CENTER FOR FOREST PRODUCTS BUSINESS
DEPARTMENT OF SUSTAINABLE BIOMATERIALS

Increasing Exports of US Wooden Modular Homes to Developing Countries Systems.

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VIRGINIA TECH

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1. Acknowledgements

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2. Executive summary

Sustainable housing is one of the fundamental necessities for socio-economic development. Yet a considerable population of the developing world is living in substandard houses. On the other hand, developed countries like the United States have substantially improved the residential construction sector by engineering new materials and developing efficient systems.

This study attempts to link this supply capacity of the system built wood construction sector in the United States to urban low-income housing markets in the Latin-American region. Expansion to new markets and diversification to new products can rejuvenate this industry in the U.S. Linking the manufacturer with potential buyers overseas would need efficient production, logistics and marketing systems. This research is focused on product development for bottom-of-the pyramid buyers to give them an affordable yet sustainable alternative to traditional systems. Interviews and survey tools were used to assess key aspects of housing deficits in target demographics of the South and Central American regions. System built wood construction manufacturers in the U.S. were assessed to identify barriers and incentives for internationalization and how they differ from exporting to non-exporting manufacturers within the same industry. Findings indicate that developing products for social housing programs can provide access to potential untapped markets. Lack of existing wood construction in some of the selected markets indicates the possibility of resistance to acceptance but also assures no local competition. The learnings can also contribute to opening of new markets for exports of prefabricated wooden buildings in other housing sectors.

3. Introduction

The construction industry in the United States is one of the major industries in the country. In 2014, the sector accounted for 3.8 percent of the annual Gross Domestic Product (Bureau of Economic Analysis, 2016). Over the past 15 years, the sector has experienced fluctuations and endured a challenging time. Starting with a decent share of 4.5% in the year 2000, the construction sector experienced a frenzy growth with flourishing of the US economy until 2006. The sector was badly hit during the December 2007-June 2009 recession with a net employment decline of 19.8 percent (Hadi, 2011). The loss of 1.5 million jobs was the largest decline amongst the non-farm industries. Residential construction was the most badly hit with the effect starting almost a year before the start of the actual recession. The market and condition of the residential industry has improved ever since but this improvement is coming at a considerably slower pace (U.S. Census Bureau, 2016). As a result, the companies in this sector need to prepare themselves to face any similar market disruption in the future. The development of a robust business model with diverse market penetration could be one of the options to grow and prepare for any similar catastrophe (Baack, Harris, & Baack, 2013).

Based on the method of building, the wood residential construction sector in the U.S. is divided into two sectors namely the site-built and the factory built (also called system built) home industries. There is a considerable difference in the share of market between these sectors. Site-built residential construction essentially dominates the market controlling as high as a 97% of the market share in 2014 (U.S. Census Bureau, 2016). Figure 1 shows the trend of new single family homes completed in the U.S. over a period of 12 years (1992-2014).

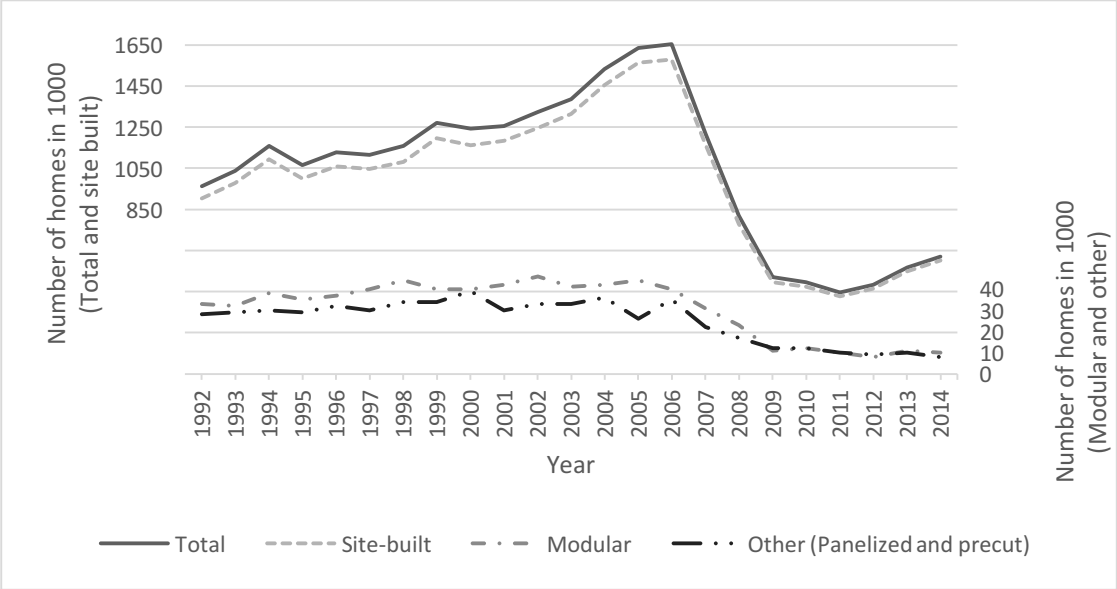

Figure 1 New Single Family Homes Completed in United States (1992-2014)

In order to better interpret the above graph, the axis are split into two groups. The axis on the left shows the number (in thousands) of the completed total and site-built houses. The axis on the right shows the number (in thousands) of the completed factory built (modular, panelized and precut) houses. Despite being technological mature, the factory built sector has yet to make its mark in the residential construction market as depicted in Figure 1. This indicates a need and possible opportunity for the factory built sector to grow and improve its contribution. Several studies (Apgar, Calder, Collins, & Duda, 2002; Bady, 1996; Wherry, 2009) suggested an inherent potential in the factory built sector for increasing its market share.

3.1. Use of wood in construction

Sixty percent of the raw materials extracted from earth are used in construction (Bribian, Capilla, & Uson, 2011). From this volume, buildings represent 40% and the rest is infrastructure like roads, bridges, and others. The sector alone contributes a substantial share in global resource consumption. But this also means that there is a possible opportunity to innovate and improve this usage because consumption of nonrenewable and non-replenishable resources can lead to

devastating effects on the environment. Wood is extensively used as a construction material in many parts of the world because of its availability, cost, ease of working, renewable nature, attractive appearance, performance, and serviceability if built and maintained properly. The Consortium for Research on Renewable Industrial Materials (CORRIM) group showed using Life Cycle Assessment (LCA) of wood, steel and concrete frame showing that the net CO_2 emissions avoided when using wood construction was 55 metric tons while steel and concrete had a higher carbon footprint with additional net CO_2 emissions of 185 and 167 metric tons respectively (CORRIM, 2004). With responsible forest management practices assuring a sustainable supply, wood has been proven to be a better choice of construction material (Smith, 2010). Certain concerns like fire, structural durability and moisture damage always put wood construction in an inferior spot. Bad heat conducting nature of wood and use of proper fire prevention structural and non-structural components in construction assures enough safety (Smith, 2010). Building design according to performance codes and timely maintenance can assure better structural performance and prevention from any moisture damage.

3.2. What is system built wood construction

Construction technology is the process of constructing or building a product, commonly known as a structure and using different materials, methods, and equipment (Carswell, 2012). Different structures can be constructed depending upon the type of material or method being employed. Over time, the construction industry in the United States has grown and differentiated itself into different independent but functional categories. This transformation in the construction industry has been relatively slower as compared to other areas of engineering and technology (Gianino, 2005). The central topic of analysis for this study is the system built wood buildings constructed

majorly in the controlled environment of a facility. This is also known as off-site construction or factory built construction. Depending upon the extent of prefabrication, these off-site manufactured systems can vary from just pre-cut and prefabricated components to panelized leading up to fully advanced volumetric modular systems. Factory manufactured components in these systems replace some of the on-site labor built structures. The process is mainly feasible in repetitive components of houses like, walls, floors, doors, and windows, etc. When these structures are assembled on the site, it can be very effective in saving time. The following section discusses different types of construction systems in this category.

3.3. Types of System built construction

This report introduces 3 different types of manufacturing techniques used in the United States for residential wood construction.

3.3.1. Prefabricated systems

This is the most basic type of off-site factory manufacturing of building components. This system evolved with the wide spread of lumber mills which started to supply processed dimensional lumber to the builders. All of the cutting, drying and processing is done in a central location and then supplied to the builder on the construction site. The builder would then use these to make walls, floors or roof systems. This system further gained popularity with the development of engineered wood products like Structural Insulated Panels (SIP), trusses, I-joists (WoodWorks, 2014; WRAP, 2007), etc., which required mechanized manufacturing by skilled labor and cannot be done easily on the construction site.

3.3.2. Panelized systems

With further development in factory manufacturing of wood products, the wood products industry moved to assembling the prefabricated products into larger panels or complete

assemblies. These panelized systems can be engineered according to construction design. Use of computer aided design further helps the manufacturers to manufacture exact dimensions quite easily (WoodWorks, 2014; Chiang, Chan, & Lok, 2006). Using panelized systems, complete wall panels, floor, and roof systems can be delivered to the construction site ready for assembly and installation. Some systems come even with plumbing and electric fittings so that factory built systems are not tampered.

3.3.3. Modular systems

This is the most advanced building system in which the entire house is divided into independent modules during the design. These modules are then built in a factory on a production line like any other manufacturing process. Controlled environment, skilled labor, and use of automation in construction make this off-site manufacturing very quick as compared to on-site construction. These modules are fitted with all the utility fittings and insulated properly before they leave the facility. Some modules might even come with interior finishing like carpeting, kitchen cabinets and shelves, etc. A complete module is transported to the job site where it would be connected and sealed with the rest of the structure to complete the building. This type of the building system has a maximum amount of prefabrication ranging up to 95% of the total construction work done off-site. In order to assure sufficient safety and durability, the modules are inspected at factory during construction and on-site at the time of installation as well. This method can complete a project in half the time as compared to traditional stick built on-site construction (WoodWorks, 2014; Blismas, Pasquire, & Gibb, 2006).

4. Literature review

4.1. Current state of industry in the United States

The residential home construction industry in the United States is extremely scattered by nature (ProBuilder, 2016). The top 20 giant construction companies in the residential sector accounted for only 17 percent of the market shares. The bottom 100 companies together accounted for only 2% of the market shares. Seventy percent of the market was operated by the non-giant small companies (Figure 2). This shows that the majority of the market is being operated by small and medium companies.

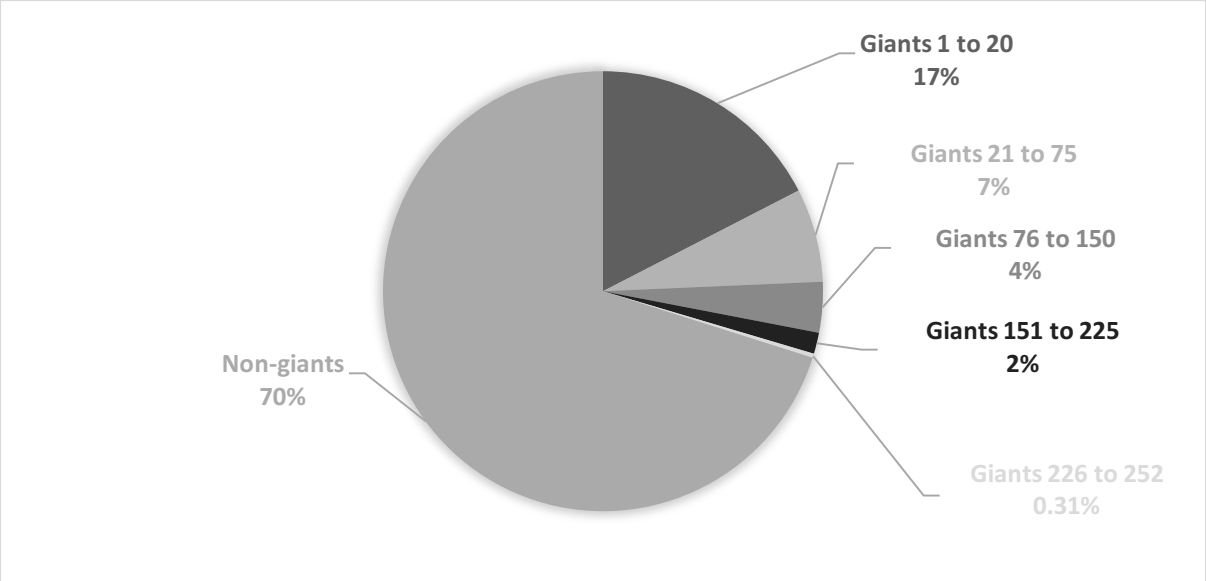

Figure 2 Housing Giants Market Share, 2016

ProBuilder (2016) also highlights major challenges and opportunities identified by the giant residential construction companies. Table 1 summarizes their findings in each of the two categories along with the proportion of responses. Lack of skilled labor and increased competition indicate that the construction companies need to diversify and mechanize their process in order to stay competitive. This also means that companies need to move to new

market segments which is also seen as an opportunity by most of the major companies. The companies also feel that it is important to improve the operational efficiencies in their processes.

Table 1 Biggest Challenges and Opportunities Anticipated by Giant Companies in 2016

Challenges		**Opportunities**	
	Response Proportion		Response Proportion
Availability of land	51%	Operational efficiencies	56%
Scarcity of skilled labor	51%	Niche market opportunities	40%
Increased Competition	27%	Market expansion	39%
Rising Home Prices	19%	Economic recovery	28%
Government Regulations	15%	Better marketing	28%

Carter (2015) reported a detailed analysis of the off-site construction industry in the United States. A total of 717 businesses were estimated to generate a revenue of $7.4 billion. Two hundred and twenty six million US dollars out of these revenues were expected from exports. The expected profits for the industry in 2015 were $161.8 million and the industry showed a decent growth of 4.9 % for the period of 2010-15. However, this growth is expected to reduce to 2.3% in the next 5 years. It is alarming as the author mentions that “Despite slow sales growth, the industry will lose ground to traditional housing.” Table 2 summarizes the current structure of the off-site construction sector in the United States.

Table 2 Industry Structure: Off-site Construction in U.S. (2015) *(Carter, 2015)*

Factor	**Status**	**Factor**	**Status**
Life cycle Stage	Decline	Industry assistance	Low
Revenue Volatility	Medium	Capital Intensity	Low
Concentration Level	Medium	Regulation Level	Medium
Technology Change	Medium	Barriers to Entry	High
Industry Globalization	Low	Competition Level	High

Due to the slow and decreasing growth rate, the sector is in a declining stage of its life cycle. Owing to major acquisitions and mergers posted since the 2008-09 economic downturn, the sector is fairly concentrated now with few companies contributing considerably to the overall revenues. This also makes it harder for new businesses to enter and compete at the top of the sector. Despite the usual belief, the industry is less capital intensive and more labor intensive because of the higher share of customized orders and the industry has a very low level of globalization with limited trading across the globe. According to the Consumer Financial Protection Bureau (O'Hollaren, 2017), the median annual household income of manufactured homebuyers is slightly over $26,000. This is roughly half the median income for families buying other homes. When traditional site-built homes drop in price and become more widely affordable, demand for manufactured and modular homes declines because of consumer's preference of traditional on-site constructed homes. Suppressed conventional home prices spurred many of these low-income consumers to purchase traditional homes. The system built industry is thus consequently forced to price their products competitively. According to the Census Manufactured Homes Survey (O'Hollaren, 2017), the real average price of a manufactured home grew at a tepid annualized rate of 1.5 percent over the five year period before 2016 (latest data available). Combined with rising input prices, this trend has led to declining profit margins for this industrial segment (Carter, 2015).

The three companies in the sector controlling more than 45% of the market share in 2015 were Berkshire Hathaway Inc. (28.0%), Champion Enterprises Inc. (10%) and Cavco Industries Inc. (7.8%). In terms of product segmentation in 2015, 55.3% share was expected to be of manufactured mobile homes, 33.6% of prefabricated wood buildings (that includes panelized and

precut buildings), and the remaining 11.1% was nonresidential mobile buildings. Manufactured mobile homes shared the largest fraction of the product sales. In terms of market segmentation, 60.3% of the revenue was generated from the retail trade where most operators either have their own stores or market distribution channels to multi-brand stores. In contrast, wholesalers generated 36.6% of this sales.

Existing international trade for the industry is very low at a mere 3.1% of the annual revenue (Carter, 2015). In 2015, the factory built home industry alone recorded total exports of $226.8 million (Figure 3). Seventy four percent of it was to Canada and mainly because of geographical proximity (Carter, 2015). Japan, Australia and Mexico together accounted for another 15.7%. The remaining 10.3% of the share is dispersed among the rest of the global market. Figure 3 shows the distribution of exports and share for each country. This shows that the export market for this product is still in its early stages of development and there could be an opportunity for companies manufacturing wooden homes to exploit export markets.

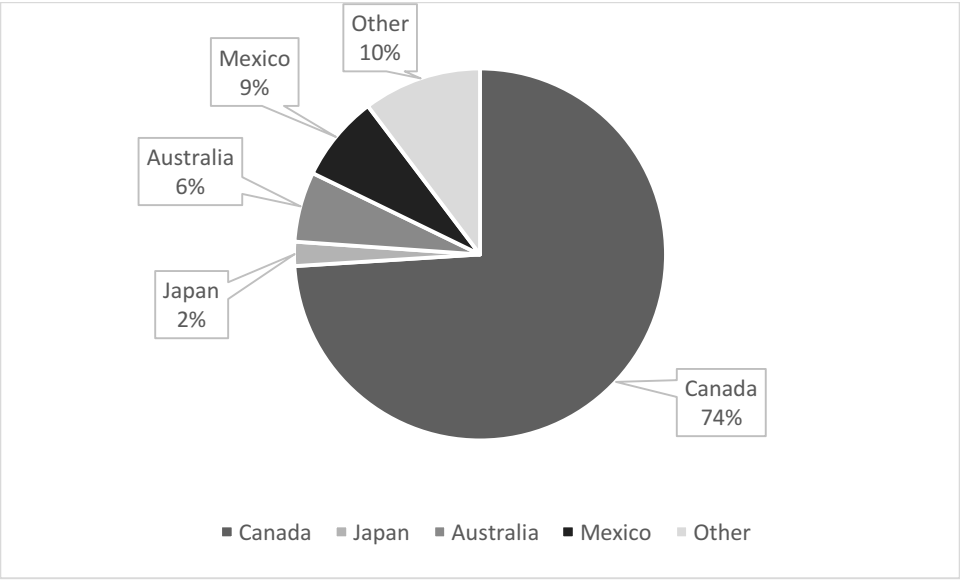

Figure 3 Exports of Factory Built Construction Industry (2015)

This also shows that the factory built home industry has a very small share in exports as compared to other forest products. This is despite the fact that manufacturing needs considerable capital investment in setting up and maintaining the facility. Higher-value added products create more jobs and value for the U.S. economy as compared to low value or raw products. Thus there is a need to further promote and increase the global operations of this sector in order to benefit the economy.

4.2. Housing market of developing countries in South and Central America

Housing conditions strongly influence physical and mental health of the dwellers, education, access to economic opportunities and vulnerability to social ills (Bouillon, 2012). Thus it is extremely important for people to have sufficient and sustainable housing at affordable prices.

South and Central America (including the Caribbean) are among the highly urbanized regions of the world. It is estimated that this urban population will grow from 75.5 % in 2010 to 84.6 percent in 2030 and match the likes of developed regions of Western Europe and North America. (McBride & French, 2011). Urban cities attract jobs, investments, and people leading to the growth of the region. A fast growing urban population would mean increased need of housing in the cities of the region but this becomes a major challenge in accommodating increasing populations with services, employment, and shelter. However; the majority of the countries in South and Central America have not been able to withstand the immense pressure on the supply and cost of urban land and housing. “Of 130 million urban families in the region, 5 million rely on another family for shelter, 3 million live in houses that are beyond repair, and another 34 million live in houses that lack either title, water, sewage, adequate flooring, or sufficient space” highlights Bouillon (2012).

Based on the nature and additional efforts required to achieve minimum standards of dwellings, housing gaps can be classified as quantitative and qualitative shortages. Quantitative shortage includes housing units that are damaged beyond repairs and are not suitable for living. Qualitative shortages include households living in units with insecure tenure or illegal titles, temporary structure, inadequate sanitation, and overcrowding (Bouillon, 2012, p. 26; Rojas & Medellin, 2010). Bouillon (p.27, 2012) also quantified both of these qualitative and quantitative shortages in the region of Latin America and the Caribbean. Table 3 summarizes the findings. Due to inequality in household income in the region, the populations per quintile vary a lot. As a result and despite of the majority of the poor suffering from housing shortage, most of the households that fall in higher quintiles experience housing deficit. As reported, the poor with housing deficit consisted of 9.8 million households but 32.3 million households facing deficit in the region were not poor.

Table 3 Regional Housing Shortages in Latin America and the Caribbean 2009 (Percent of the Households) (Bouillon, 2012)

				Urban quintiles by per capita household income				
Housing Gaps	National	Urban	Rural	I	II	III	IV	V
Total Shortages	37	32	60	52	39	32	24	16
Quantitative Shortages	6	6	5	9	8	6	5	3
Qualitative Shortages	31	26	55	43	31	26	19	12

Table 3 highlights averages of the region but this shortage differs significantly from one region to another. Rojas and Medellin (2011) suggested that since each country in the region has different socio economic and geopolitical structures, so that; the shortage should be tackled differently. Figure 4 shows the percent of households in Latin America and Caribbean regions (Bouillon, 2012,

p. 28). The shortage is most profound in Bolivia (75%) and is lowest in Costa Rica (18%). Since the trade relations of most of these countries with the United States are amicable and supportive (Baack, Harris, & Baack, 2013), the manufacturers and suppliers of houses in the U.S. can explore the region as a potential market opportunity.

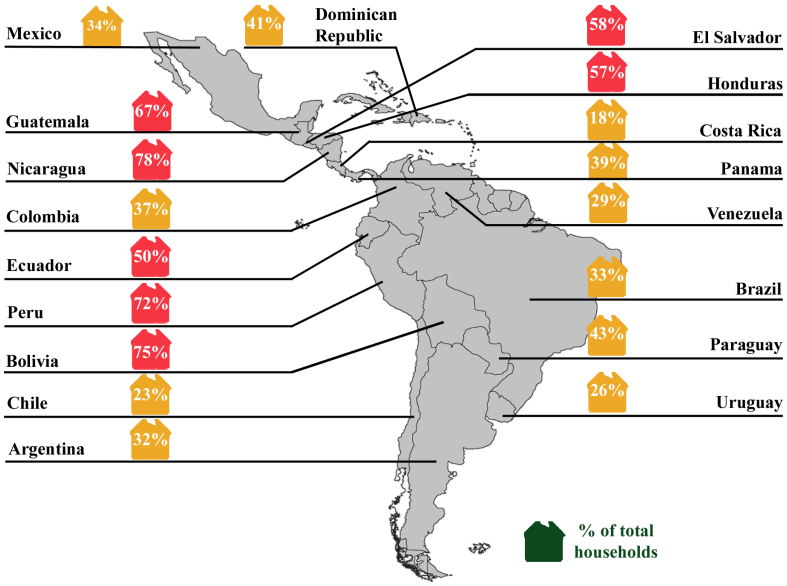

Figure 4. Housing Deficit by Countries, 2009 (Percent of Households) *(Bouillon, 2012)*

As a part of this research, Peru, Ecuador and Colombia were selected as candidate countries for conducting an assessment of the potential implementation of U.S. manufactured, system built, wooden homes. These countries are selected because of the existing housing deficit in the region (Figure 4). These countries thus can provide a considerable new market segment where the U.S. manufacturers can export. These countries also have amicable trade relations with the United States through different trade agreements making business transactions hassle free. Cultural difference is a major barrier to exports. All three of these countries have some similarities with the United States in a socio-economic culture that would further support any business endeavors and product acceptance (Baack, Harris, & Baack, 2013). Lastly the political structure of these

countries is fairly stable to safeguard and support any business transaction. With an attempt to be environmental friendly, these countries are eagerly attempting to shift to decrease their dependence on non-renewable resources (Stickney, 2014). Thus it was important to study the government policies regulating social housing projects in the region and existing use of wood in construction and identify different stakeholders involved in the social housing value chain.

Although prefabrication is a mature method of construction in many European countries and in the U.S., several countries in Latin America are still not familiar with this method. Because of the nature of their socio-economic system, Latin countries tend to use more actual manpower for constructions rather than prefabrication methods. Construction methods that require a lot of physical labor such as masonry, hand painting or cast-in-place concrete are common in the region (Brednoord, Lindert, & Smets, 2014). This gives companies in the U.S. a critical advantage to manufacture and fulfill this housing demand in the region with the advancement in its prefabrication systems and application of sustainable practices in wood construction. The geographical proximity, trade relations and existing business corridors would further support this endeavor.

4.3. System Built wood construction: Drivers for future growth

With aim to become efficient, communities all over the world are under pressure to create better-performing buildings that meet stringent codes and are cost effective. In addition, consumers are demanding high quality and a reasonable price. But in a world full of improvements due to technology, many construction systems seem to lag behind in the adoption of innovation and offer solutions that still fall short of meeting customer requirements. System built construction that includes off-site manufacturing of components in a closed environment

can assist not only in meeting the above mentioned criteria but even surpass them (Wherry, 2009). Mechanization and industrialization of construction is good for the economy as it can provide steady year-round employment with higher-quality building. Manufacturers in the U.S. can explore new market opportunities even with existing production capabilities.

The key feature of system built construction and adoption of factory manufacturing techniques in the construction sector is an improvement in project schedules (McGraw-Hill Construction, 2011). With optimized manufacturing processes, builders can achieve considerable improvements in the time taken to complete a project, including reduction of construction costs by optimizing material use and reducing waste. In addition, there can be substantial improvements in site safety with the majority of the work done in the controlled environment of a manufacturing facility. Another advantage is that green and energy efficient buildings can be constructed more efficiently when using prefabrication. Finally, prefabrication in construction can also give builders and architects a flexibility to use a wide range of materials and work without any interruption by inclement weather conditions (McGraw-Hill Construction, 2011). As the industry gains more maturity, these factors would further encourage the builders to adopt higher levels of off-site manufacturing in the residential construction industry.

4.4. Exporting system built wooden houses

Pre-manufacturing of houses in a controlled environment and shipping them to the construction site is not a new idea. The U.S., being one of the largest producers and consumers of wood fiber, is perfectly poised to lead the global market. But this industrialized wood construction sector has been losing ground over the past decade even in the domestic market to on-site construction. Considering this background, these companies could expand to niche international markets by

developing specific products. The experience of manufacturing for domestic markets, efficient building guidelines, availability of efficient delivery networks, and favorable international trade treaties places the US manufacturers in a favorable position to export this type of housing solution.

Economic problems for the construction market have become a global trend. However, even as the United States continues to grow at a slow but steady rate, opportunities are emerging for international contractors in developing countries, particularly those rich in resources (Zhang & Toppinen, 2011). At the same time, the rise of construction activity in developing countries has caused an increase in competition in the global market. Due to the instability of the global economy, the international construction market has been continuously marginally shrinking in recent years. The Engineering News Report (ENR)'s Top 225 International Contractors list indicates the global shift in the international construction market. The Top 225 as a group generated $383.66 billion in 2010 contracting revenue from projects outside their home countries, which is slightly lower than 2008's figure of $390 billion (Reina & Tulacz, 2011). Top 225's regional revenue breakdowns also indicate that contractors are shifting their focus to new and emerging markets. International revenue fell 6.6% to $94.18 billion in Europe. It also fell 6.6% in the Middle East to $72.43 billion and 6.5% to $32.61 billion in the U.S. By contrast, international contracting revenue rose 25.6% to $34.05 billion in Latin America and in the Caribbean, 6.7% to $60.59 billion in Africa and 4.7% to $76.64 billion in Asia and Australia. This shift in focus is leading to upheaval for major international contractors (Reina & Tulacz, 2010). The shift could be caused by the growth of mining sectors and the associated infrastructure required in these countries. As a traditional developed country, the U.S. plays an important role in the world. Many industrial

sectors of the U.S. lead the world economy and construction as one of these sectors. With the development of internationalization and globalization, the construction industry in the developing world has become more involved in the international market. This is even more important for residential construction where suitable housing is not just a requirement but a necessity for living a quality life. Therefore, system built, wood housing manufacturers are strategically poised to take advantage of this huge market share.

Entering new and untouched markets is also beneficial for the sector as internationalization and exports can prove to be strategically important for the U.S. manufacturing companies as it offers access to high and strategically consistent market shares without investing heavily in capacity improvement. The companies can keep using their existing facilities and manufacture for international markets (Steinhardt, Manley, & Miller, 2013). This would also increase the existing revenue share for the system built housing industry from exports ($226.8 million in 2015). Getting into exports would also expand the existing export base of the U.S. forest products sector.

Exporting clearly requires a long-term outlook from the company. The decision to enter the export market requires the manufacturer to commit sufficient managerial, economic, and financial resources to the task. Table 4 highlights the major activities associated with exporting.

Table 4 Major Activities Associated with Exporting (Evans, 1990)

STEP 1 **Management Commitment**	**STEP 2** **Analyze objectives, strengths, and weaknesses**	**STEP 3** **Develop contacts and collect current market information in the United States**	**STEP 4** **Conduct market analysis**
	1. Short- and long-term goals 2. Personnel	1. U.S. Government and State agencies 2. Banks with international	1. U.S. export statistics 2. Foreign import statistics 3. Current market

	3. Resources 4. Production 5. Financing 6. Knowledge of export Marketing	departments 3. Freight forwarders 4. Marine insurance agents 5. U.S. port authorities	developments and trends 4. Import barriers 5. Other factors (political, economic, geographic, and cultural)
	STEP 5 **Country/market selection** 1. Demand potential/ trends 2. Product identification 3. Standards and specifications and trends 4. Language requirements 5. Distribution channels 6. Business practices 7. Tariff and nontariff barriers 8. Licensing/phytosanitary requirements 9. Legal considerations 10. Shipping costs	**STEP 6** **Develop marketing approach** **targeted to every countries** 1. Organization of the firm 2. Determine production 3. Contact foreign importers 4. Schedule marketing/ sales trip to the country or market	**STEP 7** **Trade servicing** 1. Product development/ modification in response to changes in demand 2. Attention to importer's needs/ commitment to the market 3. Periodic visits to the market to maintain good customer relations and develop new contacts 4. Refine marketing approach

Thus, each company must weigh the advantages and disadvantages of exporting to determine if projected profits, possible losses, and inherent risks justify management's commitment to exporting. The analysis of previous research on exports of the wood housing manufacturing industry in the U.S. yielded some important findings:

- The majority of businesses in this industry are small to medium sized firms with annual sales of $7.4 billion (2015) and a profit of $161.8 million. Share of exports for the same year was $226.8 million.

- Internationalization within the industry is relatively low; most manufacturers operate domestically and sell within a relatively limited geographic scope. Transportation costs can go as high a 10% of total cost of the product.
- As mentioned before, international trade for industry products is negligible. Industry's performance in international trade is also impacted by the level of internationalization in upstream industries as this affects the availability and price of wood materials for system built home manufacturers.
- Findings show that firms acknowledge that exports offer growth opportunities. However; there exists various legal, economic and political risks associated with dealing in foreign countries.
- Product quality, customer relations and custom design are considered to be the most important business success factors.
- The companies that are currently exporting reported no negative impact of internationalization on their domestic sales. But the share of exports as compared to domestic sales is very limited.
- Majority of exports currently are done to Northern Asia and the Pacific Rim regions of the world.
- Companies that are not exporting currently also want to know more about exporting their products.

4.5. Barriers to the industrialization of wood construction

Prefabricated systems might have additional costs in the project like shipping, craning, installation on site, additional manufacturing and company overheads (Prefabitats, 2016). Key drawbacks with the practice of building off-site are:

- Design limitations: Despite the ease of working with wood, the architects and engineers are limited by the feasible manufacturing configurations. For example, a simple rectangular wall with parallel top and bottom plates is far easier to automate and produce in a factory than walls with irregular dimensions and/or sloped tops. There is also a limitation of dimensions of panels due to machine and transportation medium restrictions (Anderson & Anderson, 2007).
- Shipping: The units, irrespective of their intermediary form, are required to be shipped to the construction site. Shipping costs associated with modules are considerably larger than that associated with panels and kits owing to the large size. This post manufacturing transportation is generally limited by the medium of transportation, distance and route followed and are often viewed as incremental costs (Chiang, Chan, & Lok, 2006). But it is also important to note that not all of these costs should be considered additional as the traditional site built system also requires raw materials to be delivered to site. This increase in turn also limits the size and scale of manufacturing operations (McGraw-Hill Construction, 2011).
- On-site installation: Prefabricated construction requires the use of cranes and associated skilled labor at the time of installation on site. The requirements and complexity depends upon the nature of prefabrication; modular, panelized or precut along with the complexity in each design. The cranes act as a fixed cost and when coupled with the costs of hiring skilled

operators can act as significant incremental cost. Such heavy machinery is not otherwise commonly implemented in an on-site traditional construction system. Degree of prefabrication is an important metric in this system. It differentiates the amount of work completed in the controlled environment of the factory and the remaining amount of work done on-site. The cost fractions will then depend upon the nature and location of the project (Anderson & Anderson, 2007).

- Manufacturing overhead: This is the major fraction of manufacturing cost which is usually omitted when comparing with on-site construction (Prefabitats, 2016). Overhead costs associated with the production facility like rent, depreciation, management, utilities and insurance, safety and quality control and unallocated personnel. The best way to minimized these costs like any other manufacturing process is using economics of scale and scope provided there is a potential market.
- Company Overhead: The prefabricated systems can be more expensive than the traditional construction because the manufacturing companies tend to keep considerably higher margins as compared to traditional contractors. This can be to cover corporate overheads. These companies also offer better working conditions, assures safety of the workforce and have different departments (marketing, design, engineering and procurement) as compared to general contracting firms (Ludeman, 2008).
- Negative perception of quality: Off-site construction even in the domestic residential construction market of the U.S. is widely associated with a stigma of low quality buildings that have a short life span and would need replacement (McGraw-Hill Construction, 2011).

- Fear of innovation: As with any other mature industrial sector, fear of change also holds back the innovation in construction. Builders often try to avoid using system built components as they perceive it to be inconvenient and expensive (McGraw-Hill Construction, 2011).
- Lack of information and understanding: It is really important for all the stakeholders (clients, developers, owners, designers, and engineering and construction professionals) to have confidence and clarity of the approach to implement prefabrication. There is a deficit of reliable information allowing owners and building professionals to make an informed decision while selecting a particular building system or approach (Stickney, 2014).

In order to be competitive with traditional site built homes, prefab companies need to cover incremental costs. This can be achieved by using economies of scale and scope (Baack, Harris, & Baack, 2013). Large scale provides companies the benefits of reduced material, shipping, craning and site development costs. This also leads to a decrease in manufacturing and corporate overheads. The prefab companies can invest in automated production lines, develop multiple configurations with the same facilities, and a reduction in inventory and labor costs. However, all of this is possible only when there is enough demand in the market. This can be a bit difficult when only a single market is being targeted and no single location is capable of offering enough volume on its own. Figure 5 gives a perspective of the financial performance of this industrial sector in 2015 (Carter, 2015). After a hard hit by the recession, a total profit of only 2.2% was expected in the fiscal year 2015 and a majority (62.2%) of the revenue is used to purchase raw materials. Surprisingly, the labor costs are considerably higher when compared to the wood products sector in general by 7.4 %. This could be because of the labor intensive customizations which means that smaller firms have an inability to invest in more automated facilities. Other

expenses included but not limited to rent and utilities are interest, general selling and administrative expenses, restructuring, marketing, and legal expenses.

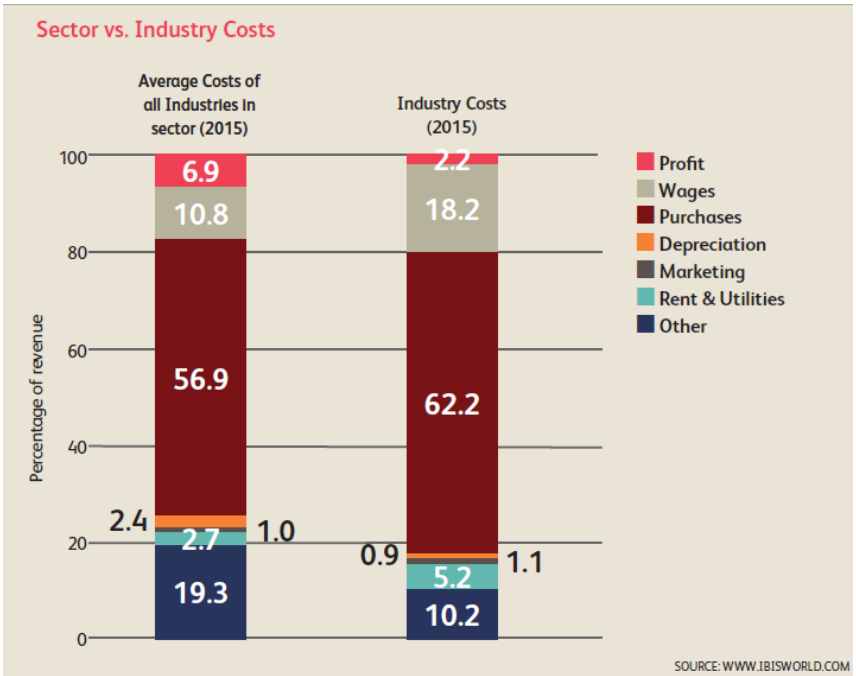

Figure 5 Cost Structure of the Off-Site Manufacturing Industry in 2015 and Comparison with Wood Products Sector *(Carter, 2015)*

Despite the above mentioned hurdles, prefabricated companies are more capable of incorporating green technologies and designing more efficient buildings. This can be achieved through centralization and incorporation of design, engineering, procurement and manufacturing making it a competitive advantage over traditional site built construction technology (McGraw-Hill Construction, 2011).

5. Methodological aspects

5.1. Motivation for this research project

System built wood housing alternatives built in the U.S. have the potential to fulfill the housing deficit gap in developing countries by exporting an affordable substitute compared to current practices. Companies manufacturing system built homes in the U.S. can also substantially improve their business performance by exporting to these potential overseas markets. But there are many barriers associated with such an internationalization operation of factory built homes (Steinhardt, Manley, & Miller, 2013).

It is important that the units are designed specifically to fulfill local needs and match required standards in order to be successfully accepted in the market. There is a considerable gap of knowledge in understanding the local regulating policies, construction codes, potential housing demand and segmentation, cultural aspects impacting the design and architecture of residential construction in international markets. This information would also be useful in adjusting features to adapt to local conditions, designing the marketing strategies, and mode of introducing system built, wood construction systems in the target countries (Baack, Harris, & Baack, 2013).

This would give manufacturers in the United States an opportunity to expand to new and diverse markets as millions of families try to substantially improve their quality of living (Bouillon, 2012). Focusing on affordable housing would be a win-win situation where the manufacturers would get access to large potential markets and an opportunity to reduce social inequality by generating new employments and the households can get an affordable alternative for the traditional construction system in foreign target markets. This would also be beneficial for the governments

of target export countries that are trying to promote environmentally sustainable alternatives in the construction sector.

5.2. Objectives

This research is aimed at identifying potential expansion opportunities for system built wood house manufacturing companies in the South and Central American countries. The existing production chain will be evaluated to identify factors supporting or hindering the possible business expansion to the urban social housing markets in Peru, Colombia and Ecuador. Such an alternative can act as a sustainable (economic and environmental) alternative for low-income households living in these countries. This would benefit both the manufacturing companies in the U.S. and the deficit market in target countries. Following are the three objectives of this study:

1. Identify incentives and barriers for successful implementation of exporting system built wood homes to developing countries.
2. Identify factors differentiating exporting firms from non-exporting firms and barriers of exporting system built wood construction.
3. Establish and validate the export assessment model using resources, availability, capability and export venture strategy in system built wood construction industry.
4. Develop a marketing training manual for the system built wood housing manufacturers in the United States to export to selected countries.

5.3. Methodology

Case studies, personal interviews and surveys were used to do an exploratory and descriptive analysis to assess export markets for the system built wood houses. The following section gives detail of how each objective was implemented in this research

5.3.1. Objective 1: Identify incentives and barriers for successful implementation of exporting prefabricated wood homes to developing countries.

This objective aimed at understanding the potential opportunities for using system built wood homes manufactured in the U.S. as an alternative to traditional construction in the target countries. Different factors control the possible acceptance in the market. Thus, stakeholders involved in the residential construction sector were interviewed to evaluate their views and understanding of wood construction. Interviews were conducted with government agencies regulating residential construction, builders, suppliers, and construction project managers. Interviews were drafted to cover essential features of social housing projects in target countries. The size of the potential market segment that can shift to wooden houses, if introduced through social housing projects, was accessed through different stakeholders. Stakeholders were also asked about their awareness of the use of wood in construction. The questions were made from the factors identified through the literature review. Potential opportunities and drawbacks associated with the residential construction market were also recorded. Short surveys to access awareness about prefabricated wood construction among the four major stakeholders in social housing value chain from the target countries were also conducted. These were government agencies, construction companies/builders, project developers and raw material suppliers.

Activities: For assessing the urban social housing markets in developing countries of South America with a housing deficit, Peru, Colombia and Ecuador were selected. The selection was based on a high qualitative and quantitative deficit in these countries (IDB, 2012) and ease of getting access to the stakeholders. Stakeholders in urban social housing projects were identified and contacted to understand the nature of the target market. The information was used to evaluate opportunities for U.S. manufactured wood homes in this market segment. Interviews were conducted in person and any relevant data/information was recorded. Social housing project sites were also visited.

Methods used: Case studies, used for objective 1, are empirical forms of inquiry with a systematic approach of information gathering. This approach goes beyond pure data gathering by including different approaches of information collection. In-depth interviews were designed to gather information about, but not limited to, the research problem. This generally involves recording life experiences and histories, related documents and participant's perception. This presents an opportunity to bring out the potential discrepancies or fallout related to the research topics which might be missed by other approaches. Therefore, case studies can be attributed to be an efficient way of detailed and in-depth data collection method (Berg, 2004).

The U.S. commercial service offers "The Gold Key Matching service" where they help U.S. agencies in finding potential links to gain knowledge and access to overseas markets. This is done by arranging interviews in advance with preselected stakeholders (International Trade Adminstration, 2016). Structured interviews were conducted to collect information and document data. Representatives from government agencies were questioned on the policy regulating construction projects and use of wood as a structural component. They were also asked about social housing programs supported by the government, policies determining foreign involvement, and future strategies in the housing construction market. The next group was the construction companies. This group was vital to understand the nature of native construction. They provided information on current social housing markets, consumer trends, scale and timeline of the projects and cultural aspects specifically relevant to certain segments of the market. They can also act as a medium for the U.S. firms to enter into the markets of target nations in the future. Other groups that were interviewed included regulatory agencies and non-for-profit organizations. Financing agencies were helpful in learning about the project allotment, and management procedures. The interviewees were also given an opportunity to add their own personal opinion on the topic at the end of the interview. These interviews were done in person by visiting the countries. The interviewees were asked open-ended questions in order to record their perspective of social housing projects and the

possibility of using factory built wood housing systems in future projects. Information about the policies regulating housing for low-income households was also collected. Existing housing projects were visited to understand the typical features, social aspects and scale of such projects. **Error! Reference source not found.** summarizes the approach used in the study for objective 1.

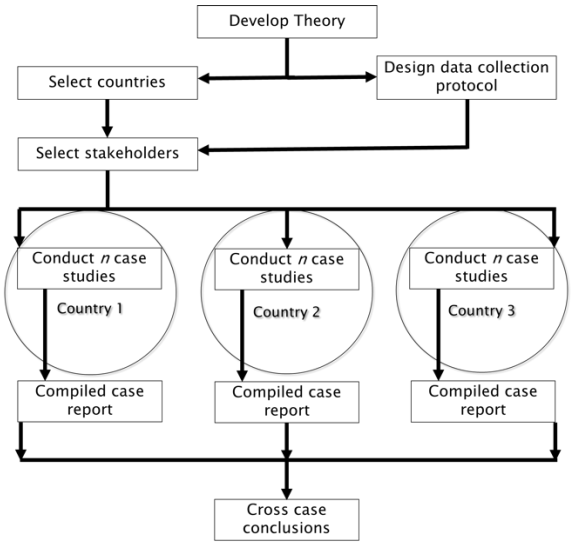

Figure 2 Market Assessment Methodology used for Objective 1

Means of assessment: Since the interviews had overlapping questions, the information was cross validated between different stakeholders. These interviews were documented, revised and validated through secondary sources as well. A detailed summary of all the interviews was prepared that would act as a guide for the U.S. manufacturing companies attempting to access the social housing market in the selected countries.

Limitations: The data collected was country specific and cannot be used for other countries in the region. Some of the information collected was limited to a selected stakeholder's perspective. Also, details of the project parameters (design, cost, timeline, scale, etc.) would vary from one city to the other even within a country.

Expected outputs: Through this objective, an understanding of the nature and scale of prevalent construction projects used social housing in selected countries was expected to be gathered. This would be used to characterize the market and evaluate possible expansions in this market segment.

5.3.2. Objective 2: Identify factors differentiating exporting firms from non-exporting firms and barriers of exporting system built wood construction.

This objective aimed at identifying the differentiating firm level characteristics among exporting and non-exporting system built wood house manufacturing companies in the United States. The population of interest for this research was the manufacturers of system built wood construction systems in the United States classified under NAICS 32199201, 32199202, 32199205 and 32199206. A sample of 1021 firms was selected randomly stratified by each state. The collected data was analyzed using Mann-Whitney tests of independence to see if there is any statistically significant difference between the exporting and non-exporting firms in the United States. The data collected from the exporting firms was also analyzed to identify barriers to export.

Activities: The first step in this objective was to design the questionnaire. This involves conceptualizing questions that will in turn be used to measure the relationship between variables and effects based on the theoretical framework (Dillman, Smyth, & Christian, 2009). The designed questionnaire was then sent to the sample 1021 firms. The collected responses were used to assess the difference between exporting and non-exporting firms. Export status of the firm was assumed to be independent categories and the hypotheses were designed to test different dependent variables. Since the data collected was ordinal in nature, a Mann-Whitney test was used to study the potential relationship and to test the hypotheses. Table 5 summarize hypotheses corresponding to each category addressed in the survey.

Table 5 List of Hypotheses for Objective 2

Category	Null Hypothesis	Variable	
		ID	Name

Number of Employees	H1: There is no difference between the average number of employees working for exporting firms and the employees working for non-exporting firms.	VAR4	Employees
Total Sales	H2: The sales level of exporting firms and the sales level of non-exporting firms are the same.	VAR5	Sales
Age of Firm	H3a: The average age of exporting firms and that of non-exporting firms is the same.	VAR9	Experience
Value of Firm	H4a: The average value of exporting firms and of non-exporting firms is the same.	VAR6	Value
Sales growth	H5a: The annual growth rate of exporting firms and of non-exporting firms is the same	VAR10	Growth
Business success factors	H6a: Importance of **product quality** to exporting firms is same as that to non-exporting firms.	VAR16.1	Prod_qual
	H6b: Importance of **product availability** to exporting firms is same as that to non-exporting firms.	VAR16.2	Prod_avail
	H6c: Importance of **product pricing** to exporting firms is same as that to non-exporting firms.	VAR16.3	Prod_pricing
	H6d: Influence of **raw material's cost** in final product cost for exporting firms is same as that to non-exporting firms.	VAR16.4	Raw_mat_cost
	H6e: Influence of **transportation cost** in final product cost for exporting firms is same as that to non-exporting firms.	VAR16.5	Trans_cost
	H6f: Importance of good **sales team** to exporting firms is same as that to non-exporting firms.	VAR16.6	Sales_team
	H6g: Importance of **customer relations** for exporting firms is same as that to non-exporting firms.	VAR16.7	Cust_rel
	H6h: Importance of **timely delivery** for exporting firms is same as that to non-exporting firms.	VAR16.8	Time_del
	H6i: Importance of **selecting agents/distributors** for exporting firms is same as that to non-exporting firms.	VAR16.9	Sel_agent
	H6j: Importance of **market expansion** for exporting firms is same as that to non-exporting firms.	VAR16.10	Mark_expan
	H6k: Importance of **marketing and promotions** for exporting firms is same as that to non-exporting firms.	VAR16.11	Mark_promo
	H6l: Importance of **after sales services** for exporting firms is same as that to non-exporting firms.	VAR16.12	Aftr_sale_serv
	H6m: Importance of **on-site support** for exporting firms is same as that to non-exporting firms.	VAR16.13	On_site_support
	H6o: Importance of **product modification** for exporting firms is same as that to non-exporting firms.	VAR16.14	Prod_magn
	H6p: Importance of **custom design** for exporting firms is same as that to non-exporting firms.	VAR16.15	Custom_design

	H6q: **Commitment to expand markets** for exporting firms is same as that to non-exporting firms.	VAR16.16	Expansion_commit
	H6r: View on **exports as long term sustenance** for exporting firms is same as that to non-exporting firms.	VAR16.17	Commit_Export
	H6s: Importance of **participation in trade shows** for exporting firms is same as that to non-exporting firms.	VAR16.18	Trade_shows

The objective also aims to identify the major barriers faced by the system built wood housing manufacturers in the United States. So the respondents were asked to rate the barriers on a scale of 1 to 5 anchored at not important to extremely important. Table 6 lists the barriers experienced by an export venture.

Table 6 Barriers to Exporting System Built Wood Houses from the U.S.

Barriers	**Variable**	
	ID	**Name**
My product is not easily exportable	VAR25.1	Prod_exportibility
Don't know much about the exports and not sure where to start	VAR25.2	Export_know
I'd worry about getting paid	VAR25.3	Payment_prob
Regulatory complexity	VAR25.4	Reg_complexity
Unaware how to use foreign trade agreements	VAR25.5	Foreign_trade_agreem
Difficulty to get financing for foreign customers	VAR25.6	Financing
It would take time from my regular domestic sales	VAR25.7	Effect_domestic_sales
Insufficient protection of intellectual property rights.	VAR25.8	IPR_protection
Too costly	VAR25.9	Costly
Finding on site work force in foreign markets	VAR25.10	Site_Support
Difficulty in finding customers	VAR25.11	Finding_customer
Difficulty on forming partnership or joint ventures with local businesses	VAR25.12	Partnership_difficulty
After sales and maintenance services	VAR25.13	Partnership_difficulty

Methods to be used: The responses were collected through a mail survey implemented from March till April, 2017. There were three waves of responses. The first wave of respondents filled the questionnaire after they received their first copy and mailed it back within 2 weeks. The second wave of the respondents were those who responded after receiving the reminder post card. The third wave of responses were

those who returned the questionnaires sent to them after 4th week. They received a different cover letter urging them to respond to the survey.

Means of assessment: The first step before using the survey data was to conduct non-response bias and check if the respondents from all the three waves represent the same population. Non-response bias can be assessed in different ways. Ratio of exporting and non-exporting firms and classification of the respondents on the basis of the number of employees. Once it was determined that the pattern of respondents in all the waves are not different from each other, it was safe to assume that they were coming from the same population and could be used as a representative sample.

The responses to all the variables used for hypothesis testing in Table 5 have an ordinal scale. So the Mann-Whitney test was used to determine independence between two groups and test the hypothesis. Mann-Whitney, being a non-parametric test, works by merging two independent samples together for the purpose of ranking. These numbers are then ranked in an ascending order and the sum of ranks for each group is calculated. Just as any comparison test, the statistical significance levels are determined at certain Type I and Type II ???? what??? represented by the σ and P-value respectively. The p-values indicates the association between exporting and non-exporting categories for each factor. In statistical hypothesis testing, a type I error is the incorrect rejection of a true null hypothesis (a "false positive"), while a type II error is incorrectly retaining a false null hypothesis (a "false negative").The comparisons would be useful to identify key factors that differentiate the exporting firms from non-exporting firms.

Descriptive analysis was used to analyze responses on barriers to exports. The perception of the exporting firms on the factors impeding export operations would in turn be useful in developing strategies for purposed expansion to low income social housing in this study.

Limitations: Based on the number of responses, the respondents from the sample may not represent the actual population. Low response rate can reduce applicability of statistical tests and reliability of results. Thus in such cases, the results cannot be extended and generalized to represent the entire industry.

Expected outputs: Through this objective, an understanding of key differentiating factors between the exporting firms and non-exporting firms in the system built wood manufacturing industry in the United States will be developed. Analysis of barriers to exporting would be useful to identify key problems being faced by the industry. This information can be used by the companies to selectively identify and invest in important factors while planning any business expansion through exporting.

5.3.3. Objective 3: Establish and validate export assessment model using resources availability, capability and export venture strategy in system built wood construction industry.

Export performance measurement is important to benchmark and measure performance of exporting firms. This objective measured the export performance of exporting firms recorded through the survey and use the information to validate the theoretical model to measure performance developed through the literature review.

Activities: The sample surveyed in objective 2 were also asked about their current export status. Those companies who were exporting or have exported system built wood homes in the past were asked additional questions.

Methods to be used:

For objective 2 and 3, survey methodology was used to assess the system built wood construction industry in the United States. Survey research is an observational study approach where inferences are drawn about the population by collecting information from a sample using a questionnaire designed based on a predefined problem (Babbie, 2010). This study approach needs definition of theories underlying the problem phenomenon. With the background knowledge from previous work and developed theories,

hypothesis for the problem that are testable aspects of theories. From these hypothesis, research questions are developed which are in turn used to form theoretical framework to guide the design of the survey. There is a difference between a list of questions and the survey questionnaire (Dillman, Smyth, & Christian, 2009). These questions can also be in the form of statements upon which respondents are asked whether they agree or disagree. Indexes and scales can be used to measure the degree of approval, importance, and frequency. The questions can be designed using two different approaches: open or close ended questions. Open-ended questions allow respondents to provide their own opinion as an answer but close-ended ask the respondent to pick from the provided alternatives only. Thus while the former are ideal to gather in-depth information, the later are ideal when the researcher knows and cares only for responses from specific, preselected options. In terms of analyzing the collected response quantitatively, the responses to open-ended questions would need to be coded. Responses to close-ended questions can be directly assessed quantitatively using it as numerical data. Both categories can be single or multiple responses (Babbie, 2010). This approach of surveying is again an observational not experimental approach where the study subjects are observed without influencing them, same as case studies discussed before. This is an effective way to collect data as it can be self-administered removing the need of researchers to travel. This quantitative method is also beneficial when the inferences can be drawn about the population from a small representative sample selected without any bias. Surveys can be used to conduct exploratory, descriptive, and explanatory or even a combinations of these depending upon the goal of studies (Blanco, 2014). Exploratory research is useful when the aim is to increase understanding of the relevance of a topic for the population or to assess the feasibility to conduct a larger study. Descriptive approach is used to describe characteristics and/or behaviors of the population. Explanatory surveys are conducted to understand the reason things happen (Vaske, 2008).

Survey design

The structure of the mail questionnaire focused on five key business dimensions impacting export performance of the U.S. system built wood housing industry. These dimensions were extrapolated from extensive literature review focused on industry demographics, internal resources available to the firm, external factors impacting the firm, export venture strategy and export venture performance. These dimensions were addressed through different group of questions. These questions were grouped under demographic information, business success factors, transportation and delivery factors and barriers to exports. The questionnaire was divided into two segments differentiating the respondents into exporting and no-exporting firms. Only exporting firms were asked to respond to the latter two groups, i.e. transportation and delivery factors and barriers to exports, along with additional demographic information for exporting firms. Two types of questions, namely categorical and five-point interval scale, were used to assess the five dimensions of the questionnaire. The questionnaire also had an open-ended question to gather respondent's opinion/remarks on exporting system built wood buildings. Each questionnaire also included an introductory section with details of the study and researcher's contact details to support the cover letter mailed along the questionnaire.

The survey consisted of 26 questions grouped into 5 different sections: namely "General information," "General Characteristics of the company," "Business success factors," "Transport and delivery" and "Barriers to export." The first question of the survey, from the General information section, asked if the companies did manufacture system built wood homes to filter respondents from manufacturers to non-manufacturers. Only respondents that manufacture were asked to continue with the survey. "General characteristics of the company" had 19 questions about the company 5 out of which were specifically for the exporting firms. "Business success factors section" had 18 sub-questions that all respondents were requested to answer. "Sections on transport and delivery section" and barriers to export with 13 sub questions each were directed specifically for the companies that export or have exported in the past. The last question of the survey gave respondents an opportunity to add their additional comments/

recommendations for researchers. Figure 3 shows the survey design and implementation strategy used in the study.

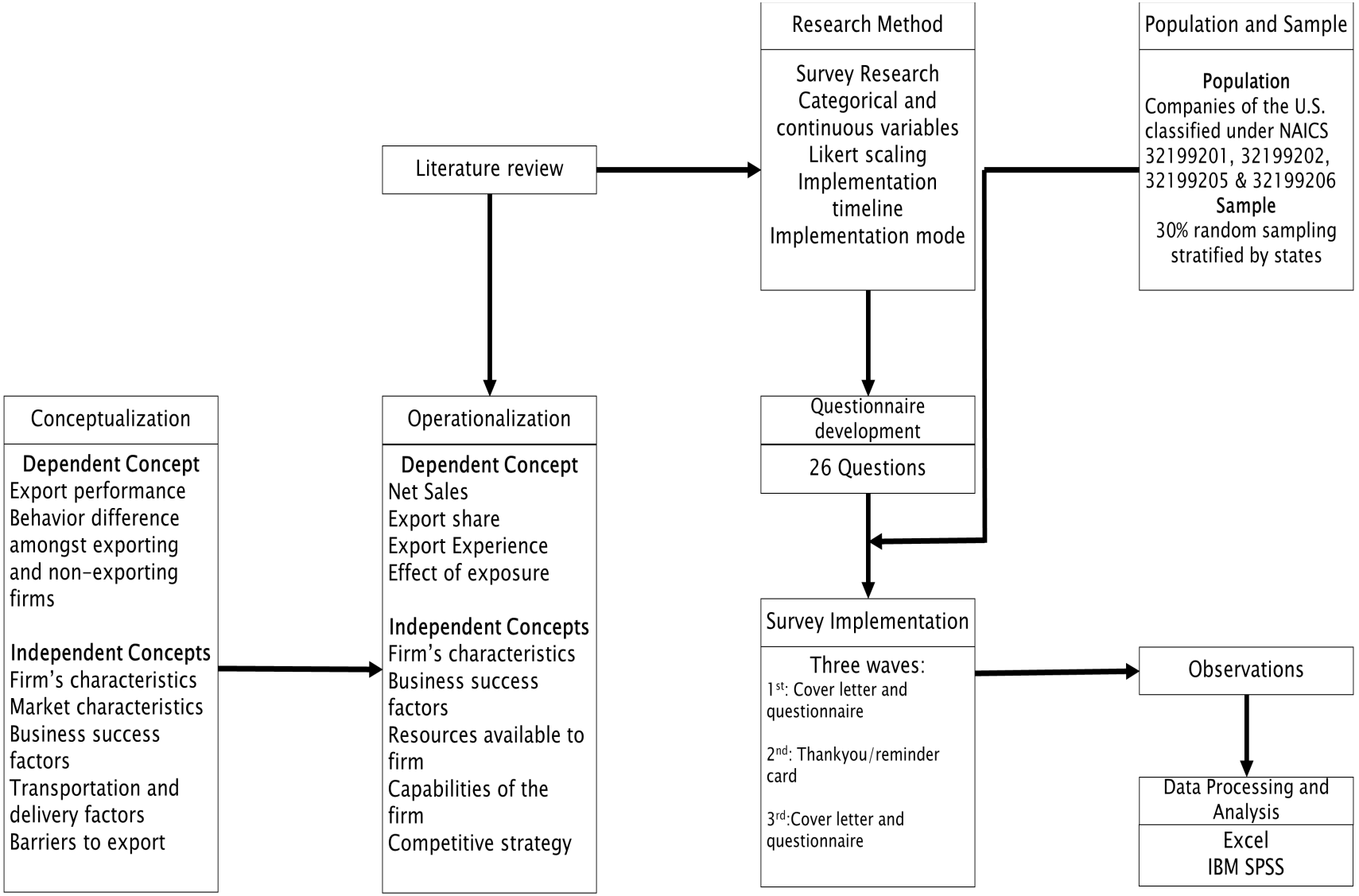

Figure 3 Survey Design Methodology

Population

The population under study was U.S. system built wood housing industry. A complete contact list of 3166 firms classified under NAICS 32199201, 32199202, 32199205 and 32199206 was purchased from an industry directory (SICCODE.com, 2016). The classification 321992 under NAICS covers Prefabricated Wood Building manufacturing and the list had all the companies collected by the vendor up till December 2016.

Sample selection and survey implementation

Sample group mailing list was derived from the population list by randomly selecting one-third of the companies from the population list for each state making it a stratified random sampling. This led to a sample size of 1021 companies selected from the population list for the survey. The survey was implemented on March 21, 2017 through first class mail to assess the difference between exporting and non-exporting firms and export venture performance of exporting firms. Implementation of survey is not just sending out the questionnaire, but should also look into tactics to motivate the respondents to participate and see the potential value of the research (Dillman, Smyth, & Christian, 2009). This involves multiple aspects of visual design of the instrument, solicitation techniques and developing a proper communication strategy during the process to engage the subjects of the study (Blanco, 2014). Dillman recommends a five steps process for conducting mail surveys and obtaining a higher response. It involves a) a pre-notice letter, b) questionnaire mailing (with cover letter), c) thank you post card, d) replacement questionnaire (with cover letter) and e) a final contact notice. A similar strategy was employed for this research. Each of the recipients received a cover letter, questionnaire with a unique tracking number and return envelope through traditional mail or "snail mail." The return envelope had first class pre-paid postage to encourage responses. A unique identification number linked to each questionnaire helps in expediting the envelope packing process, aid response monitoring and provides a method for follow-up actions on non-respondents (Biemer & Lyberg, 2003; Rea & Parker, 2005). A communication timeline

was established according to the guidelines of Dilman (2000) for traditional mail contacts. The correspondence consisted of three written forms of communications in a two weeks period. The first correspondence was the questionnaire with cover letter introducing the study and a pre-paid return envelope. A two week reminder/thanking postcard was sent to all the sample. It thanked the recipients who have already responded to the survey and requested the non-respondents to participate as well. After an elapse of another two weeks, all the non-respondents were sent another mailing with the same questionnaire, pre-paid return envelope but a different cover letter reminding of the importance of a response. Table 7 shows the correspondence timeline in the implementation of the mail survey used in this study.

Table 7 Correspondence Timeline for Implementation of Survey

Correspondence	Date	Time Mark
Cover letter with questionnaire (1021 in total)	March 21st, 2017	Day 0
Postcard (Thank you/reminder) (1021 in total)	April 4th, 2017	2 weeks
Reminder letter to non-respondents (Different cover letter with same questionnaire) (977 in total)	April 18th, 2017	4 weeks

Means of assessment: First part of this objective involved measuring the reliability of the variables measuring factors affecting export venture performance to be used for the modeling process. Reliability of the constructs can be checked by various methods. This study used Cronbach's alpha coefficients (Cronbach & Meehl, 1955). The second part of the analysis consisted of evaluating the relationship between the dependent variables measuring export venture performance and explanatory variables as defined in the research design. The independence between these sets of variables were tested with Fisher's exact test (Agresti, 2002). This was followed by performing a simple linear regression between all the explanatory variables altogether and each one of the response variables. Contingency analysis to test categorical data (Agresti, 2002) were conducted to explore the behavior of each individual variable

and the potential relationships among them to assess the association between the responses and factors developed from the theoretical model.

Limitations: Power of a statistical test is the probability that a test will reject the null hypothesis when the null hypothesis is false. The two major factors affecting the power of a study are the sample size and the effect size. Thus, insufficient sample availability highly restricts application of statistical tests. Applicability of these statistical tests can further be confirmed by their conformity tests. For example, reliability of regression analysis depends upon the regression coefficient. High regression coefficient (closer to 1) indicate a stronger empirical relationship between the dependent and estimating variables and vice versa. Low regression coefficients obtained would indicate inability of the model to predict meaningful relation.

Expected outputs: Export venture performance model developed through this objective can be used to measure the export performance on four financial and non-financial indicators using resources, capabilities and strategies of the venture as estimators.

5.3.4. Objective 4: Develop a marketing training manual for the system built wood housing manufacturers in the United States to export to selected countries.

This objective aimed to develop a summarized introductory and guidance manual based on findings of this study to be used by system built wood building manufacturers in the United States. This manual can be used my manufacturers along with government and non-profit organizations aiming to support and expand the business of US manufacturers to the markets of South America. This report is structured to briefly introduce the features of system built wood construction in the United States. Key segments of this report include the residential construction market in the U.S. followed by benefits of using wood in construction. Classification and discussion of system built wood construction in the residential market of the country is another important factor to be included in the report for information of all the stakeholders. Current international operations by the business should also be analyzed since this study also aims at

assessing foreign operations and exports of system built construction. The report would also be used to share the findings of this study of market assessment of urban social housing in developing market with stakeholders in system built in the wood construction industry. Key conclusions can be drawn from these findings to identify need and key opportunities for the sector to grow in the international market. Approach used in this study would also be included to in this report so that the stakeholders can utilize to build a viable business plan based on this research.

6. Results: Market opportunities for Urban Social housing in Peru, Colombia and Ecuador

This section summarizes the findings of the study from the market analysis conducted in Peru, Colombia and Ecuador. Being the first of its kind in the region specifically for analyzing market opportunities for U.S. built prefabricated panelized wood housing systems, the focus was to gather macro information from the major capital cities of the target countries. Key highlights of policies and schemes associated with the social residential housing are discussed first followed by current solutions in the market by major construction companies. The findings also include highlights of major financial and supervising institutions supporting/ monitoring such projects.

6.1. Lima, Peru

With the construction industry being one of the engines of economic growth, current housing deficiency is a major concern of the Peruvian government. There is additional pressure on the government as the cities expand and the households migrate to urban areas in search of better jobs. This also leads to an increase in land prices indirectly affecting the construction costs. Most of these migrating households are low to medium income families that move instead to illegal constructions on the periphery of the major cities. Figure 8 shows the types of houses currently available to low income households in the periphery of Metropolitan Lima, Peru.

Figure 8 Current Housing Solutions for Low Income Households in Metropolitan Lima

Policy: Techo Propio/ Adquisición de Vivienda Nueva (AVN) [Own Roof/New Housing Acquisition] is an umbrella policy in place to support social housing projects. This program has been implemented since 2002 with the aim to create a subsidized housing market for low-income households. The policy attempts to resolve the problem of high and increasing costs of land and construction, informality and social inclusion.

Current status of residential construction: Brick and concrete are the most commonly used materials in construction. Prefabrication, both in wood and concrete, is not commonly used in residential construction. Despite different support programs, there are only a few builders in Lima, Peru working exclusively in social housing projects due to lack of profitability using the current construction methods. Progressive housing is a common feature of low and middle income households in the country where they start with a very basic structure and empty lot. The family build floors and expand the house over time. Despite that, there weren't any specific cultural/regional design/architectural requirements reported, the durability and maintenance of wooden buildings as compared to concrete buildings in the humid climate of Lima can be a deciding factor. According to CAPECO (Chamber of Construction, Metropolitan Lima), metropolitan Lima alone had an expected demand of 443,544 units in 2014. But there were only

27,952 (6.3% of the demand) homes built. Fifty percent of the unfulfilled demand was for the units below the sale price of 40,000 USD (ownership cost including land and construction).

Use of wood as a construction material: The use of wood is limited to non-structural applications only. There are few high cost projects that used wood for structural applications but the market share is very limited. The policy has a major role to play in regulating the use of wood. According to existing guidelines, only the indigenous species can be used as a structural component in government projects. There is a provision to include foreign wood species after going through the testing procedures. Grades of materials and guidelines approved by the U.S. agencies could be easily accepted by the Peruvian regulatory agencies and could help speed up the process. The interviewed stakeholders widely acknowledged the benefits of wooden construction in the form of better seismic resistance, lower construction time, and low cost, environmental friendly over concrete construction. Wood construction can also be used as emergency shelters in the remote regions of the country. Ease and speed of building a prefabricated house can have an extra edge over concrete construction.

6.2. Bogota, Colombia

The Colombian housing market varies from luxurious homes to temporary shacks with bare minimum infrastructure. While there is a well-developed mortgage system to finance housing, the low income households still fail to get houses from the formal market. As a result, this section of the market resorts to informal construction. In Bogota alone, 54 % of the homes built between 1993 and 2005 were built informally (Florian, 2011) which in itself varies in quality and concentration across different parts of the city.

Policy: The state does not build homes under any schemes, but encourages and supports the private sector. Proposals for projects are invited once a need is determined by the government. The proposals are examined and projects regulated by Findeter, a third party mediator and a developmental bank. Findeter is a financial management institution for social housing and is also involved in budget planning each year. The proposal does not specify any material or design usage. Project designs have to be approved by the government entity, "Curaduria Urbana" before it's implemented. These homes should be durable and hard to break in. Despite high government interest, only a few construction companies participate in social housing projects. Returns from the projects were reported to be highly dependent on a scale of projects. As of March 2016, the housing policy in Colombia had four different schemes to support housing needs of low income households.

- Mi Casa YA (My House Now): This is a short term policy to support eligible households with income between 2 to 4 times the current legal minimum wage (689,455 Colombian Peso or 230 USD/month, 2016) to buy houses costing from 70 to 135 times the legal minimum monthly wage. The scheme was designed to benefit 130,000 households from 2015-2018. These houses can range from 16,100 – 31,050 USD.
- VIS (Affordable Social Housing): This program aims to build houses under the value of 135 legal minimum monthly salaries. Currently, a demand of 77,000 houses is estimated in this program. This policy covers houses under the cost of 31,050 USD without any restrictions on selection of beneficiary households.
- VIPA (Priority Interest housing): The maximum value of houses built in this program cannot exceed 70 legal minimum monthly salaries i.e. a total cost under 16,100 USD. This type of

housing targets population in extreme poverty, the network “red unidos”, displaced the rural population by guerrillas, and displaced citizens by natural disasters. The average size of these homes is 48 m^2. The program aims to cover more than 100,000 households in different zones (4, 5 or 6) of urban areas.

- *Fondo de Estabilizacion de la Cartera Hipotecaria* (FRECH): FRECH is a public hedge facility supporting social housing. The benefit provides reduced interest rates to eligible households and act as a stabilization buffer to counter inflation.

This limiting cost also includes the lot cost (< 53 m^2) which goes up to 10 % of the total cost of the single family unit. The allotted project may include availability of a fully developed site with installed utility lines or it may also include site development as the builder’s responsibility.

Current status of residential construction: The building code is designed specifically to withstand high seismic activity. The projects also need to demonstrate effective performance with energy and water consumption efficiency, a focused area in current national Sustainable Energy law. A total of 19,758,964 m^2 in area licenses were issued in the year 2015 for residential house construction out of which 25 percent (4,971,147 m^2) of the land was dedicated to VIS projects. The majority of the households that fail to get support from any of these schemes; prefers progressive housing as a solution through self-help process. This incremental self-construction is major feature of the low-income housing market in Bogota as well. Concrete in combination with steel is the most prevent construction material in the nation. Share of other materials, including bricks is approximately 11 percent. Every new material to be used in construction requires an approval from the Colombian Society of Engineers.

Use of wood as a construction material: The majority of the interviewees reported lack of expertise for building with wood. Current use of wood in construction is predominantly limited to non-structural applications. This is also due to unavailability of graded, rated lumber and the negative impression of wood construction. Wood materials are considered either for expensive construction projects or very low cost temporary housing. Three types of projects involving wooden construction in Colombia were recorded. TECHO, nonprofit international firm, has built 1500 units (6X3 meters) in Valle Aurra region of the country. These units were reported to be imported from Chile. Programa “Aldeas” (Program “Village”) is one of the flagship initiative for social housing by EPM, group of companies located in Central America, Chile, Mexico, United States, Spain and Colombia, with headquarters in Medellin, Colombia. Wood from their private plantation was used to develop the project. The project aims to deliver 1400 homes in 3 phases. Along with poor families, they are also covering households relocated due to hydrothermal projects in 6 districts of the region.

A foreign company can participate in the bidding process by demonstrating a construction experience of up to 5 years or by partnering up with local companies. Current housing projects for low income households range from 100 to 2000 dwelling units per project. With current practices, at least 400 units are necessary to make a project profitable for the builder. Big companies already tend to subcontract construction processes if deemed feasible. The builders prefer vertical construction to reduce costs but the people like horizontal construction more.

6.3. Quito, Ecuador

The housing deficit in Ecuador is spread across both the rural and the urban parts of the nation. Housing conditions vary considerably from city to city, but unfortunately there is very little data to compare cities in Ecuador, either among themselves or with cities outside Ecuador.

Policy: The constitution of Ecuador guarantees the right to housing which implies that the state is responsible for ensuring that all its citizens are properly housed. But it's not the state's primordial function to produce the necessary assets and services, but the state will guarantee that society will have the required mechanisms for accessing these assets and services. The government's basic role will be to motivate, channel, facilitate, regulate, set norms, and to coordinate the agents engaged in urban development. The government has taken an enabling role where instead of being directly responsible for producing the houses, it oversees and corrects the housing sector as a whole. In other words, the government enacts and enforces laws and regulations, corrects market failures, and provides institutional, technical, and financial support to the stakeholders, while relinquishing control over the building, lending for, buying or selling, owning or renting, managing or maintaining houses and apartments. This enables the key stakeholders in the housing sector dwellers and communities, builders, lenders and local governments to work efficiently and equitably towards meeting housing needs.

Current status of residential construction: Evaluating the housing markets, despite the slow economic growth, it is fairly easy for the buyer to secure credit and get a home. Progressive housing is again one of the major features defining residential construction in low and medium cost construction. The household expands the building both vertically and horizontally on the same lot over time. This cultural aspect is used by the builders as well. Selling a unit with basic,

minimum required construction reduces the cost. It also gives the household an option to make a custom designed unit that best suits their needs. One of the companies interviewed during the visit has very efficiently incorporated modular design to allow future expansion and delivers units with different finishing levels to keep the costs down.

The social housing policy requires the unit cost to be under $40,000 USD where 15-20 % should be allocated to the land cost and rest is allocated to the site development and construction. Many companies develop projects with units of mixed costs ranging from medium to low in order to assure the overall viability of the project. These builders also prefer vertical construction to save on land costs. But the consumer still prefers detached homes or horizontal homes. Since the current use of wood is limited with little wood working knowledge, there is a need to develop marketing and promotion plans educating the stakeholders of the benefits of wood in construction.

Use of wood as a construction material: The use of wood is majorly restricted to non-structural applications. Limited knowledge about the application, poor perception and availability of wood were found to be the major reasons for low utilization of this resource in residential construction. Despite low current use, the market size and push to find alternating materials capable of better sustaining the earthquakes provides an opportunity to promote the use of wood as a structural component in residential construction. This was evident from the increasing use of Bamboo in residential construction of earthquake prone coastal regions. The perception to use it as structural component among the low-income consumers changed substantially after a recent devastating earthquake in April 2016 in the south-eastern region of the country. But lack of performance standards for building with Bamboo or any other alternate material was a major

concern among the builders and designers. There are no reported restrictions on the use of wood in construction. There are agencies that can assist the companies in planning projects and drafting proposals for the social housing projects. There is no restriction on participation of foreign companies provided the project is approved. The awareness of benefits of using wood and education and the perception of using it can be a major hurdle in the Ecuadorian market. But the push to find renewable materials and architectural abilities when supported with correct programs can help break this taboo. This would help opening new markets for wood construction in general and prefabricated wood building manufacturers in the United States can take the lead in this market.

6.4. Summary of findings

This study introduced the possibility of using a prefabricated wood construction system developed in the U.S. to develop affordable alternatives to current construction practices in urban social housing. Table 8 summarizes findings across all of the three countries. As highlighted before in the report, pre-fabrication in building helps in optimizing construction by reducing time, environmental effects, health and safety risks, building defects and its life cycle cost. The technique also increases net productivity, whole life performance and net profitability. The housing market deficit of the studied countries summarized shows an opportunity for innovative techniques to fill the gap. Wood pre-fabricated housing systems can be one of the possible alternatives. This generates an opportunity for such system manufacturers in the U.S. These manufacturers can take advantage by developing custom products for each housing market segment.

Table 8. *Summary of the findings*

	Peru	Colombia	Ecuador
Identified housing deficit (fraction of total households)	72%	37%	50%
Government's concern to tackle social housing	Yes	Yes	Yes
Traditional construction method	Block and concrete	Block and concrete	Block and concrete
Preferred building type	Detached	Apartment buildings (Up to 5 floors)	Both detached and apartment homes
Average floor area of social housing (m^2)	20-25 m^2	20-30 m^2	45-60 m^2
Selling price of single family homes (USD)	$25,000-$45,000	$16,000-$32,000	< $40,000 (social housing) $40,000-$70,000 (public housing)
Profitability of social housing projects	Average	Below average	Average
Use of wood in construction	Non-structural	Non-structural	Non-structural
Building code for wood	Absent	Present	Present
Restriction on using imported wood species	Yes	No	No
Awareness of use of wood in construction	Limited	Limited	Limited
Social perception of wood construction	Poor	Poor	Poor
Other probable markets	Mining displacement camps and housing in hilly regions	Projects with less than 250 units	Coastal and high seismic prone regions

Due to the urgent need and large scale of projects, social housing segment can prove to be a favorable segment. Existing trade channels and policies between the U.S. and these three countries would further support such expansion. The mode of entry depends upon the levels of corporate control, internationalization costs and associated risk that the company is willing to maintain. U.S. pre-fabricated system manufacturers can go international by exporting straight to the local builders with or without using intermediaries. Direct exporting would mean least

investment risk and costs but lacks the control over supply chain. Manufacturers from the U.S. can also make long term partnerships with local agencies to form joint ventures with a certain level of ownership. Local partners can be responsible for providing access to the residential construction market, site selection and development while the U.S. manufacturers could be responsible for developing and manufacturing the wood housing systems. This entry mode would involve higher costs of internationalization as compared to exports. The risk of failure now would be shared between both the partners. Joint venture involves formation of a separate legal entity. If any of the partners is not willing to do that, there is an option of formulating strategic alliance. It is very similar to joint ventures but does not involve formation of a new organization. Another major entry mode that the companies in the U.S. can take is by establishing a wholly owned subsidiary. But this would require the U.S. companies to comply with local rules, adjust to local culture and language, accommodate to local economic conditions and expect support from the local infrastructure.

6.5. Survey results

A total of 108 responses were received from the surveyed sample. This represented 10.6 percent of the sample. Out of this response, only 25 of the respondents answered positive to the first question and continued the survey questionnaire. Only these were the respondents that reported to be manufacturing system built prefabricated wood building systems. The rest of the respondents returned the survey questionnaire without answering any other questions. Thus only these valid responses could be used in analysis. Moreover these responses represent only 0.8 percent of the total population of 3166 companies considered in this study. Low response rate restricted the extrapolation of results and conclusions from the sample to the population and limits the use of results only as a case study within the industry instead of an overall representation.

Log Cabin Homes and Buildings were found to be a most widely manufactured product line among the respondents. Fifty-two percent of the respondents reported it to be one of their products. This was followed by Modular Systems with 28 percent respondents manufacturing the system. Precut and others category which included Mobile HUD homes and stick built construction were both reported by 24 percent of the respondents as one of their products. Only 16 percent of the respondents reported to manufacture Panelized Systems. Table 9 summarize responses of the survey across different product categories.

Table 9 Response Summary on Different Construction Methods

Construction System	Number of respondents in each category	Manufactured by (Fraction of respondents)	Mean level (S.D.)	Median level	Range
Panelized System	4	16%	65% (43.56%)	75%	10% - 100%
Modular System	7	28%	70 % (28.28%)	50%	40% - 100%
Precut System	6	24%	48.33 % (29.94%)	50%	10% - 100%
Log Cabins homes and buildings	13	52%	83.08 % (21.36%)	100%	50% - 100%
Others (Stick built and Mobile homes)	6	24%	63.33 % (31.41%)	55%	20% - 100%

* The sum of total respondents across 5 categories will not be 100% as each respondent can be manufacturing more than one product.

For the responding firms, 81 percent of these construction systems were built for the residential market and the remaining 19 percent for the commercial sector on average. The majority, with 24 percent of the responding companies had 1-4 full time employees working for them. The median category of the number of employees among surveyed companies was 10-19. There were only two respondent companies that had more than 250 full time employees and only one of them had more than 500.

On average, the respondents reported to be manufacturing 74 units of houses each year with an outlier company that reported to be manufacturing 4000 units alone. The average size of units being manufactured by the respondents was 2240 sq. ft. ranging from 1400 ft^2 to 6000 ft^2 in area. Manufacturing

firms in this industry are fairly old and experienced. Eighty-three percent of the respondent companies reported to be in business for more than 20 years. Only 4 percent of the companies that responded were younger than 5 years. In terms of growth, 45.5 percent of the responding companies reported to experience less than 5 percent annual sales growth per year over the past five years. The median sales growth for the respondents was still 6 to 10 percent. Median delivery distance for the respondents' ranges from 200-300 miles and the average transportation cost incurred by the companies that responded was 6.3 percent. Contractual trucking is the most common delivery mode used by the responding companies. Ninety-six of the respondents used it to deliver on average 71 percent of their products. Forty-four percent of the responding companies used company trucking to deliver on average of 27 percent of the customer orders. Customer trucking, rail and others (via sea) were not widely used means of transport among the respondents. Less than 10 percent of the respondents reported to have used them. Interestingly, only 24 percent of the respondents were ever involved in developing products and participating in the low income housing market and all of these efforts were dedicated to domestic markets.

Only thirty-six percent of the responding companies reported to have conducted any export at any point of their business operations. When asked about interest to get into exporting to those that are not currently exporting, 56 percent responded positively and wanted to learn more about international business expansion. For the companies that did report exports, the share is quite small. Approximately 90 percent of the exporting respondents reported to have less than 10 percent of their total sales coming from exports. The regions of the world that are currently serviced by the United States system built wood construction sector were also inquired. Northern Asia and Pacific Rim reported the highest share of exports from this industry. Table 5 summarizes the share of exports to regions of the world. The sum total of the share here will not be 100 percent as a company can export to more than one region.

In terms of experience, the majority (55.6 percent) of the responding exporters have been in an international business for over 20 years. Close to twenty-two percent of these exporting respondents

reported to have been involved in the export business for less than 5 years. Wholesalers/distributor was reported to be the most commonly used by the U.S. companies. Close to 67 percent of the companies used this medium. No respondent reported to have a sales team in the foreign market for direct selling. One respondent reported to have sold directly to the foreign builder. Interestingly, none of the exporting respondents increased their employees or manufacturing capacity specifically to support export activities.

Table 5 Export Share for Each Region

Region	**Share of exporting respondents (Count)**	**Region**	**Share of exporting respondents (Count)**
North America	44.4% (4)	Western Europe	22.2% (2)
South Africa	11.1% (1)	Eastern Europe	22.2% (2)
South America	33.3 % (3)	Middle East	0%
Central America	44.4% (4)	Southern Asia (India/Indonesia/Malaysia)	22.2% (2)
Northern Asia and Pacific Rim (China/Japan/Taiwan)	77.8% (7)	Other	11.1% (1)

7. The way forward

- **Increase the market share**

The system built wood construction industry in the U.S. needs to better communicate its value to residential consumers. Current market share highlights this need. Without this added value proposition, the industry will eventually lose ground to traditional on-site construction. Product quality, customer relations, and custom design were the three most important success factors for the industry in this research. The companies should build on these performance measures to improve their market share.

- **Industry collaboration and integration**

One of the key barriers that was identified in this research was lack of sufficient collaborative efforts. It is particular not to just the system built sector but all of the residential construction industry. This was further supported by this work that identified knowledge and information related factors preventing foreign trade. The majority of the companies surveyed in this research lack required knowledge for using foreign trade agreements and associated regulatory complexity. Difficulty on forming partnership and providing after sales service were the other two important barriers to exports. The companies can come together and work on these issues collaboratively with a comprehensive focus of improving long term acceptance both in the domestic and international market.

- **New markets and market segments**

Findings from the research indicate that the sector needs to increase its market share in the residential construction market as compared to the other developing countries in Europe and

North America. It is clear that more research and development needs to be conducted both to develop product and market. This would help the industry to gain confidence of stakeholders and move to a widely appreciated technique. Some of the current requirements include further improving design and manufacturing capabilities to develop custom products both for domestic and international markets. The companies also need to invest in researching new and innovative ways to convey the benefits of off-site wood construction and hence convince more customers to use it.

- **Need for better guidance and communication**

The industry should work on developing a best practices guide that includes all the information regarding performance, quality, materials to be used, dictating construction codes and benefits of projects preventing confusions of owners, professionals and associated jurisdiction authorities. It is also important to have a consensus of all the stakeholders and use regular communication during marketing, development and promotion of system built wood construction projects.

7.1. Specific Recommendations

- Develop extensive programs and marketing strategies to introduce system built wood construction manufactured in the United States targeted for specific markets. Such programs should be directed at informing and educating all stakeholders associated to the housing market. This should include but not limited to builders, consumers, suppliers, government officials and policy makers as key stakeholders who would need to be informed of the benefits of using off-site construction. This might include project demonstrations, information on performance of such systems, educational activities and developing partnerships.

- Use existing manufacturing and export of wood housing systems all over the world to develop benchmarks and identify best business practices.
- Analyze social perceptions, current construction practices used in new markets or specific market segments and use the information for developing custom design and production systems.
- Demonstrate risks and returns of system built wood construction solutions compared to traditional construction.
- Develop easy to use custom guidelines both for domestic and international markets for the stakeholders to use and make informed decisions on incorporating system built wood construction solutions into projects. It should include design principles, performance guidelines, building strategies, and project timelines to be used as tools to support strategies and associated decisions.
- Provide overview of manufacturing and supply capabilities of the industry in the United States to be used by associations and trade groups in foreign markets. This also includes developing long term associations.

Develop long term plans for internationalization of U.S. manufacturing. Identify partners, develop associations and develop an investment roadmap aiming to make a successful export business model.

Specific strategies that can be implemented in studied market of urban social housing in Peru, Ecuador and Colombia

- Develop awareness programs by partnering with stakeholders in target markets with an aim to educate on the benefits of wood construction. These programs should be designed and implemented specifically for each of the stakeholders in the housing value chain to the foreign market. Programs developed for government should aim at assisting policy and regulatory framework for using wood construction. Programs for construction companies and builders should intend to introduce principles of wood construction as associated design parameters used in residential construction in the United States. There should also be programs for the final consumers to help improve the perception of use of wood in construction. This can include but not limited to different demonstration projects, development of education materials in the local language highlighting risks and returns associated with prefabrication of wood construction.
- Based on the inputs from stakeholders, develop a roadmap with key indicators impacting decisions to use wood prefabrication from the beginning to the end. This should include development of custom design parameters depending upon the local environmental conditions and selection of appropriate materials. There should also be tools in place to incorporate efficient certification systems in place to assure uniformity and replicability in future projects. This can be done by using the construction code in the U.S. and that of the target market.
- The companies in the United States interested in exporting to these markets should also work closely to understand local building criteria, biding strategies, project economics and critical stakeholders in the complete value chain.

- Develop product performance parameters acceptable in the foreign market. These product performance standards for structural testing, serviceability, consumer perception, durability and protection, social acceptability, energy and environmental performance, fire and seismic performance, acoustic performance and onsite installation and after sales performance.
- Since a single manufacturer in the U.S. might not be able to invest in all of the above mentioned recommendations, formation of a consortium or an association of the companies dedicated to working closely with the stakeholders in foreign markets in mapping out and identifying key actors. The findings from interviews conducted in this study according to agendas attached can act as a guideline in drafting the initial planning.
- The association of manufacturers in the United States should also work on developing an overview of existing manufacturing capabilities and identify major companies that have the capacity to export.

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9. Appendix

9.1. Meeting agenda for Lima, Peru

Gold Key Service

Schedule of Appointments - Lima, Peru

Virginia Tech University

Prepared for:	Mr. Gaurav Kakkar, Virginia Tech University
	Dr. Bob Smith, Head Department of Sustainable Biomaterials
Contact:	Gustavo Romero - Commercial Specialist
Email:	gustavo.romero@trade.gov
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Contact:	Erickson Rafael, Commercial Assistant
Email:	erickson.rafael@trade.gov
Phone:	(51) 947-033-261
Translator:	Mariella Luna
Cell:	(51) 997-978-804
Driver:	
Cell:	
Vehicle:	

Wednesday October 14, 2015

08:45 – 09:00AM	Meet-up at lobby
	Hotel Westin – Calle Las Begonias 450, San Isidro – Lima

10:00 – 11:00 AM **InGroup – InMobiliari / InConstructora**

Av. El Derby 250 – Of.2001 Surco

Phone: (51)-1-615-3800 Ext.3914

Contacts:

Ing. Adolfo Molina, Ing. Alfredo Trabucco, Sr. Juan Carlos Alvarado

Erika Rodas, InConstrutora Secretary

erodas@inconstructora.com.pe

Company Description:

InGroup (InMobiliari, InConstructora, InGerencia, ViBien) dedicated to the construction of residential, business, commercial and social housing projects like "Mi Vivienda" around Lima.

Web: www.inmobiliari.com.pe

11:30 – 12:30PM **Ministerio de Vivienda, Construcción y Sanamiento**

Paseo de la República 3361, Edificio Petroperú, San Isidro

Phone: (51)-1-211-7930 Ext. 1701

Contacts:

Arq. Lucia Ledesma – General Director for Programs and Housing Projects

Sonia Huaman, Vice-Ministers' Secretary

Shuaman@vivienda.gob.pe

Company Description:

Lead Government agency in the field of Urban Planning, Housing, Construction and Sanitation, responsible for designing, regulate, promote, monitor, evaluate and implement sectoral policy. Contributing to the competitiveness and sustainable territorial development of the country, benefiting preferably population with fewer resources.

Web: http://www.vivienda.gob.pe/

LUNCH

03:00 – 04:00PM **PROMOCASA**

Av. Mz. W2 Lt 8 Sector E-4 – Pachacutec, Ventanilla - Callao

Phone: (51)1-641-9475

Contacts:

Julio Quispe – General Manager

Cesar Leon – Commercial Manager

Technical Staff

cleon@promocasa.pe

Company Description:

Promocasa with 11 years of experience on Construction has been involved in social housing projects working along with Government agency with "Techo Propio" and "Mi Vivienda" projects.

Web: http://promocasa.pe

CONFIRMED

CAPECO (Friday 16th at 4PM)

Víctor Andrés Belaunde 147 - Edificio Real 3 - Of. 402 San Isidro - Lima

Phone: (51)-1-422-5566 Anex.216

Contacts:

Jose Luis Ayllon – Instituto de Construcción y Desarrollo President

jayllon@capeco.org

Company Description:

CAPECO, "Construccion Peruvian Chamber" is an organization, grouping and representing firms that operate in the construction sector in Peru. With over 50 years of experience. Organizer for ExCon – Peru.

Web: http://www.capeco.org

CONFIRMED

GMI S.A. (TBD in the morning)

Av. Paseo de la Republica 4667, Piso 7, San Isidro - Lima

Phone: (51)-1-213-5600 Anex.5843

Contacts:

Jorge Pimentel – Industry Division Manager

jpimentel@gmisa.com.pe

Company Description:

GMI, a leading Engineering Consultancy company, part of Graña y Montero Group. It has over 28 years of experience. Involved with multi-family residential house projects.

Web: http://www.gmisa.com.pe/en/

9.2. Meeting agenda for Quito, Ecuador

FINAL REPORT

GOLD KEY MATCHING SERVICE
DEPARTMENT OF SUSTAINABLE BIOMATERIALS, VIRGINIA TECH

For: Mr. Gaurav Kakkar, Graduate Research Assistant, Department of Sustainable Biomaterials
Dr. Henry Quesada, Associate Professor, Department of Sustainable Biomaterials
Dr. Robert Smith, Professor and head, Department of Sustainable Biomaterials
E-mail: kakkarg@vt.edu

PREPARED BY:	LODGING: Quito
Sofía Zárate, Commercial Specialist **Phone:** +593-2-398-5512, Cel: 0981329500 **E-mail:** zaratesc@state.gov	Torres de Suites by InAmazonas Av. Orellana 1172 y Av. Amazonas +593 2-297-2102

To conduct your matchmaking service, Partner Post Ecuador office contacted 18 companies/organizations in Ecuador. The companies/organizations were carefully selected from our local contacts, industry sector directories, our Client Management System, local association lists, and other Commercial Service sources.

Based on the telephone conversations, e-mail correspondence and the information gathered from your presentation, we feel these firms can provide good insight for your research. We are still in the process of confirming matchmaking meetings with them. Please review the information provided and let us know your comments.

SUMMARIZED AGENDA

Tuesday September 6, 2016

Inmobiliaria CORBAL Mr. Jeff Sheedy CEO sheedyjeff@gmail.com	**Time:** 8:30am – 9:30am **Location:** Naciones Unidas 234 y Sánchez de Ávila. Teléfonos de contacto: 593.2.2451.122, 593.2.2451.125, Celular: +593987376800
Confirmed www.corbal.com.ec	
Company profile: Inmobiliaria Corbal - Ciudad & Campo Cía. Ltda. was created in April 1974 to provide quality Real Estate services in Ecuador. The experience and expertise of its leaders allowed them to form a professional, efficient and visionary team that has achieved positive results. One of their key areas is Real Estate promotion.	

Wednesday September 7, 2016

EMPRESAS PUBLICAS PICHINCHA/ COVIPROV Guillermo Fernando Ruiz Cisneros fruiz@empresaspichincha.com, Arq. Mauricio Peña mpena@empresaspichincha.com Arq. Juan José Crespo, Gerente de la Unidad de Vivienda jcrespo@empresaspichincha.com, Arq. Claudia Páez, cpaez@empresaspichincha.com, Arq. Juan Carlos Báez	**Time:** 8:30am – 9:00am **Location:** Corea E1-48 e Inaquito. Edificio Colegio de Ingenieros Civiles de Pichincha, piso 4, Unidad de Negocios Inmobiliarios. Teléfonos: del (593)-02 - 2279-918 al 2279-929
Confirmed www.heq.com.ec https://www.facebook.com/COVIPROV/info/?entry_point=page_nav_about_item&tab=page_info	
Company profile: Empresas Públicas Pichincha/Coviprov is the housing company of the Province of Pichincha, with fourteen years of real estate experience. The goal is to satisfy the housing demand, preferably of families that do not own homes, in compliance with rules and regulations. The company strives to continually improve processes and providing a rapid, timely and after-sales service.	

UN TECHO PARA MI PAÍS ECUADOR **Gabriela Arrastua, gabriela.arrastua@techo.org**	**Time:** 10:00am – 11:00am **Location:** 10 de Agosto y Villalengua, Edificio Inteca, Of 402. Teléfono: 0969096670.
Confirmed www.techo.org/paises/ecuador/	
Company profile: Techo is an organization operating in Latin America and the Caribbean that seeks to overcome poverty experienced by thousands of people live in slums, through joint action by its people and young volunteers. Techo is convinced that poverty can be overcome if society as a whole recognizes that this is a priority issue and works actively to resolve it. Therefore, ROOF has three strategic objectives: 1. The promotion of community development. 2. The promotion of awareness and social action 3. The impact on policy. 85,000 families have worked together with volunteers in the construction of their homes.	

ARCHITEKTEN Arq. Felipe Palacios Partner fpalacios@architekten.land	**Time:** 12:00pm – 1:00pm **Location:** Distrito Creativo La Tejedora. Oswaldo Guayasamín E5-25 y Siena, Oficina 6. Cumbayá. Ofico: +593 2 2891 911, Cell: +593 984679588
Confirmed architekten.land/	
Company profile: Architekten is a collaborative and multidisciplinary studio, interested in exploring innovative solutions and opportunities in the overlap of space, program, form, budget and materiality. It is comprised of a team of architects who believe in the power of design as a tool to transform cities. Architekten has some experience with the use of sustainable materials in Ecuador.	

[Lunch, Location TBD]

COLEGIO DE ARQUITECTURA Y DISEÑO INTERIOR CADI – USFQ / COLLEGE OF ARCHITECTURE AND INTERIOR DESIGN Diego Oleas, M.Sc Director de Relaciones Internacionales CADI doleas@usfq.edu.ec icevallos@usfq.edu.ec	**Time:** 2:30pm – 3:30pm **Location:** CADI-USFQ, en la sala de profesores. Universidad San Francisco de Quito Diego de Robles y Vía Interoceánica, Cumbayá. Teléfono: 297 1764 / 297 1700 ext. 1527
Confirmed www.usfq.edu.ec/programas_academicos/colegios/cadi/Paginas/Contacto.aspx	
Company profile: The College of Architecture and Interior Design offers programs aimed at reaffirming the postulate that architectural design has been and will be the basis of professional education. The education of students is aimed at the development of a high level of excellence in project design and in their ability to build them effectively. The program provides students with rigorous training that integrates the creative and technical aspects of Architecture and Interior Design.	

COLEGIO DE ARQUITECTURA Y DISEÑO INTERIOR CADI – USFQ / COLLEGE OF ARCHITECTURE AND INTERIOR DESIGN	**Time:** 3:30pm – 4:30pm **Location:** Universidad San Francisco de Quito Diego de Robles y Vía Interoceánica, Cumbayá. Teléfono: 297 1764 / 297 1700 ext. 1527
Confirmed	Presentation by Dr. Henry Quesada "Mechanical, Acoustic, and Fire Properties of Southern Pine Cross-Laminated Timber."

Thursday, September 8, 2016

ECO-ARQUITECTOS Arq. Pablo Castro Director General pablo@tec.com.ec	**Time:** 8:30am – 1:30pm **Location:** Burgeois N34-507 y República. Teléfonos: 3 317 206, 3 316 429, 3 317 423.
Confirmed www.eco-arquitectos.com/web/index.php/nosotros/asociados	
Company profile: ECO Architects started operations more than 30 years ago by Eduardo Castro Orbe. It is mainly engaged in the construction of housing complexes in the form of price at cost. In 1999, the government created the "Housing Bonds" and the company created a partnership with the Ministry of Housing (MIDUVI) to run real estate and housing projects. Until today, this company has built more than 100 projects around the country, mainly in Quito and San Antonio de Pichincha. ECO Architects S.A. has 70 technicians and has built 48 buildings, 1,022 multifamily homes, 4,830 social housing homes and a total of 2,212 housing bonds executed.	

[Lunch, Location TBD]

AIMA (ECUADORIAN ASSOCIATION OF INDUSTRIAL WOOD) Christian Riofrío Director Ejecutivo director@aima.org.ec	**Time:** 4:00pm - 5:00pm **Location:** Av. Amazonas y República, Edif. Las Cámaras, Piso 7. Telf: (02) 226 0980 / (02) 243 9559. Cel: 099 333 8136. director@aima.org.ec
Confirmed www.aima.org.ec	
Company profile: Aima is a trade, national, private, nonprofit organization created in 1976 under Ecuadorian law, with the aim of promoting sustainable forest development, encourage reforestation and promote the growth and competitiveness of the timber industry.	

SECRETARÍA DE TERRITORIO, HÁBITAT Y VIVIENDA, DIRECCIÓN DE EJECUCIÓN DE PROYECTOS Y ESTUDIOS (MUNICIPAL HOUSING COMPANY IN QUITO) Carlos Francisco Estupiñan Trujillo, Especialista de Ejecución de Proyectos y Estudios (carlos.estupinan@quito.gob.ec) Sebastián Zuquilanda Peralvo, Gerente General (dzuquilanda@hotmail.com, sebastian.zuquilanda@quito.gob.ec)	**Time:** 12:30pm – 1:30pm **Location:** Av. Amazonas N79-39 y Av. de la Prensa, Centro de Eventos Bicentenario, Tercer piso. Teléfonos: (593) 2 3303682 ext 146 - 120.
Confirmed www.quito.gob.ec/index.php/secretarias/secretaria-de-territorio-habitat-y-vivienda	
Company profile: The Empresa Pública Metropolitana de Hábitat y Vivienda was created to execute the policies issued by the Metropolitan District of Quito (Municipality) on land supply; urban development and promotion of first homes for families or individuals; families with low and middle-income, vulnerable or in a risk situation; urban renewal and housing improvement: new housing for land owners in urban and rural areas, thereby helping to reduce the housing deficit.	

[Lunch, Location TBD]

MIDUVI, Subsecretaría de Hábitat y Asentamientos Humanos (MINISTRY OF HOUSING) Verónica Bravo Subsecretario de Estado (vpbravo@miduvi.gob.ec), Elvia de Lourdes Villafuerte, Servidor Público 1, (lvillafuerte@miduvi.gob.ec)	**Time:** 3:30pm – 4:30pm **Location:** Av. Amazonas entre Luis Cordero y Calama. Teléfono: (593) 2 2983-600 ext 1002, 1031
Confirmed www.habitatyvivienda.gob.ec/	
Company profile: Promote sustainable urban development and a dignifying and safe habitat. Exercise stewardship and implement public policy, guaranteeing citizens access to a safe and healthy habitat, decent housing and inclusive public space.	

CÁMARA DE LA INDUSTRIA DE LA CONSTRUCCIÓN, CAMICON (CHAMBER OF CONSTRUCTION) Ing. Iván Zaldumbide Jefe del Departamento Técnico izaldumbide@camicon.ec Arq. Daniela Cifuentes dcifuentes@camicon.ec Ing. Estefanía Abad eabad@camicon.ec Ing. José Parrales jparrales@camicon.ec	**Time:** 9:45am – 10:45am **Location:** Calle Juan Pablo Sanz e Iñaquito esquina. Edificio CAMICON. Telefonos: (593)-2 2442187 2439241 2432370 ext. 630 / 0998768773. izaldumbide@camicon.ec
Confirmed www.camicon.ec	
Company profile: The Chamber of the Construction Industry is an organization that promotes socio-economic development and welfare of the population by promoting the construction of infrastructure and quality housing, by promoting ethics and transparency principles, as well as care for the environment. The Chamber provides training, mediation, legal advice and research services and organizes trade shows and events for its members and the community.	

CORPORACIÓN FINANCIERA NACIONAL - CFN Ing. Santiago Revelo S. **Gerente de División de Productos y Servicios** srevelo@cfn.fin.ec	**Time:** 11:00am – 12:00pm **Location:** Iñaquito 36A, entre Naciones Unidas y Corea, Telf: + (593 2) 3935700 - ext. 2163. srevelo@cfn.fin.ec
Confirmed www.cfn.fin.ec/	
Company profile: The National Financial Corporation is a public financial institution whose mission is to channel financial and non-financial products aligned to the National Plan for Good Living to serve the productive sectors of the country.	

9.3. Meeting agenda for Bogota, Colombia

AMCHAM MATCHMAKING SERVICE

AMCHAM MATCHMAKING SERVICE
VIRGINIA TECH

For: Gaurav Kakkar
E-mail: kakkarg@vt.edu

PREPARED BY:	LODGING: Bogotá	TRANSLATOR
Natalia Mendez, Trade and Investment Center Executive **Phone:** (57 1) 587 78 28 ext. 123 **Mob:** 318 409 69 14 **E-mail:** centrodecomercio2 @amchamcolombia.com.co		
TRANSPORT		

SUMMARIZED AGENDA
Monday, March 14th 2016

ARRIVAL TIME OF THE DRIVER	Time:
HOTEL	

CAMARA COLOMBIANA DE CONSTRUCCIÓN **Karen Ortega - Construction Studies Coordinator**	TIME: 10:00 AM
Confirmed	Address: Carrera 19 # 90 - 10 - 3d Floor, Camacol Building Phone: +57 (1) 743 0265 ext. 1365 E-mail: kortega@camacol.org.co Web site: www.camacol.co
Profile: CAMACOL leads the urban responsible and sustainable development, looking for a deficit reduction housing and the projection of the sector to new business opportunities and new markets.	

CONSTRUCTORA OIKOS **John Jairo Beltrán – Planning Control Manager**	TIME: 4:00 PM
Confirmed	Address: Carrera 16A # 78-55, 6th Floor Phone: +57 1 651 6141 **E-mail: gerenciasip@oikos.com.co** Web site: www.oikos.com.co
Profile: OIKOS line of construction development is based on 4 pillars: Architectural design and coordination of technical studies, Budget and Programming work, Construction of Buildings and environmental sustainability and operational efficiency. This company makes various housing projects for low income families in Colombia known as social housing.	

Wednesday March 16th, 2016

ARRIVAL TIME OF THE DRIVER	Time:
HOTEL	

CONSTRUCTORA BOLIVAR **Fernando Ospina - Director of Research and Processes**	TIME: 9:00 AM
Confirmed	Address: Calle 134 # 72 - 31 (Av. Boyacá con Calle 134) Phone: +57 1 6258330 E-mail: fernando.ospina@constructorabolivar.com Web site: www.constructorabolivarbog.com
Profile: CONSTRUCTORA BOLIVAR has released the construction of urban projects for all social strata and now has full capacity to perform the work of Construction Management, Sales and Promotion directly.	

AMCHAM MATCHMAKING SERVICE

Tuesday March 15th, 2016

ARRIVAL TIME OF THE DRIVER	Time:
HOTEL	

CONSEJO COLOMBIANO DE CONSTRUCCION SOSTENIBLE **Miguel Orejuela – Education Director**	TIME: 9:00 AM
Confirmed	Address: Carrera 7 No.74-56 Office 609 Phone: +57 1 7430950 E-mail: educacion@cccs.org.co Web site: www.cccs.org.co
Profile: The Colombian Sustainable Building Council (CCCS) is a private nonprofit organization founded in 2008. This organization leads the transformation of the collective consciousness towards a sustainably built environment with the support of its strategic capital and +200 Members (companies, schools, universities, NGOs and associations).	

Instituto de Desarrollo Urbano - IDU **Sandra Liliana Angel - Deputy Director General Infrastructure**	TIME: 11:00 AM
Confirmed	Address: Calle 22 # 6-27 Phone: +57 1 338 6660 ext. 1801 E-mail: sandra.angel@idu.gov.co Web site: www.idu.gov.co
Profile: Governmental entity that looks to develop integrated urban projects to improve mobility conditions in terms of equity, inclusion, safety and accessibility of the inhabitants of the Capital District.	

FINDETER **Ana Maria Cifuentes-Planning Manager**	TIME: 11:30 AM
Confirmed	Address: Calle 103 No. 19-20 Phone: (571) 623 0311 E-mail: icastro@findeter.gov.co acifuentes@findeter.gov.co Web site: www.findeter.gov.co
Profile: Findeter is the development bank for sustainable infrastructure in Colombia. The organization leads and finances programs of national and regional interest focused on sustainable projects. Findeter works with the Colombian Government though the Ministries of Finance and Public Credit, Housing Minister and national agencies such as the Department of National Planning, among others.	

METROVIVIENDA **Alejandro de Angulo - Technical Director of Works**	TIME: 2:00 PM
Confirmed	Address: Calle 52 No. 13 – 64, 7th Floor Phone: +57 1 359 9494 ext. 440 E-mail: alejandrodeangulo@metrovivienda.gov.co Web site: www.metrovivienda.gov.co
Profile: Metrovivienda is a company of the town hall of Bogota that promotes the construction and acquisition of affordable housing in the city, with the primary aim of ensuring the most vulnerable and disadvantaged housing a decent housing with access to public services, recreation areas, facilities for urban areas, and in general, spaces that promote the effective exercise of the full human rights.	