the project but also result in a detriment to the underlying asset, affecting the HOA and homeowners moving forward.

Evidently, solving this conundrum could potentially make developers and HOAs strong allies and strategic promoters of our service. Even though they are not the direct target customer of our product, they can provide a direct channel to access new unfinished housing owners. Therefore, we have focused on leveraging our extended network with developers to establish a mutually beneficial relationship where we offer tools that add value and mitigate their current risks in exchange for an efficient and cost-effective means of accessing our target customer base through them.

3.3 The Solution: MVP

Successful entrepreneurial ventures often prioritize understanding their customers and the problems they are trying to solve before deploying a solution. Common mistakes include investing high levels of energy and resources in building a solution before acknowledging the real customer's needs, willingness to pay, or alternatives to using the product. To avoid these mistakes, we first sought to understand the stakeholders and their role in the cycle before taking our solution to market. This helped us prioritize the features the product should offer and ultimately outline a minimum viable product (MVP). The platform needed to offer a seamless customer journey to engage an audience that was still partially digitized, as well as a design component, financing options, and overall bridge the quality, schedule, and communication gap resulting from informality. Adding value to key players, such as developers and contractors, would also be crucial to the success and sustainable adoption of the product.

The MVP would be the first version of a web-based platform that facilitates homeowners' access to design, financing, and construction services to enhance their substandard units. It aimed to transform a process that is currently fragmented, full of hassles, and quality and design constrained, into an automated experience that leverages technology to reduce times and grant access to a myriad of features that contribute to the overall improvement of the physical state of the dwelling and hence the owner's quality of life. Although limited in scope and funds, this prototype aimed to confirm the product-market-fit and gauge homeowner engagement to gather data that would serve to consolidate a future and more robust solution that would have a deeper impact on the way VIS homeowners interact with their fit-out and contractors.

Figure 15 illustrates the actual homepage of the first version of www.tervi.co, where homeowners can get a sense of the services that are offered and become familiar with the brand, traction, and value proposition. The interface is interactive and intuitive, offering assistance throughout the user journey, and providing immediate help via WhatsApp, which is the most commonly used chatting application in Colombia and Latin America.

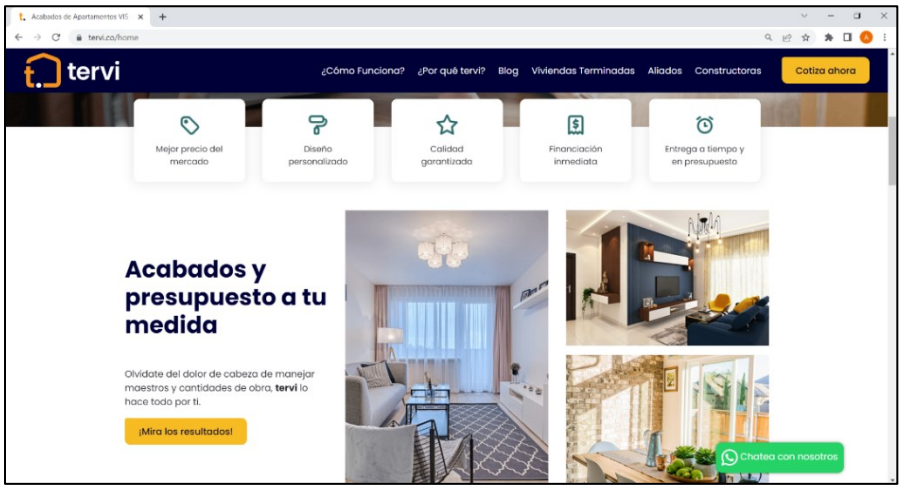

Figure 15 - Tervi's Homepage Interface

3.3.1 Designing a Home

Design options for furnishing and finishing core and shell VIS units are virtually nonexistent. A proper design not only enhances aesthetics but also optimizes space usage, promotes human interaction, and determines usability, ultimately impacting how people inhabit their homes. Unfortunately, after delivering the units, developers typically fail to provide any guidance in this process, leaving the household to define the scope of design based on specific needs in order to estimate the cost of the fit-out. Architects and interior designers usually find the VIS market unattractive due to limited budgets and small apartment sizes, leading them to focus on higher-end products that yield better returns. This results in homeowners and contractors being responsible for design, despite their limited experience, which often leads to preventable mistakes. Material procurement and logistics are also significant barriers, requiring specific references, upfront payments, wastage control, and delivery logistics.

Overall, there is significant room for improvement in the design process. When approached correctly, it can result in a more efficient construction process with fewer contingencies. A rigorous

design provides solid plans and specifications, which lead to clear budgets, schedules, and execution. It is also the first instance in which the household fosters a sense of belonging towards their new home by portraying their preferences and needs. Consequently, we envisioned the first version of Tervi as a solution capable of providing meaningful impact by automating this process to bridge the design gap without compromising aesthetics, while also accounting for the fact that most customers are budget-constrained.

Based on the fact that VIS units across the country share standardized architectural characteristics, delivery state, and space designation, we were able to leverage our experience to develop various design kits with providers to streamline the traditional process. While these kits can be adjusted to accommodate minor changes, they offer predetermined design tendencies, thereby reducing an activity that previously required multiple intermediaries and over a week's time, to just a few minutes. To get started, homeowners simply enter basic information into the platform, including their personal contact information, area of the unit in square meters, number of rooms and bathrooms, location, and delivery date (as shown in Figure 16).

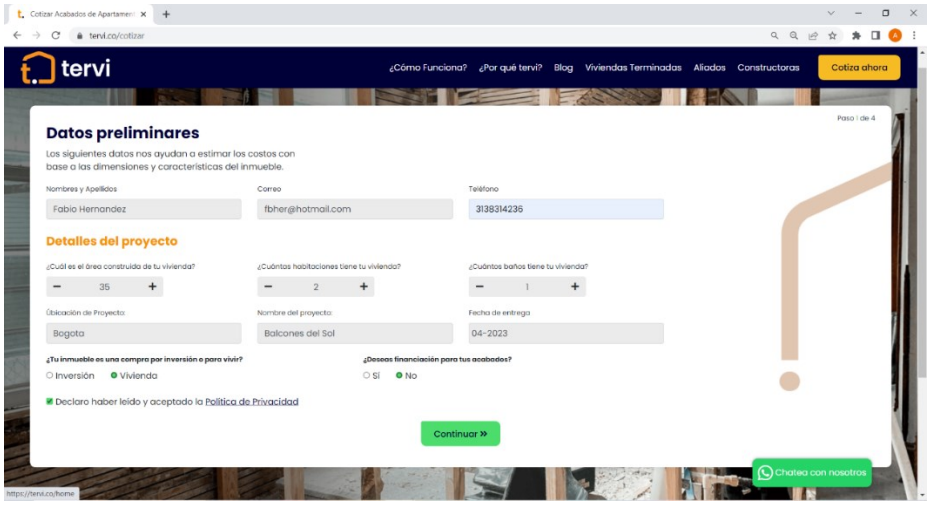

Figure 16 - Information Input

Using the information provided and our regularly updated cost database, the platform calculates three different budget options for the homeowner to continue with the design process based on available funds to commit to the fit-out. The basic kit includes paint, floors, and simple finishes to enhance the unit to a minimum standard. The medium range builds upon the basic kit and includes carpentry and cabinets, while the plus version incorporates granite or quartz countertops, better

fixtures, and appliances. We call this step "designing to budget," which has proven to be an essential feature that allows customers to understand their limitations based on available resources and access an option that improves the quality of their dwelling while accounting for their paying capacity.

Figure 17 illustrates the three alternative budget scopes in Colombian Pesos (COP) for a 35 square meter apartment with two rooms and one bathroom in the city of Bogota. The lower range is equivalent to approximately $3,300 USD, while the plus option is around $6,000 USD, representing approximately 13% to 16% of the unit's initial price.

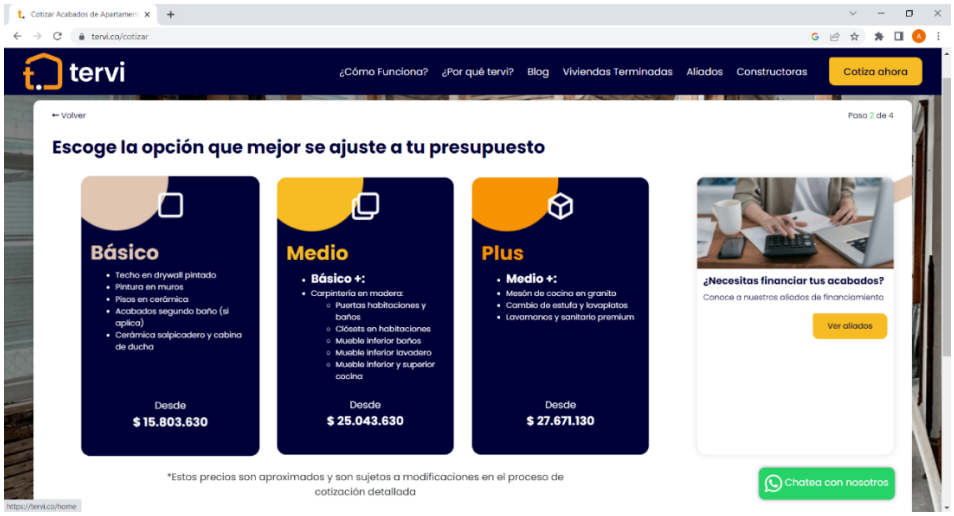

Figure 17 - Basic, Medium and Plus Budget Alternatives

It is important to note that a significant percentage of VIS households are often burdened with credit and lack the necessary cash flow to pay upfront for their finishes. To mitigate this reality, the platform creatively maximizes the limited budget by merging the predetermined design tendencies with some of the basic elements delivered in the shell dwelling by the developer. Once the owner selects from the budget alternatives, they can see a schematic rendering of how the different design tendencies could look like. For the MVP, we aimed to be as lean as possible given our restricted operating capacity and initially developed three tendencies for all three budget scopes, resulting in nine kits in total to offer a moderated number of options that appeal to homeowners.

Based on market research and assessments with several architects and interior designers, we offer the same scope for each budget kit but with varying tendencies curated to each customer's

preference. The platform offers three tendencies: Mediterranean, Scandinavian, and American, to assist the homeowner in the process of identifying a pre-determined suitable option rather than starting from scratch. Naive in design, VIS owners have shown a preference for selecting a fit-out based on existing options rather than describing their expectations, which is often complicated and requires back and forth messaging, in-person meetings, shipping of samples, and other time-consuming steps that extend the traditional process. By making the digital journey as visual as possible, we enable the platform's users to resonate with one of our predesigned options and save time and costs in this process. Additionally, this enables us to plan and standardize material procurement logistics by knowing beforehand the available options with providers in our network, which eventually makes the construction phase more efficient.

Figures 18 through 20 exemplify the various combinations of tendencies that are available on the platform, as shown on the interface after the homeowner has made a budget decision. These combinations are represented by renderings of the three main spaces in the dwelling: the kitchen, room, and bathroom. Each tendency is accompanied by a brief description of its characteristics and traits, to inform and assist the homeowner in making their selection.

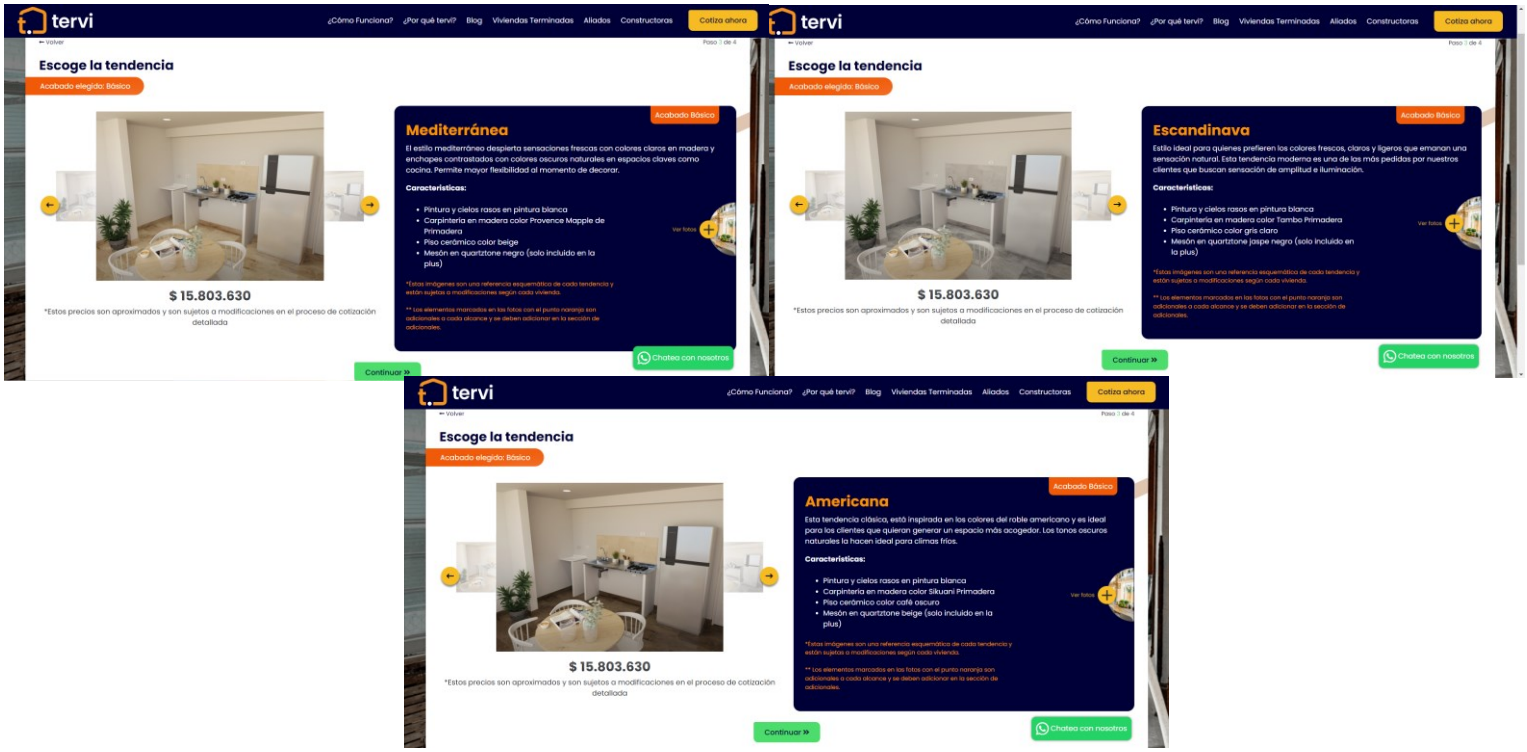

Figure 18 - Design Tendencies for Basic Budget Range

Note that Figure 18 shows a basic budget kitchen in the three different design tendencies where the stainless-steel stove and sink element delivered by the developer, as seen in Figure 11, is used to optimize costs. In Figures 19 and 20 the same kitchen is upgraded including carpentry and cabinets in the medium option, and the granite countertops on the plus one.

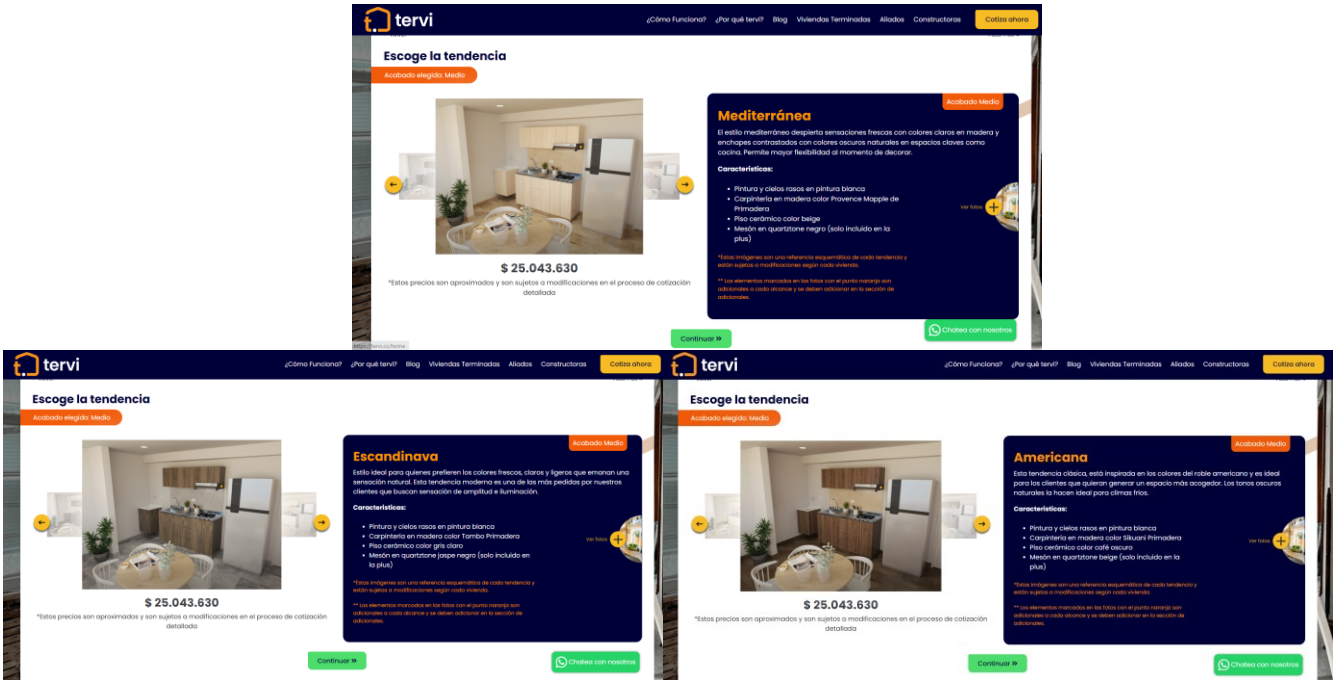

Figure 19 - Design Tendencies for Medium Budget Range

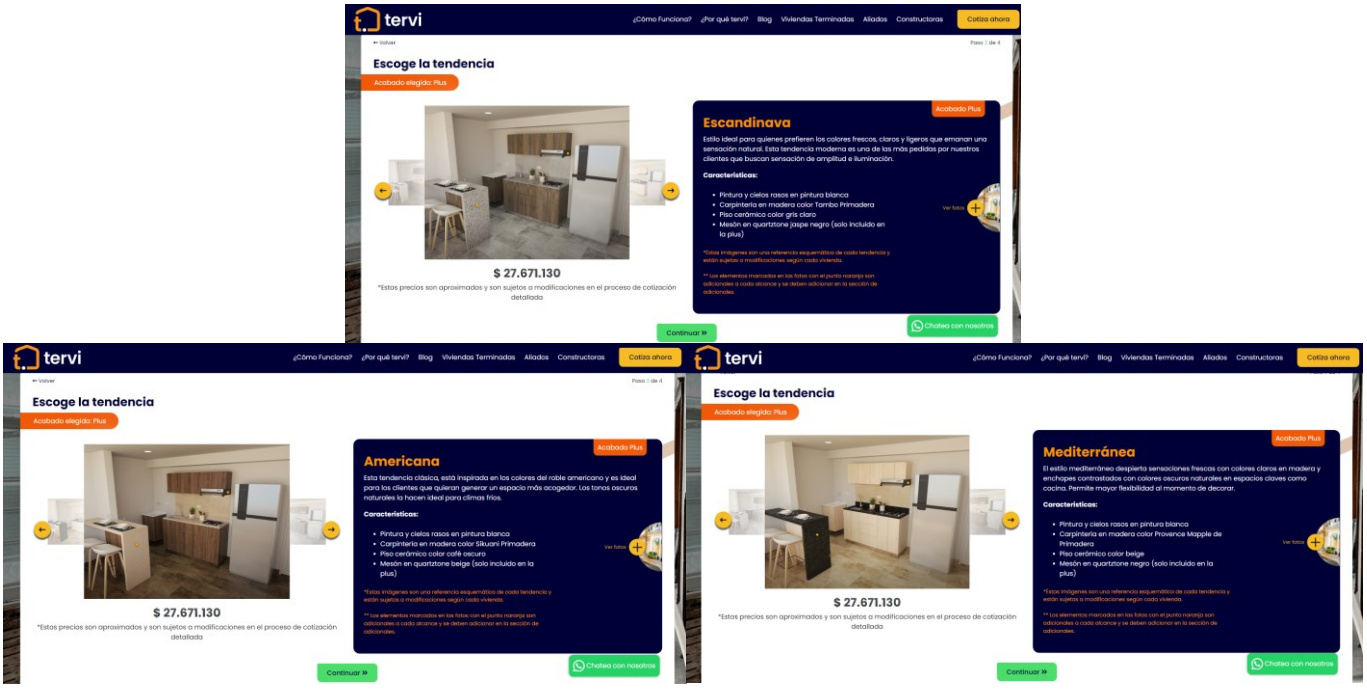

Figure 20 - Design Tendencies for Plus Budget Range

Evidently, the higher the budget range selected, the more elements and materials are incorporated into the tendency. However, one of the qualities of this virtual showroom is that homeowners can clearly grasp that there are several ways of finishing their dwelling without committing as much money and yet upholding aesthetics. Since inception, we've been trying to prevent a high degree of customization beyond the predesigned kits to facilitate the construction phase and future scaling of the solution. However, we realized that the service needed a level of flexibility to accommodate the homeowner's specific requests.

Consequently, the final step in the design and scope process after selecting the budget and design tendency allows the homeowner to include additional elements such as curtain blackouts, upgraded fixtures or shower, a kitchen island, and door enhancement, among others that are commonly requested in this type of housing. It is worth noting that the estimate's value can also be seen live through the process to express cost variations through this last step, where additional items can be included. Figure 21 outlines the interface through this last step, where the customer can check out after adding items to the selected design tendency and receive a detailed cost estimate summarizing the entire design process via email.

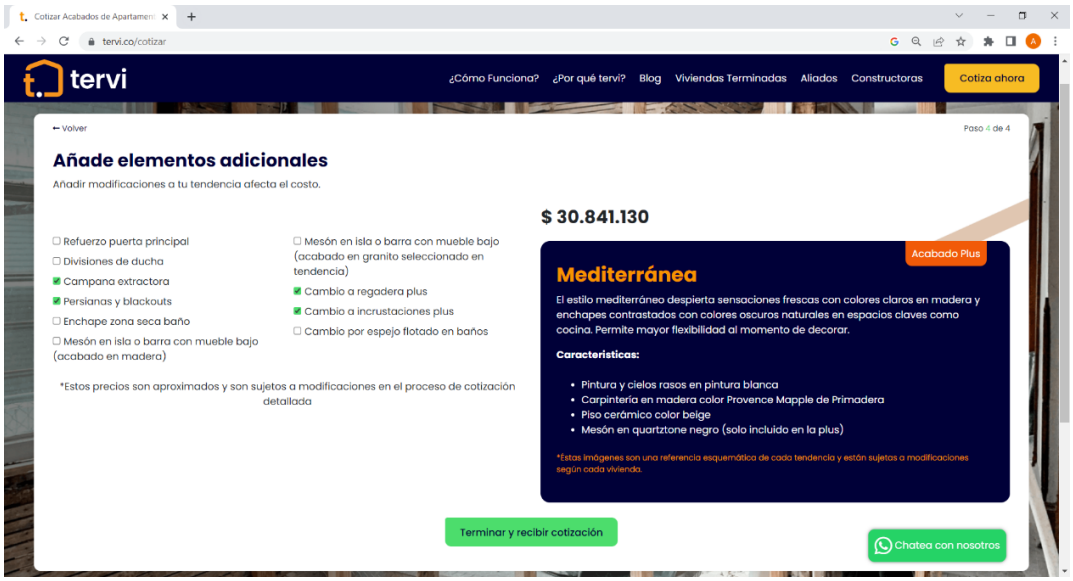

Figure 21 - Additional Items Interface

After receiving a detailed estimate and gaining a clear understanding of what their finished dwelling could look like, the homeowner's personal information is collected and organized in a database through our customer relationship management (CRM) system. This system enables us to perform daily follow-ups with customers, scheduling virtual or in-person meetings to answer any

questions and sign contracts to proceed to the construction phase. As we continue to scale our solution and gather layout and homeowner preference data in different markets, we aim to incorporate data analytics to strengthen our design feature. Our vision is to correlate design with the unit's performance in the market (rent and value), allowing us to assess which improvements maximize the homeowner's investment given the location of their home and scope of the renovation.

3.3.2 Financing the Improvement

Prior to the construction phase, the platform offers financing options to synchronize the household's design scope with their actual purchasing power. As outlined in this thesis, it is no secret that unfinished housing creates financial barriers for VIS homeowners to upgrade their units from the state of delivery. Even though Tervi's value proposition reduces time, increases quality, and improves the overall experience in the design and construction process, the financing component is significant for a large portion of the VIS customer base to even access the service.

Therefore, acknowledging the customers' financial limitations above-mentioned, as the primary market research revealed, overcoming this hurdle was necessary for the solution to be successful. The challenge arises because 60% of VIS households earn less than 4 MMW, approximately $1,031 USD a month. As per regulations, assuming they are spending the maximum amount allowed to service the mortgage as a share of gross income (40%), they have only $618 USD left to cover all other monthly expenses. This reality indicates that homeowners with no available savings under this category will have difficulties paying for a service that can cost between 5 to 10 times their monthly disposable income, and financing becomes the only alternative. To address this issue, we narrowed down our options to an asset-light approach that could facilitate access to credit without us directly providing it or assuming the risk of default, given the limited resources we had for the MVP.

Renovations and fit-outs that are currently carried out by informal contractors are often paid in cash without any contract or liability, which makes it difficult for formal lenders and other fintech companies to enter the market. With Tervi, the transparent formalization of the process enables lenders to capture a specific type of product that they previously did not have on their radar. Once the customer completes the design and estimate process outlined in the previous section, the platform offers access to a network of affiliated lenders that can offer financial services digitally.

While this could potentially represent another business vertical, the MVP is designed to be as lean as possible. The solution leverages agreements with traditional lenders to build upon their frameworks and allows homeowners to find capital to undertake their improvements if needed from third parties. Currently, Tervi has agreements with three different lenders, and homeowners can be redirected through the platform to their individual web portals where they are asked to provide personal information to undergo a digital underwriting process that determines whether they are eligible for credit to finance their fit-out. Figure 22 portrays the interface that is displayed after the customer finishes the design process and is emailed a detailed cost estimate.

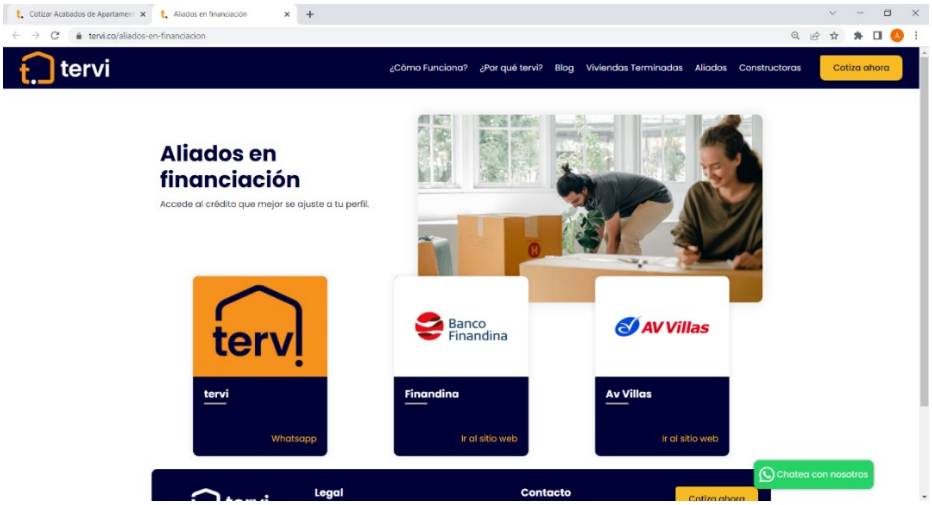

Figure 22 - Financing Feature Interface

Note that the interest rate, loan amount, required information and processing times vary among different alternatives, and the platform only serves as a broker that connects the homeowner with the financial institution. This modality intrinsically benefits the business model given that it broadens the customer base that can access the service and the lender disburses the funds upfront directly to Tervi reducing the working capital needs and receivables turnover. Having solved for the required funds to undertake the home improvement, the last step that culminates the value proposition is the construction.

3.3.3 Transforming the Shell to a Home

The first two steps of Tervi's action plan have digitized and automated an outdated process that used to require a high investment of energy and resources without technology. With the use of the platform, designing, cost estimating, and obtaining funds can be completed in minutes through a

single channel. However, the final product requires traditional brick and mortar construction to transform the unfinished dwelling. Although a thoughtful design process eases construction, this final phase aggregates several variables such as labor, material quality, and workmanship that define the outcome of the production process. Delivering high-quality standards, on schedule, and constrained by a fixed upfront cost agreed with the homeowner represented a challenge in a sector traditionally controlled by informal contractors and maestros. At this point, the overall performance of the service will be evaluated regardless of previous steps, as added value materializes and becomes more tangible for the customer when they can see the results of the construction.

Tervi's first objective was to completely insulate the homeowner from the hassles of the construction process, bypassing the usual stress that comes with this phase. Today, a homeowner working with an informal contractor needs to deal with workers, supervise and self-manage the execution, and provide and control material use. Inexperience can come at a high cost, and communication with the maestro can be intermittent. As a response, through Tervi's integral service, the customer can now be confident that the build-out is being performed with quality standards according to the parameters established in the design phase. Since the service provided is all-inclusive, and the design and specifications are clearly defined in the previous step, once Tervi receives the keys to an apartment, there is no additional input required from the owner. Tervi is currently developing a new feature that will enable customers to follow the progress of their fit-out with pictures and a construction log through the platform, streamlining communication with the construction team.

On average, it takes Tervi between 6 to 8 weeks to complete a unit, depending on its size and scope of design. This is almost a month less than what traditional contractor alternatives in the market offer. Additionally, the solution provides a financing option that enables VIS homeowners to contract a whole package and fully complete their unit in an 8-week schedule, instead of staging the finishing progressively based on fund availability.

This efficiency is primarily achieved due to two main reasons. Firstly, as Tervi scales and achieves volume, having predesigned kits with recurring materials facilitates bargaining power to negotiate materials in bulk and have a more effective supply chain with providers. This results in reduced costs that are translated into affordable fit-outs for the final customer. Secondly, instead of relying on a single Maestro with limited working capital and expertise to be responsible for the entire renovation,

Tervi works with contractors by specialties, as traditionally done by general contractors. The company has several subcontractors that specialize in floors, paint, drywall, glass, carpentry, and appliances. This allows for seamless deployment of each activity at the right moment by synchronizing beginning and termination dates that help optimize the subcontractor's capacity and reduce the overall duration of the construction phase.

Through the MVP, Tervi has engaged several subcontractors and worked closely with them in the process of formalizing their business. This ensures that their employees have social security and labor regulation requirements and, more importantly, guarantees a stable workflow. For many of these Maestros and contractors, access to the market is limited, and their informal nature commonly hinders their ability to offer a more professional service. By being affiliated with Tervi, they engage in an educational process, where incorporation as a small enterprise, specialization, and skill development are fostered to qualify them and refine workmanship. Through this process, contractors progress as they specialize in a single discipline, increasing their overall income, hiring more employees, and triggering new opportunities. Moreover, the results of this synergetic relationship are starting to demonstrate an unprecedented quality in the final product that is already transforming the lives of several families. Figures 23 through 25 gather the before and after photos of some of the multiple home improvements that have already been delivered.

Figure 23 - Before and After Transformation. Vernazza Project in Bogotá

Figure 24 - Before and After. Nexus Project in Bogotá

Figure 25 - Before and After. Vernazza Project in Bogotá

3.4 Go To Market Strategy

Tervi has demonstrated a substantial improvement in the status quo at a controlled MVP scale with the homeowners who have opted to use the service. However, to maximize the impact that the solution can have on the broader VIS population, scaling the solution to make it available for as many households across the country as possible will be necessary, yet challenging. If VIS housing sales continue to lead the market in Colombia, there will be over 100,000 yearly unfinished units in the pipeline, and capturing even a portion of them will demand an innovative customer outreach plan, an

extensive team, capital, a robust provider and contractor network, as well as an effective go-to-market strategy.

Since its inception, scaling the strategy has been one of the major obstacles that mentors and advisors at MIT have emphasized. Although the design and financing seem manageable for a rapidly growing company supported by technology, the construction component involving complicated logistics, subcontractor management, hefty procurement processes, and stringent quality control as the number of units under construction increases, poses a risk that cannot be ignored. The initial idea of directly accessing the homeowner VIS market as a B2C approach quickly crumbled when the business plan was outlined. We decided to take a step back to the stakeholder mapping process in primary market research and realized that housing developers could be a valuable ally to directly access customers.

Offering the solution through unfinished housing developers as a sales channel would trigger broader access to virtually every VIS homeowner moving into an unfinished dwelling. By acknowledging the underlying pains that developers were facing, we realized that there was room for adding value without necessarily incurring further costs on either side, entailing a considerable reduction of our customer acquisition costs. As the sales force of the developer and the physical infrastructure serve to promote our product, we limit the number of sales associates and marketing expenses. Moreover, as this symbiotic relationship generates an overall increased satisfaction of the final customer that can now access an integral home improvement service, more developers will be attracted to the solution as network effects are accomplished. This mutual benefit agreement is feasible given that Tervi reduces the risks and resources that today developers assume when informal contractors compromise the general state of building structures and common areas (elevators, hallways, lobby, etc.), in exchange for access to the customers that they already acquired.

In addition to this intrinsic gain that is perceived by having a professional and quality-supervising manager like Tervi rather than dozens of Maestros with no aligned interests, we developed a series of additional incentives that remain low in cost for us but maximize the value of the developer. First, we provide more tools to the project's sales team to rotate lagging inventory by offering discounts on our kits to customers to encourage the purchase of the shell unit. Second, we engage the homeowner

from day zero when they first meet the developer (this can be up to 2 years before the unit's delivery)[3] and handhold them through the process of selecting a design kit to establish an estimate and then provide financial education to help them gather the required resources for the fit out. The last incentive offered is a showroom in an apartment that hasn't been sold within the project. This alternative enables future homeowners to see a one-to-one model of how their home could look, accelerating the developer's sales cadence, yet only reasonable in projects with over 200 units where the cost of the showroom can be amortized. Figure 26 exhibits the showroom that we recently completed for Prodesa, a major developer in the Bogotá region.

Figure 26 - Tervi Showroom Balcones de Soacha Project

Leveraging our network and previous experience we have already signed agreements with 4 important VIS developers to offer our services and have several others on the pipeline. There is a demonstrated interest and willingness to engage with our solution to solve some of the caveats they currently deal with while improving the experience of their customers that have repeatedly manifested to resent developer´s lack of involvement in the finishing process. The developer´s role as a main agent in the go-to-market strategy seems to be the ideal avenue to scale the solution and make it available for the broader VIS market. Beyond being a channel to access VIS projects, that commonly

[3] Due to market standards in Colombia, housing units are usually sold prior to beginning construction and homeowners start committing a 20% to 30% down payment from up to 2 or 3 years before delivery. According to local bank regulations a construction loan is only issued after 60% of the project is already presold.

have more than 200 units, being focalized in clustered projects as opposed to being scattered across several units in the city makes the business case more appealing. Repetition of layouts enables us to better standardize the design kits, maximize productivity, limit material wastage, and have a concentrated and reduced quality control team. This results in economies of scale as we negotiate volume with a higher bargaining power and logistics are smoothened when working in major sites. The agreement with the developer also facilitates storage space and allows us to piggyback on the installed logistics of their construction team whenever a project is phased out and they are still on site.

On the design front several efficiencies are also achieved, given that prior to offering the solution the developer shares with Tervi all the architecture, structural, and MEP plans. This information facilitates considerably the process of establishing detailed measurements and design kits as well as providing a more personalized experience for the homeowner that can now previsualize in the platform a more detailed rendering of the fit out based in the actual plans of the dwelling. With partnered developers the platform has a tailored interface (a variation of the one exposed in section 3.3) for each project that streamlines the information required from the customer and yields a more accurate estimate. Figure 27 displays the access interface to the projects of some of the developers we have partnered with to date.

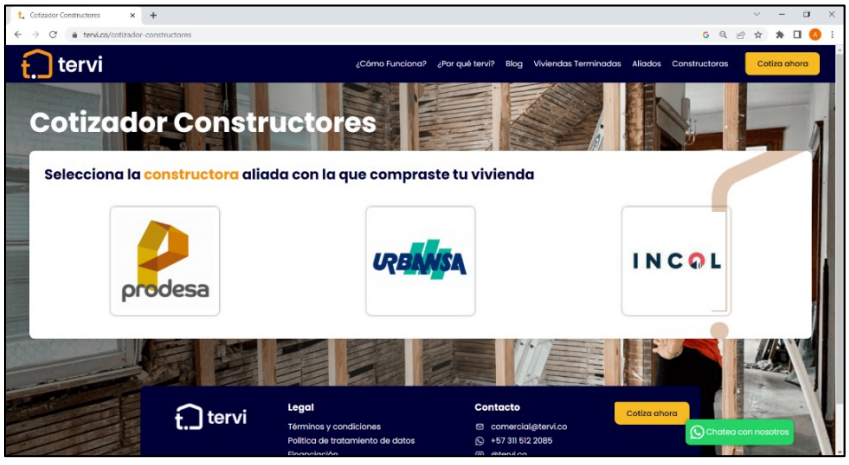

Figure 27 – Partnered Developer Interface

With this feature, potential friction of the original user journey outlined in section 3.3 is lowered. Given that we have all the information regarding space designation and area of the unit upfront, with

only personal information we can directly present the different budget alternatives and then the design tendency specifically applied to the layout of the project´s apartment type. This makes the homeowner´s experience more personalized and allows them to previsualize a more accurate representation of how their dwelling can be look after the intervention. Figure 28 shows the interface of a medium budget kit for an atypical apartment in a project in Bogotá with INCOL, a medium sized developer that recently started offering our services.

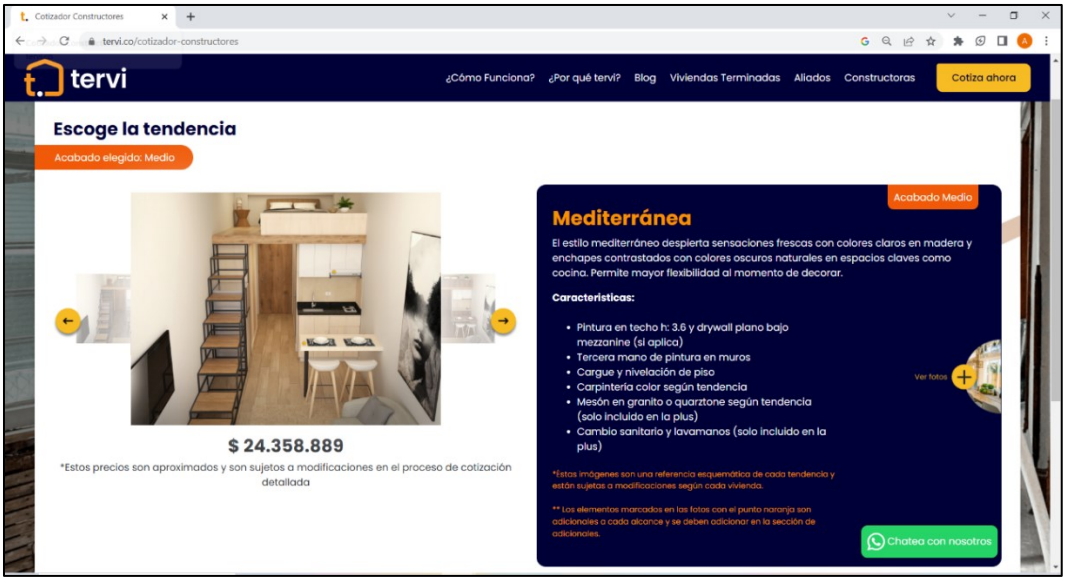

Figure 28 - Interface for Developer Projects: Atelier

Although the developer plays an external role in the core of the value proposition of Tervi, they are evidently a valuable channel and possibly the only avenue to fully expand and access the broader VIS market. Accounting for their key function in the business model will be necessary as the solution develops further features in a way that they continue to perceive value and become promoters of Tervi. This relationship built on trust and mutual gains, will guarantee a sustainable scaling plan that will ultimately bolster the capacity for impact that the solution brings forth.

3.5 Identified Challenges and Alternatives Moving Forward

In light of a successful MVP that proved product market fit to an extent and provided a better understanding of involved stakeholders, several challenges were also identified that need to be considered for the solution to be sustainable moving forward. The first version of the platform has limitations in scope and so does the operating capacity of the company, hence efforts in upcoming

phases need to address two main identified hurdles: financial constraints for homeowners to access the service and operating capacity while scaling.

3.5.1 The Financing Gap

On the financing front, through this document we have mentioned that most of Tervi's customer base is composed of first-time VIS homeowners that are only eligible for a mortgage with the assistance of government subsidies. Although currently the platform intends to provide an alternative to the lack of cashflow to finish by offering access to different financial entities, we have witnessed that several owners are credit burdened with the existing mortgage and are not qualifying to access these traditional loans. Even if the solution streamlines the connection with the source of capital, lenders will deny a loan when underwriting a customer with an elevated income to debt ratio and limited credit score. This restriction frames two possibilities, either innovate on a financial product with third party entities or develop a vertical with embedded financial services in-house.

The fact that the home improvement adds value to the underlying asset represents an opportunity for disruption. If a VIS unit costs $150 Million COP (~$33,000 USD), without accounting for the natural appreciation of the unit, an improvement worth on average $25 Million COP (~$5,500 USD) is adding 16.67% of value to the base of the collateral. If the homeowner has disposable income and the underlying asset is worth considerably more than the value initially contemplated when underwriting, additional room for credit can be carved out. Based on this logic, with Credifamilia, a mortgage focused bank in Colombia, we are running a pilot to explore the possibility of developing a home improvement loan that stacks over the mortgage and becomes an extension of the initial loan under the same terms. Accounting for the increased value of the equity will ultimately allow more customers to be eligible for credit given that the duration and rate of the mortgage are more favorable than traditional consumer credit. We realized that the probability of placing a loan substantially increased with this modality, which encourages future strategies with lenders to be aligned in this direction. This avenue will allow us to focus on the home improvements and rely on third party entities to assume the risk and implications of lending the capital.

However, beyond the appreciation of the asset as a collateral, disposable income of the household can also be a limitation to access credit for the additional home improvement, which has led us to envision the possibility of providing embedded financial services to bridge this gap. By relying on

agreements with unfinished housing developers as a part of our go-to-market strategy, the possibility of engaging with the customer months or even years before the unit is delivered enables us to work our way around the disposable income constraint. Through this early engagement Tervi can emphasize with the owner the importance of acknowledging in advance the cost of the required fit out upon delivery and directly offer financing alternatives. Nonetheless, to pursue this initiative it is necessary to understand the finances of an average VIS household. Table 5 analyzes a case study for a VIS household accessing mortgage through subsidies outlined in section 2.3.

Inputs	
Monthly Mimimun Wage 2023	$ 1,160,000
Yearly increment MMW	7%
Years to delivery	2
Subsidized Yearly Interest Rate (FRECH)	10.5%
Subsidized Monthly Interest Rate (FRECH)	0.84%
Term of the loan (Months)	360
Monthly Household Income (3 MMW)	$ 3,480,000.00
Unit Costs	
Projected Cost of Unit (150 MMW in 2025)	$ 199,212,600
Down Payment Breakdown (Adds up to 30%)	
Mi Casa Ya Subsidy (20 MMW)	$ 26,561,680
Complementary Subsidy (10 MMW)	$ 13,280,840
Remaining down Payment Deferred Over 2 years (30%)	$ 19,921,260
Resulting Payment Structure	
Outstanding Mortgage Value	$ 139,448,820
Monthly Mortgage Installment (After deed and delivery)	$ 1,226,463
Monthly Down Payment Installment (Only during 24 month presale phase)	$ 830,053
Debt Service to Income Ratio (During Mortgage Payment)	**35.24%**
Down Payment Service to Income Ratio (During Presale Phase)	**23.85%**

Table 5 - Mortgage Debt Service to Income Calculation VIS Household Case Study

For this case the household income is 3 monthly minimum wages (MMW), that is $3,480,000 COP. Assuming that the project is going to be delivered in 2 years and the purchasing process is starting today, the projection of the unit's value by the moment of delivery when the deed is signed is calculated by considering a 7% increment yearly in the MMW. Using standard VIS rates after accessing the FRECH subsidy and if the household can access 20 MMW via Mi Casa Ya and 10 MMW via a complementary subsidy, the remaining down payment to reach 30% of the assets value is $19,921,260 COP. By using the outstanding mortgage value and the other inputs we can determine the fixed

monthly installment[4] that yields a debt-to-income ratio for this household of 35%, below the 40% cap fixed by regulation.

When the household begins to pay monthly installments to cover the mortgage after delivery in year 2, the disposable income will be 65% to cover living expenses, education, transportation, and additional debt, if any. Nevertheless, the two years prior to the delivery the household will only pay $830,052 COP a month which is their share of the down payment divided equally by the 24-month period the developer establishes for presales. Note that during these first 24 months while the household only needs to cover the monthly down payment contribution prior to paying any mortgage installment, the down payment to income ratio would be more favorable at 24%, technically leaving space for an additional commitment during this period.

Imitating the down payment scheme the developer establishes for the unit, Tervi could provide an alternative to leverage the additional paying capacity during presales to enable homeowners to start paying small monthly installments destined for the improvement. This option implies that by the time the unfinished unit is delivered the household already covered 30% of the cost of the improvement and there is a 24-month track record that measures data to profile trustworthiness and paying capacity that can potentially result in access to credit that would otherwise not be available. Table 6 outlines how the structure of the home improvement loan could look for the same household being analyzed.

[4] Calculated using Microsoft Excel Payment Function

Inputs	
Monthly Mimimun Wage 2023	$ 1,160,000
Yearly increment MMW	7%
Years to delivery	2
Interest Rate	15.5%
Monthly Interest Rate	1.21%
Term of the loan (Months)	120
Monthly Household Income (3 MMW)	$ 3,480,000.00
Unit Costs	
Projected Cost of Improvement (22 MMW in 2025)	$ 29,217,848
Down Payment (Adds up to 30%)	$ 8,765,354
Resulting Home Improvement Loan	
Outstanding Home Improvement Loan	$ 20,452,494
Monthly Improvement Loan Installment (After improvement)	$ 323,698
Monthly Down Payment Installment (Only during 24 month presale phase)	$ 365,223
Debt Service to Income Ratio (During Loan Phase After Improvement)	**9.30%**
Down Payment Service to Income Ratio (During Presale Phase)	**10.49%**

Table 6 - Improvement Loan Debt Service to Income Calculation VIS Household Case Study

Starting with a home improvement value of $25 Million COP projected at 7% yearly increments, the household would have to incur in addition to the down payment for the unit, a $365,223 COP monthly upfront deposit for the finishes. Added together during the presales period, the down payment to income ratio including both unit and improvement would be 34%, which remains reasonable for the household to bear. After the 24-month phase when the unit is delivered, the homeowner could access a loan to cover the outstanding value of the improvement which would represent an additional 9.3% to the standing debt income ratio, reaching a total of 44% to fully finish the unit. This figure implies that the household's remaining disposable income is reduced to 56% which surpasses by 4% the government's capped limit to housing expenditure via debt. To guarantee this additional loan, a second-degree lien over the asset could be explored to hedge the risk of default but more importantly there is valuable data on the homeowner's capacity to pay gathered throughout 24 months of presales.

Evidently, such vehicle will stretch the credit capacity of the household to its limit, however, it frames an interesting possibility that could guarantee the upgrade of the unit together with its purchase through an upfront integral finance-build scheme. Important to mention, that as the gross income of the household is reduced under the 3 MMW threshold, accessing credit for a 150 MMW VIS unit will become more cumbersome, and such clients will be forced to target VIP units at a price of only 90 MMW to ensure affordability. If Tervi manages to bundle the upfront purchase and

renovation financing service, this will represent a high barrier to entry to competitors, while the funding gap for households is bridged. Indeed, much of the VIS housing market would prefer an integral solution that provides funds for purchase plus the fit out of the unit. This combo would also be appealing for developers to partner with Tervi, as a complementary solution to improve service to their customers.

3.5.2 Alternatives to Logistics and Quality Hurdles Amid Scaling

Assuming that the financing challenge is solved there is still an inherent operational risk in scaling up Tervi. The traditional brick and mortar business model involves heavy logistics across several geographic locations, demanding construction management and dealing with a variety of customers with different interests. The predesigned fit outs and partnered agreements with unfinished housing developers will mitigate these challenges to some extent by concentrating a considerable portion of the renovation volume in only a few projects, allowing to reduce logistics, overhead and material costs. Nevertheless, scaling a startup involved in providing meticulous housing finishes without compromising quality control and overall performance can be challenging. When it comes to peoples' homes word of mouth is paramount, and any disruption in delivery schedule and quality can easily undermine the customer´s satisfaction.

We have highlighted the intrinsic complexities of the construction process, entailing many stakeholders and phases. Coordinating these different elements can be cumbersome, primarily because of management of the supply chain as more units come into the pipeline. Every home improvement requires a wide range of materials and ensuring these are delivered to the job site on time and in the right quantities relies on a variety of factors. Reducing such operational risk will demand a rigorous procurement and budget control process, as well as efficient communications between the construction and the sales teams to avoid inconsistencies that could potentially wind up in delays or specification errors. Optimizing logistics and deployment of resources needs to be a priority as the company expands.

Overall, standardizing processes—ranging from the design phase to construction—will eventually help limit the impact of the logistics hurdle during the scale up phase. Fostering agreements with material providers to integrate the platform with their databases—allowing Tervi to determine available stock and delivery times—will help reduce responsiveness in material deployment.

Furthermore, from a construction management perspective, analyzing packs of fit outs under execution holistically allows Tervi to negotiate and plan collectively rather than approaching every improvement individually, and should ultimately reduce reworks and material waste. All the above components, combining strong provider channels with planning and executing through standardized frameworks, will be key to mitigate logistical difficulties. Ensuring quality control, however, will demand additional efforts.

Since the establishment of the company, we have been cognizant that the less sophisticated nature of the industry in Latin America makes it harder to build disarticulated business models that rely on servicing customers through existing incumbents. For example, in the broader real estate sector in Colombia, developers are usually also general contractors and operators. Firms rarely subspecialize across categories and rather tend to be generalists. Real estate firms are vertically integrated to provide end-to-end solutions with certified quality. Confronted by this reality, Tervi has sought to be an all-inclusive solution: supported by technology automating the design and sales process, but also involved in the execution and delivery of the unit. Outsourcing the home improvement work would challenge the foundation of Tervi's value proposition, which primarily gravitates around quality, time, and affordability.

If the start-up's market strategy continues to be through developers and is expanded to other cities, a high degree of involvement in the construction can be manageable. Concentrated volume in single projects with hundreds of identical units facilitates quality control and proper workmanship. However, as the company is scales, a dichotomy arises between full involvement in construction—to ensure quality—and disintermediation as a growth avenue. Accessing homeowners through the developer channel will certainly be efficient but there will still be a considerable portion of the market that won´t be covered. This would imply deviating from a project-concentrated strategy into spreading across several locations, which will disturb logistics and quality control. By that point if the company is consolidated in the market and has developed a robust network of contractors, additional strategies to consolidate a disintermediated platform could be explored to expand its reach.

Considering that quality and logistics will eventually compromise scalability spurs us to think about the future of Tervi. The experience acquired through the process of building multiple improvements by that point will help us understand the market and customer needs. The possibility

of branching the business into two verticals could be an innovative way of leveraging the experience acquired through the full engagement in operating construction and logistics. This would allow Tervi to develop the two business lines in parallel. Maintaining an arm of the company fully engaged in the brick-and-mortar construction can guarantee secured and steady income moving forward, but to scale the solution and make it virtually accessible to every VIS homeowner in the country, doubling down on technology is the only path.

The next feature of the platform could continue to provide the technology for automated design assistance, and subsequently pair the homeowner with a vetted contractor to execute the build out, rather than Tervi being involved in all construction directly. The firm would then become a curated marketplace that provides the same features of the MVP but delegates the execution through a matching process to a contractor that meets quality standards and has the capacity to undertake the build out. This alternative would shift the burdens of logistics and day-to-day construction to the contractors, making Tervi´s role more of a supervisor and facilitator. This vertical could detonate a myriad of benefits for SME contractors and informal maestros by offering them access to a broader market, lead generation and management, quality tips, trainings, a digital construction log and other tools to become more professional, optimize and digitize their workflow. Ultimately, we would transmit all the lessons learned and efficiencies acquired during the development of the construction vertical, to empower them to formalize and take their business to the next level. A robust rating system, standardized construction procedure tutorials, and periodic quality checks led directly by Tervi would help to guarantee quality regardless of the number of units under construction.

Although ambitious and requiring thorough additional market research and a demonstrated willingness to pay on both sides of the platform, this approach could potentially be scaled to other markets, or even to up-selling other home services such as maintenance, cleaning, or plumbing among others (See Figure 29). Eventually crystallizing the concept of home improvement as a service where homeowners can find everything that they need to live better. The marketplace nature of such a platform would completely help Tervi bypass most of the logistics and quality issues if a robust network of onboarded and trained contractors join the supply side. Conscious that high informality rates in the sector complicate the digitization of SME contractors and Maestros, success will require deep educational and onboarding processes. Nevertheless, it represents an enormous potential for the region as technology continues to penetrate society at an accelerated pace. The future of Tervi

needs to capitalize on this trend and materialize the improvement of homes without compromising its value proposition, all the while adapting to economic shifts and relying on technology to scale and reach more households. Referents in the US market such as Houzz, Angie's List and Sweeten Renovation, have proven the immense opportunity and broader market that can be accessed by fully "*platformizing*" the business model and are success cases that Tervi could look up to if the decision is to follow this path.

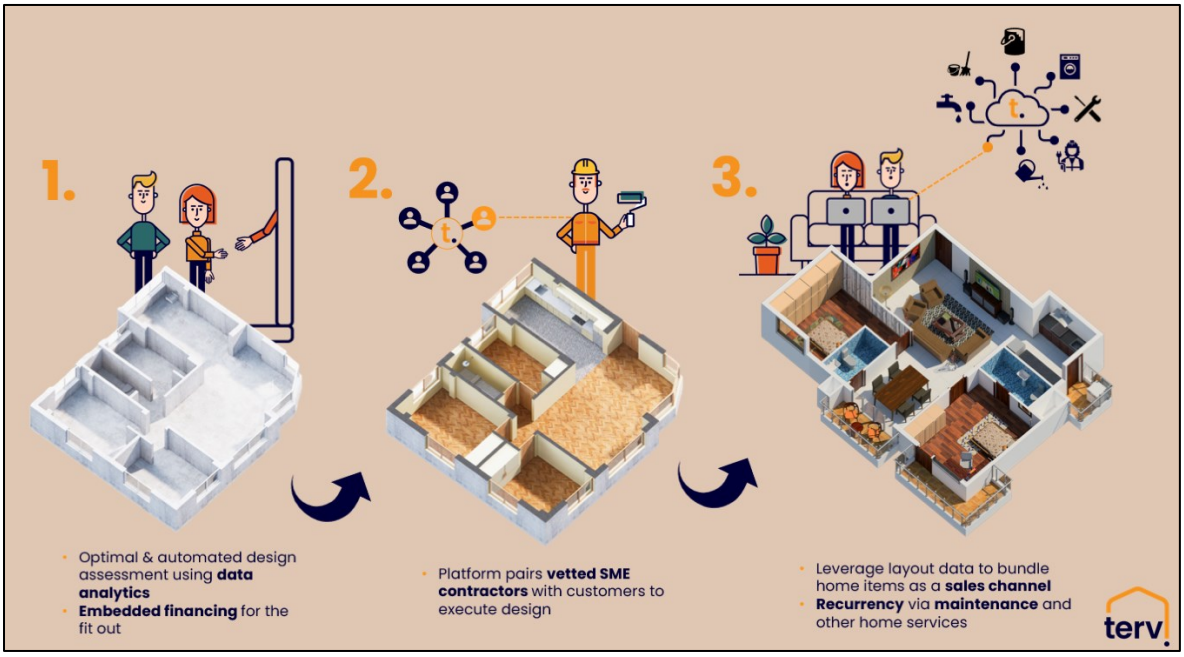

Figure 29 - Future Alternative of Tervi: Home Improvement as a Service

4. Traction and Early Impact

4.1 Customer Demographics

Regardless of what the future platform can pivot into, chapter 2 outlined the size of the housing quality problem and the urgency for a service that changes the status quo. A yearly market of more than 140,000 unfinished units crystallizes an imminent opportunity of impact. The different shapes that a solution can take become secondary if the benefited households improve their overall life quality and living standards. By simply capturing 2% of the serviceable obtainable VIS market, the solution could be helping 2,800 households yearly. Throughout the deployment of the MVP—with limited human and monetary resources—we have already been involved in the improvement of over 38 VIS dwellings across Bogota's metropolitan area, which again presages the transformational capacity of the solution. To measure impact, we have garnered information on customer demographics to better understand who is the VIS homeowner that Tervi is serving.

The information from initial customer households captured their age, gender, marital status, presence of children, and whether they are first time homeowners or not. Even if the size of the sample is limited and there is no information on household size and income, this initial data is valuable to understand the type of homeowner that is accessing the service today, and to concentrate future efforts accordingly. Note that the information of age and gender is associated with the direct customer who interacted with the online solution. Figures 30 through 34 represent the results of the 38-customer pool in pie graphs.

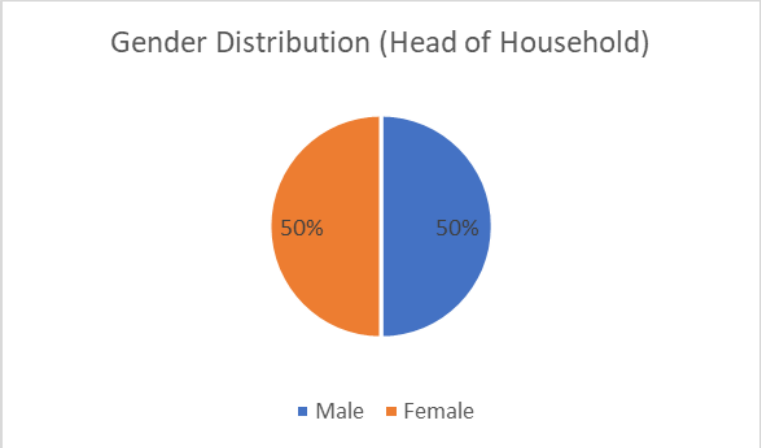

Figure 30 - Customer Gender Distribution (Head of Household)

Among the customers that have used Tervi there is an equal gender distribution, and most homeowners are between 20 to 40-years old (Figure 31). Only 3% of the sample are more than 50 years, and none older than 60. We have identified that a common VIS purchaser is a young professional with a stable job but limited income, joining funds with their couple to gather the required capital. It is also common to see middle class individuals that acquire VIS-type units as an investment or second property to rent, however these types of buyers aren't eligible for government subsidies and usually have a higher disposable income or savings to pay for both the unfinished unit and its improvements. In Colombia more than 35% of the population rents, and as multifamily building investors are not common the small-unit market becomes attractive for retail investors as a safe alternative (El Tiempo, 2021).

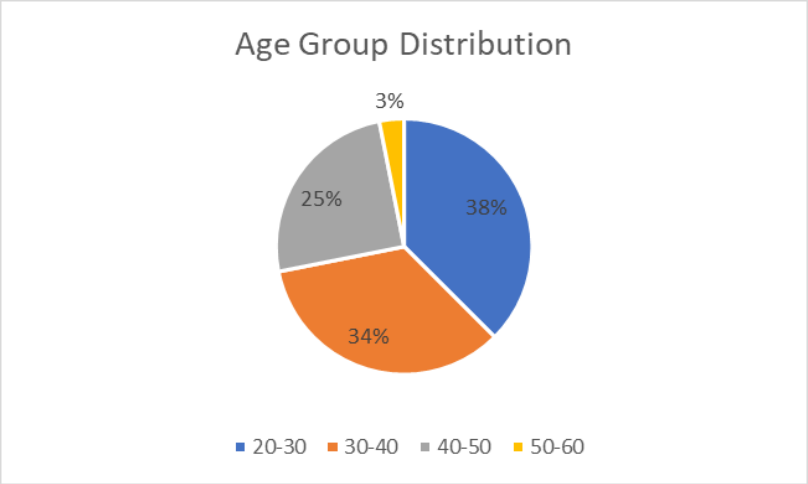

Figure 31 - Customer Age Distribution

It is worth noting that only 44% of the existing customer pool is married and only 31% have kids (Figures 32 & 33) which denotes a potential deviation compared to the average of 3.1 people per household in the latest census. Yet this might be hinting at the demographic shift occurring particularly in major cities. The fact that some of the projects that we have been working on are one-bedroom and studio units in dense areas of the city might be skewing the overall analysis of marital status, age distribution, and presence of children.

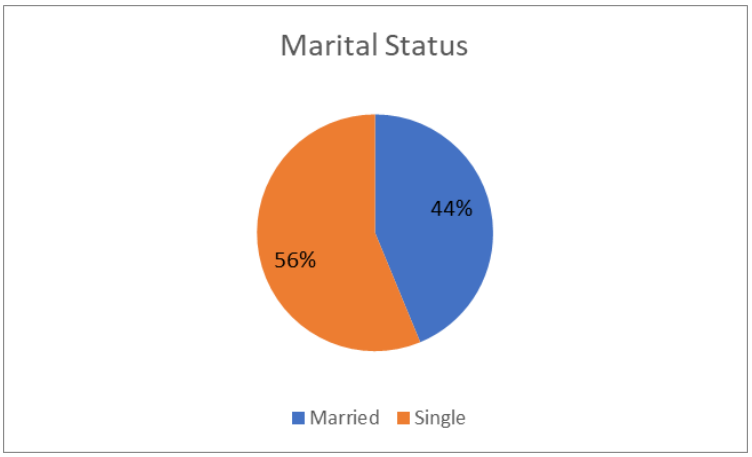

Figure 32 - Customer Martial Status

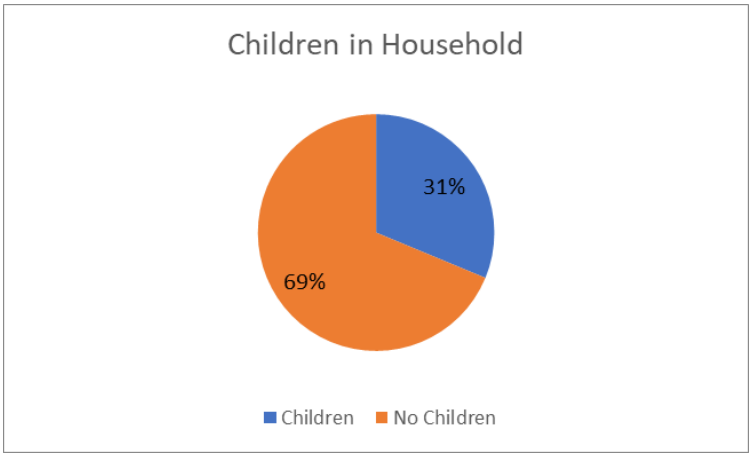

Figure 33 - Customer Children Status

The last element that we have measured by surveying customers is whether they are first-time homeowners. Given that information around income and subsidies can be sensitive to ask for, we limit the question to whether it is the first time that a home is being purchased. Usually, first-time homeowners have accessed one of the government's subsidies for support. Of the current customer base 59% are becoming homeowners for the first time. The remaining 41% could be classified as customers in the mid-income range that possibly purchased the unit and undertake the improvement as an investment. It is worth mentioning that all the units that we have been involved in represent the *"low-hanging-fruit"* of our market, as the owners have been able to pay in reasonable installments during the 8-week execution period. They represent the uncommon type of customer with savings

or available cash. The full deployment of the solution will certainly reach a broader demographic, requiring much effort to assist the less fortunate segment to afford the fit out.

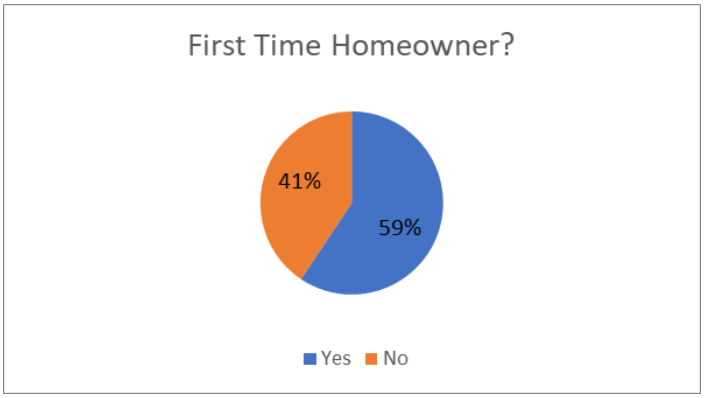

Figure 34 - Customer Homeownership Status

As we progress and broaden the service, these figures will possibly vary and shed light on more detailed insights about the benefited population, allowing us to adjust the solution accordingly. The demographics gathered to date are evidently biased given that we are only working in one city and trying to optimize our operating capacity by working in a few clusters. However, this does give us a first cut at molding the solution to address the more salient household pains. We can subsequently combine this information with available customer satisfaction surveys to measure the impact of scaling up the service.

4.2 Early Impact Metrics

The results that we have witnessed throughout the MVP represent a controlled experiment example that foreshadows the impact that could be achieved if the solution is expanded across the country. Although the initial sample is limited in size and diversity, customer satisfaction evaluations done after one month of Tervi's delivery help measure some of the results in the overall perception of life quality and livability among customers. During the IDEAS Social Innovation Challenge at MIT in the Spring of 2022, we developed a detailed customer assessment to try to capture the main spheres where our solution was impacting the way VIS homeowners live. In essence, the hypothesis is that Tervi is providing a practical solution that appears to be having a significant influence on the way people perceive their home and live their day to day.

Before diving into these metrics, it is worth highlighting that among the 38 households that we have worked with the Net Promoter Score (NPS), which outlines the willingness of a user to recommend a service on a scale from 0 to 10, is 8.7. This result means that on average the service is likely to be recommended by customers that have already used it. The index classifies customers that rate under 6 as detractors, 7 or 8 as passive or somewhat satisfied but willing to engage competitors, and 9 to 10 promoters, that is those that are satisfied with the product and would be enthusiastic to recommend it. With margin for improvement, measurements of this outcome hint that there is value being provided through the solution.

To break down the generated value it is necessary to bifurcate the analysis between first-time homeowners that move into the unit after Tervi's delivery (59% in Figure 34), and the remaining homeowners that bought the unit as an investment (41% in Figure 34). The value that the service adds to the latter gravitates around the time to lease or sell the unit. Of the 13 investor customers, 100% of the units were leased or sold within 1 month of delivery. Twelve customers in this group trying to lease out their unit manifested that the aesthetics and layout distribution facilitated by Tervi contributed to leasing the asset. The remaining customer sold the unit after the improvement and recognized that the installed finishes were a determining factor in the process. Consequently, the service provided is accelerating the returns for the owner and maximizing the investment, which is the benefit that this type of customer is expecting to get from Tervi.

On the other hand, among the 19 customers that make up the 59% pool of first-time homeowners— beyond the implicit appreciation of the underlying asset—we have strived to evaluate perceptions of value on 3 main dimensions: comfortability, hygiene, and general wellbeing. Our data is limited by qualitative and subjective elements and by the lack of a control group. We also acknowledge that correlation is not necessarily causation. However, the results are a helpful initial step to measure Tervi's impact from the perspective of the households directly involved.

4.2.1 Results on Comfortability

To determine impacts on comfortability we evaluate whether time spent in the dwelling increased and if the elements incorporated in the renovation facilitated daily activities. If time spent at home has increased to some degree, there is a preference to inhabit the space that could be interpreted as a manifestation of comfortability. Most of the customers (84%) declared to be spending more time in

their newly finished unit than they used to in the previous state or alternative living solution. Figure 35 depicts the distribution where 11% of the sample said it did not affect the time spent, and only 1% stated spending less time than before.

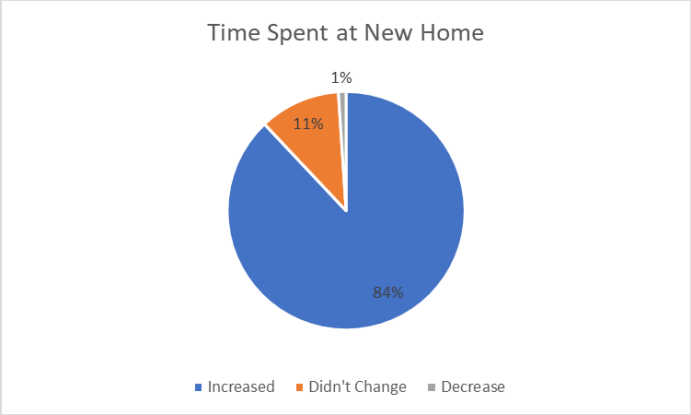

Figure 35 - Customer Survey Results: Time Spent at New Home

To verify whether the finishes facilitate daily activities, we listed different elements and asked homeowners to select those that materially improved after the intervention. The options included storage space, thermal comfort, illumination, capacity to concentrate, perception of privacy and leisure space. Combined, these parameters describe if the home improvement has had a positive impact across several dimensions that we have identified that households living in unfinished or partially finished conditions experience. Figure 36 illustrates the frequency in which each of these categories were selected by the 19-homeowner group. Note that for every category more than 50% of the surveyed households declared perceiving an improvement which denotes the influence of Tervi's intervention.

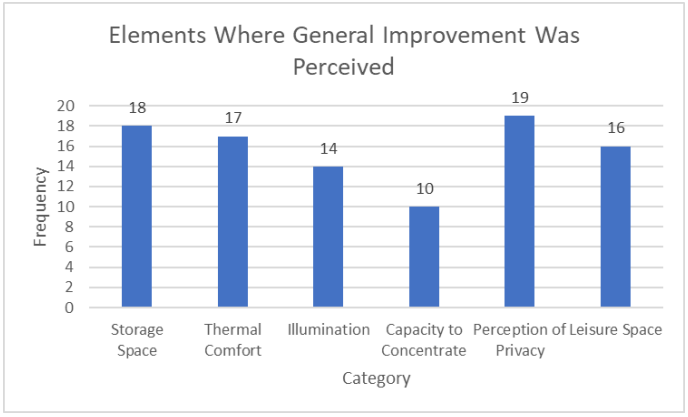

Figure 36 - Customer Perception of Comfortability Categories

The reason behind all respondents agreeing to see an improvement in their perception of privacy is explained by the fact that unfinished VIS units are delivered with no doors. It is not uncommon to see families living in these dwellings using curtains to replace wooden doors amidst the lack of options to afford one. The incorporation of closets, cabinets and other types of furniture justifies why storage and leisure space also rank as top choices, and illumination following in the list is a result of additional lighting outlets that are frequently included to better lighten key areas such as kitchen and living room. Thermal comfort, however, is worth mentioning separately as it is probably representing the most measurable impact in comfort resulting from the home enhancement.

Research conducted on thermal properties of inner coating has repeatedly demonstrated to have a direct effect on the thermal response of the space and indoor temperature because of heat-flow reduction (Meng, Du, Gao, & Yu, 2019). Given that unfinished units are usually concrete walls, increasing the thermal resistance of the element helps to limit heat conduction, which in turn reduces heat losses in cold cities such as Bogotá. A surface of 1 cm of plaster and paint can contribute 127% more of thermal resistance relative to a single 10 cm concrete wall, translating in the retention of the inner temperature and thus a more comfortable space (OTM Solutions Pte Ltd, 2020).

By aggregating the results of both questions asked regarding comfortability, we can appreciate a data pattern that bolsters the hypothesis of an overall increased comfortability index. If in the future we add additional quantitative nuance to this index, it could serve as practical opportunity to better gauge comfortability, which is usually hard to measure.

4.2.2 Results on Health

In the introduction we highlighted research that has demonstrated the impact of home improvements on health outcomes. Although the available data from Tervi´s customers is limited, there are two parameters that have a bearing on health outcomes based on existing evidence: sleep and hygiene. As part of the customer satisfaction survey homeowners were inquired about their perceptions on both parameters.

The World Health Organization has conducted research showing that sleep deprivation can cause physical effects, cognitive impairment, and mental health complications (WHO, 2004). As a

conspicuously influential variable in our lives—and one relatively easy to register—we assess if sleep among homeowners that accessed our service could be improving and hence reducing the proneness to suffer health afflictions related to lack of sleep. 58% of the respondents admitted perceiving an overall improvement in the quality of their sleep, while 32% did not notice changes and 11% manifested a decrease (See Figure 37). Although not a definitive majority, recalling the improved thermal comfort mentioned in the comfortability assessment, plus the supplying of window shades in the rooms, and doors that also help to isolate noise, it is not unreasonable to affirm that the renovations could be positively influencing the sleep among households.

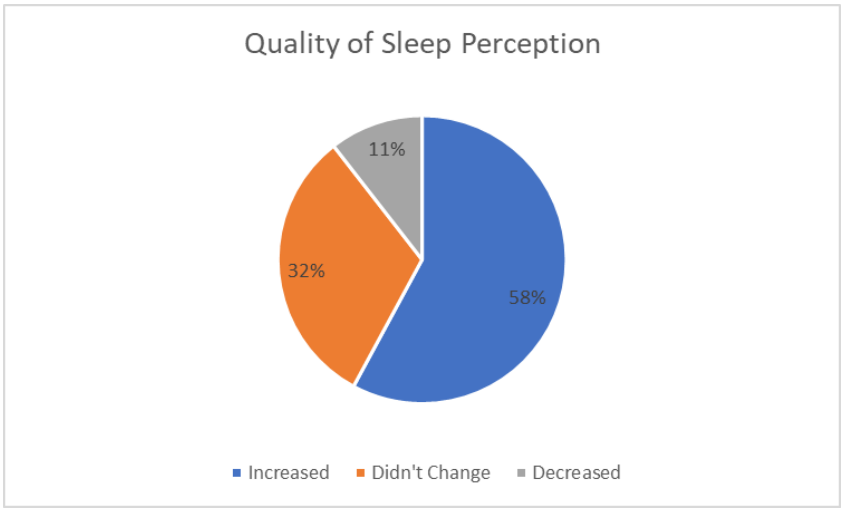

Figure 37 - Customer Survey, Quality of Sleep Perception

The second parameter that we have attempted to measure is hygiene. Lack of proper hygiene in spaces where food is manipulated or humid areas such as bathrooms and kitchens, trigger susceptibility to infectious intestinal diseases, salmonella, and dermatitis among others. Proper home hygiene has historically demonstrated to be the best way of combating home borne diseases (Stanwell-Smith, 2004). For this reason, evaluating the ease of undertaking hygiene related activities can be useful to understand the potential impact of cleanness on health. Unfinished VIS units with concrete floors and walls complicate hygiene, given the porous, permeable, and absorptive characteristics of the material. Ceramic tiles on the other hand, are hydrophobic (impervious) to avoid water filtration and provide a twofold effect in terms of hygiene and comfort. In wet areas that encourage microorganism formation (bacteria, mold, lichens, moss, fungi, etc.), microorganism growth and reproduction are inhibited by the coating of the ceramic which, additionally, facilitates cleaning with water (Moreno Berto, 2007). We inquired about the spaces of the unit where cleaning

activities were now more easily executed to evaluate if there was a shift in perception which could imply a higher frequency of cleaning, hence better hygiene conditions. Figure 38 illustrates the results, where most homeowners agreed that humid areas and floors became easier to take care of following the home enhancement.

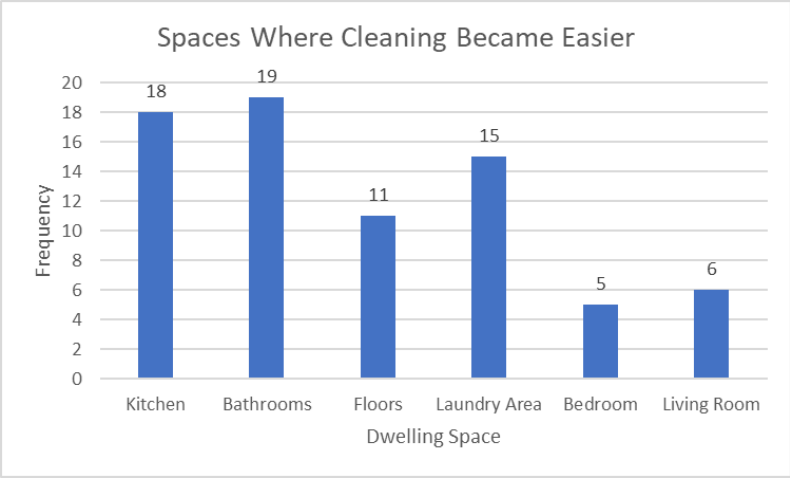

Figure 38 - Customer Perception of Increased Facility to Clean in Spaces

Kitchen, bathrooms, and laundry areas ranked as the spaces where the experience of cleaning became more seamless. Assuming that this effect derives in additional eagerness to clean, the results indicate that hygiene among the intervened households has improved and subsequently, the potential health outcomes could also be positive. In the future, a more careful and structured analysis with a larger pool of customers can be performed to better evaluate the tangible results that the solution contributes to this matter, yet the results again hint to favorable outcomes.

4.2.3 Results on General Well-Being

The last category that we established to understand the added value that Tervi grants to VIS homeowners is general well-being. Although the most subjective of the three categories, and probably the toughest to determine, we strived to assess if the household's well-being, self-perception, or dignity improved to an extent. Given that this concept can have an ample specter of factors and it can even be interrelated with comfortability and health, we approached it by listing a series of parameters that could be representative of such an index. Figure 39 portrays the different categories that were considered. Note that respondents were asked to select all that apply among the different prompts listed.

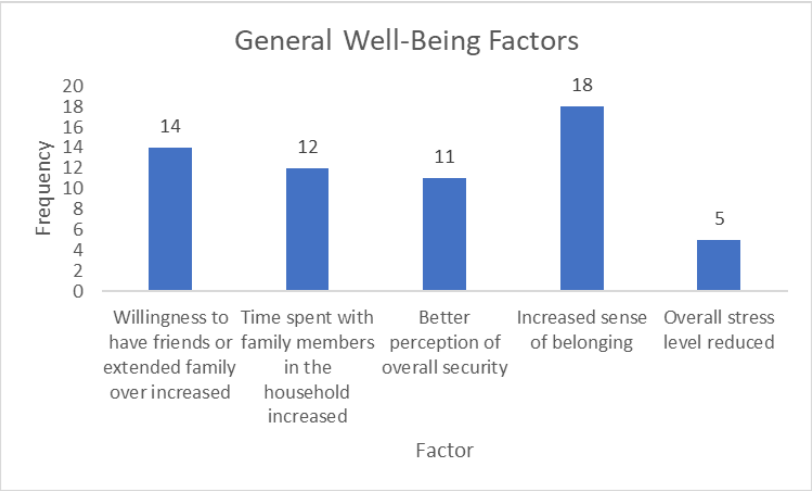

Figure 39 – Customer General Well-Being Factors

The highest option selected was sense of belonging, with 18 customers or 95% of the sample resonating with this prompt. Given that this pool is only composed of first-time homeowners it is not surprising that virtually all of them manifested that the transformation of their dwelling into a livable home detonates sense of belonging. Furthermore, 74% and 63% of respondents agreed that after the home improvement their willingness to invite friends or family over and time spent with family in the household increased respectively. Social connection and emotional support are a fundamental human need for mental and emotional wellbeing. Studies have demonstrated that social relationships have short- and long-term effects on health, and that these effects emerge in childhood and cascade through life to foster cumulative advantages or disadvantages in health outcomes (Umberson & Montez, 2010). More than half of the surveyed owners resonated with an increased perception of security, and a minor proportion of 26% perceived that their overall stress had been reduced since the renovation. Although this factor appears to be the least impactful, it might be underestimated and harder to capture, given that there is research that correlates stress with inadequate room temperature, lighting, and design.

Again, lack of a control group, diversity among the customer sample, and sample size imply that the statistical significance of these early impact metrics is low. It is important to reiterate that correlation is not causation and that these results require further research. Right now, they rather capture a pragmatic qualitative customer engagement strategy undertaken through Tervi to capture the material impacts that customers are perceiving. Nevertheless, the exercise outlines the potential

for impact that the solution can garner moving forward. The opinion and impressions of more than 38 families matters and augurs that there is material progress being achieved in comfortability, health, and wellbeing. If the vision of Tervi is fulfilled to the extent that the solution becomes available across the entire national geography, the positive influence of the transformation of the underlying living conditions and life quality of thousands of families would mark an inflection point in the housing scene of the country.

5. Conclusions & Following Steps

5.1 Reimagining the Qualitative Deficit Concept

As discussed above, the first section of this thesis touched upon the definition and implications of a qualitative housing deficit. Academia and multilateral entities have sought to establish reasonable quality thresholds to classify a dwelling's standard and define policy frameworks to improve living conditions. However, the concept of quality also encompasses a series of underlying drivers that can be more complex and ambiguous to measure, and yet remain fundamental to the everyday ways in which people interact with their homes. Evidently, access to basic infrastructure, utilities, materiality, and general stability of the dwelling are high-level standards that every housing unit should have as a starting point. Habitability though, is usually disregarded, particularly in developing countries where policy efforts are concentrated in tackling informality and the quantitative deficit.

Colombia provides a clear example of this phenomenon, where limited resources and a perceived more urgent need have prioritized the quantitative deficit. However, this has resulted in the inevitable downgrading of qualitative standards as a second-tier priority. VIS policies—delivering unfinished shells—contribute to reducing stock shortage but add a quality burden to Colombian households, even if the dwelling is technically classified above the qualitative deficit threshold. Surprising as it may sound, an unfinished VIS unit is inhabitable under existing standards, just by complying with structurally sound materials, utilities, and technical livability benchmarks. Clearly, the scope of such livability benchmarks falls short. Having a structurally stable concrete box with utilities is a data point, but it does not necessarily involve adequate living standards. Furthermore, the current system tends to ignore the barriers that unfinished housing poses to VIS homeowners in uplifting the quality and comfort of their units.

By creating and deploying Tervi's MVP, we have demonstrated that a more nuanced approach to affordable housing is required. An integral evaluation that recognizes that habitability of a space is complex and integrates fundamental parameters that affect how homeowners live. Policymakers and developers must acknowledge that their actions directly influence the spaces in which families spend a substantial fraction of their life – where they build memories, character, and cultivate a sense of belonging. Aspects that existing households consider valuable and have effects on their overall quality

of life such as comfortability, health, and well-being, are not being properly addressed. I believe that these should be factored into this quality construct.

In a constrained but valuable exercise, Tervi's approach to acknowledge customer satisfaction metrics has shed light upon a few of the implications among households following tangible quality enhancements. Tracing a threshold to define quality is not trivial, as it should capture a myriad of elements that are hard to determine, such as habitability and household dignity. However, the 38 family testimonials that have already gone through the process of transforming their unfinished dwellings into livable homes, hope to serve as a good indicator of less palpable but equally important parameters for housing quality. Accounting for these currently unaccounted for, additional parameters and thus reimagining the qualitative deficit concept may eventually pave the way for better quality housing, more valuable research to unveil the implications of limited quality on household life, and more mindful policy approaches.

5.2 Disrupting the Status Quo From a Policy Perspective

Existing policy frameworks resulting in unfinished housing are backed by indisputable figures of progress in homeownership metrics, financial stability, and overall access to essential services, representing key milestones that are improving housing conditions in relative terms. It is worth recalling that more than 700,000 families have accessed housing over the past decade, partly due to the government's efficient deployment of resources through effective housing policy. The fact that housing has become a matter of State, regardless of political filiation, is living proof of the capacity of sustainable and technocratic-based policy frameworks to generate long term impacts. Mi Casa Ya and FRECH subsidies have marked innovative breakthroughs in housing policy to optimize scarce resources and maximize the benefited population. By the same token, the private sector– spearheaded by developers – has been deeply committed to equally combating the housing shortage, demonstrating that aligning public and private interests is perhaps the best way of effecting sustainable policy.

In consequence, this thesis by no means pretends to undermine existing programs, but rather acknowledges their strengths and understands their weaknesses and shortcomings to suggest where future efforts can be concentrated to be more impactful. On the VIS housing spectrum, for instance, I propose how existing policy can be disrupted to help solve the burden that unfinished conditions bear upon first-time homeowners. Shallow data approximations could push to raise the cap on the

value to incorporate finishes, or mandate developers to deliver higher standards. The first option neglects the often-limited purchasing power of low and emerging middle class, particularly as a higher purchasing price would increase households' debt-to-income ratio and limit access to mortgages, and thus housing supply. The second option would likely discourage developers from investing in this asset class, which already has limited returns compared to market rate housing, thus constraining supply in a market that is already short on quantity. Hence, prior to suggesting any modification, it is important to understand the existing market conditions and the financial resources available.

According to official figures from the Ministry of Housing, City and Territory, the total bureau's budget for 2023 assigned by the new government is $6.4 Trillion COP of which 24% corresponds to national housing subsidies, Mi Casa Ya and FRECH mostly (Ministerio de Vivienda Ciudad y Territorio, 2023). In a simple exercise that assumes 4% of the total budget ($270 Billion COP) could be allocated to home improvement subsidies, a substantial impact could be achieved to facilitate households improving their home. Recalling the case study of the family with 3 MMW of monthly income illustrated in section 3.5.1 Table 6, a sensitivity analysis incorporating a hypothetical down payment subsidy for improvements materially reduces the resulting debt to income ratio of a potential loan for the improvement. What used to represent an additional 9% to the mortgage debt to income ratio could be considerably reduced with a subsidy as low as 5 MMW.

Available Budget	$	270,000,000,000

Improvement Subsidy (MMW)	**Debt to Income Ratio (Improvement Loan)**	**Available Number of Subsidies**
5	6.66%	46,551
6	6.14%	38,793
7	5.61%	33,251
8	5.08%	29,094
9	4.55%	25,862
10	4.03%	23,275

Table 7 –Debt to Income Ratio Sensitivity Analysis Assuming Hypothetical Improvement Subsidy

Table 7 depicts the result of the sensitivity analysis where we can evidence the dramatic reduction in the debt-to-income ratio of the improvement loan as the subsidy increases from 5 to 10 MMW. Homeowners potentially accessing 9 or 10 MMW as a subsidy to the down payment of the

improvement could keep their overall debt to income ratio—including the main mortgage—below 40%. Note that the number of available subsidies is inversely proportional to the number of MMWs provided, the higher the contribution per unit the lower number of households that could benefit from the program. Considering that on average every year around 50,000 families access Mi Casa Ya subsidies, imagining that such hypothetical policy could be assisting almost the same population but for a fraction of the cost is appealing.

Following the same dynamic that has made Mi Casa Ya successful, increasing the number of beneficiaries by limiting the amount disbursed per family to rely on debt instruments and a partial cash commitment on the household's side, housing policy can be more effective and ubiquitous. It is necessary that municipalities and federal government acknowledge the implications of the burden that unfinished housing represents to most VIS homeowners and take action to pivot into a policy approach that builds upon existing frameworks and proven successful programs to diversify the prioritization of housing quantity and consider quality. Imitating distribution strategies that have proven to work at different scales to promote new programs that focus on quality, which has been obscured from the VIS housing debate.

Furthermore, the VIS market is vast and limited supply for home-improvement services will demand more players to fully bridge the quality gap. Evidently, continued agreements with developers, lenders, and providers will promote Tervi's access to other cities and a broader market but capacity will eventually be constrained. The government must also strive for regulations to foster entrepreneurship and innovation particularly in those sectors that have historically lagged in adoption of technology, such as construction and real estate. Providing incentives for players in this niche will be key to catalyze a more competitive market translating in deeper affordability and higher quality standards.

5.3 Closing Remarks: Entrepreneurship as a Driver of Change

MIT's education and its entrepreneurial ecosystem illustrate the power of entrepreneurship and technology to drive change. As technology continues to penetrate all spheres of society, tech-enabled solutions will continue to become fundamental in solving the most pressing issues of our societies. During my time at MIT, I have been delighted to come across multiple mission-driven entrepreneurs working to improve education and healthcare access, combat climate change, and

provide financial inclusion among many others. Innovation is undoubtedly the most effective way of driving impact, and technology provides the avenue to do so at an accelerated pace.

Latin America is lagging, but recently steady progress is unveiling major opportunities, particularly to tackle the lack of services of all kinds that a 30% increase in the emerging middle class over the past decade has entailed (World Bank, 2023). Just like other platforms of such nature in the region have identified unresolved pains and sought to solve them fueled by technology (See Rappi, Addi, Mercado Libre, or Habi)[5], Tervi helps digitize a process that today is full of barriers and has ample margin for improvement. By describing the housing market context in Colombia and outlining the needs of VIS homeowners to design a digital platform, I exposed how aggregating stakeholders of a fragmented "offline" system can facilitate interactions among them. Together, streamlining home enhancements through connectivity and accessibility can help improve housing quality.

Beyond being the results of the academic endeavors in this document, Tervi is an operating business that is already materially contributing back to society, particularly to families in Colombia who need it most. I have the vision that everyone should be entitled to have a home. Not just a dwelling or shelter, but a space where safety, comfortability, health, and general wellbeing are guaranteed. As a consequence, the design and implementation of the technology to respond to existing limitations will require iterating to discover the feasible avenue to reach more households without compromising the underlying value proposition: affordability, aesthetics, and quality.

Flexibility will be essential to adjust the solution according to the homeowner's purchasing power and interests as the product evolves, to reduce potential frictions among a population that is highly informal and poorly digitized. This is especially true if Tervi pivots toward a marketplace model. Dealing with the informal contractor and Maestro base will require a participatory action plan that acknowledges their concerns and adds clear measurable value to their business. By that point, the question will be if the platform is able to fundamentally transform the status quo and contribute to formalizing the informal nature of the home-improvement industry. If this goal is accomplished, as the early transactions have hinted at through concrete impacts, the potential to reshape existing

[5] Three recognized startups in Latin America that have sought to solve emerging middle-class needs.

structures is imminent and Tervi's data will become a valuable source of information to conduct further research on the impact of housing quality on household life.

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