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Center for International Trade in Forest Products
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Opportunities for US Building Materials in the Chinese Senior Housing Market

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China faces the unique challenge of becoming a grey society before it becomes a rich society. Since there is no precedence for this, China will have to respond to a series of converging social trends that will have significant consequences on the future well-being of Chinese society. The combination of the One-Child Policy coupled with rapid urbanization and a lack of comprehensive social security/health care policies along with the changing role of women in the workforce is driving an unprecedented transformation of traditional social values. In the past, when families were larger, the children were expected to provide support for their aging parents. However, the transition from a planned economy to a market-based economy has begun to undermine the tradition of familial obligation towards parents and grandparents. For example, the One-Child Policy has led to the 4-2-1 problem (the so-called sandwich generation) where a married couple (where each spouse is usually an only child) is expected to provide support for the aging parents (4 people) of both spouses, as well as their own child. The movement of young people from rural areas to cities has resulted in the parents being left behind, often to support themselves. Finally, the transition to a market-based economy means that often both husband and wife must work very hard to establish their careers even as they start a family. With both spouses working full-time, and inadequate or expensive day care options, an estimated 30% of married couples living and working in large cities rely on their parents to raise their child. At the same time, the lack of comprehensive social security and health care programs means that aging senior citizens, with inadequate (or no) pensions, are unable to afford senior care in their later years.

The profound implications of these unprecedented changes for Chinese society can accurately be described by the Chinese phrase wei ji (危机), which is frequently used to refer to a crisis or precarious moment (wei means dangerous or precarious while ji means opportunity). The mixed message inherent in the phrase wei ji accurately reflects the current situation in senior housing in China. Insufficient government policies and programs in the face of a rapidly aging society, if not effectively resolved, could lead to a crisis within the next 10 years. Recognizing that solving this problem is beyond the means of the government, Chinese officials are looking to the private sector to help develop capacity in the senior housing sector. Thus, the rapid aging of Chinese society represents an opportunity for US manufacturers and exporters of wooden and energy efficient building materials as well as developers and managers of senior housing facilities.

To gain a better understanding of the opportunities within the senior housing sector, researchers from CINTRAFOR visited several senior developments and met with architects and developers in China. This article describes the current situation in China and identifies potential for US building materials in Chinese senior housing.

Population demographics and the growing size of the senior market

China, with an estimated population of 1.34 billion, is the largest country in the world, although the population of India (with a fertility rate of approximately 2.65 compared to 1.8 for China) is expected to exceed that of China around 2026. As a result of the higher Chinese birth rate prior to the implementation of the One-Child Policy, there were more than 170 million seniors over 60 years of age in 2010 (12.8% of the total

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Director's Notes

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The Center for International Trade in Forest Products addresses opportunities and problems related to the international trade of wood and fiber products. Emphasizing forest economics and policy impacts, international marketing, technology developments, and value-added forest products, CINTRAFOR's work results in a variety of publications, professional gatherings, and consultations with public policy makers, industry representatives, and community members.

Located in the Pacific Northwest, CINTRAFOR is administered through the School of Environmental & Forest Sciences at the University of Washington under the guidance of an Executive Board representing both large and small companies, agencies, and academics. It is supported by state, federal, and private grants. The Center's interdisciplinary research is carried out by university faculty and graduate students, internal staff, and through cooperative arrangements with professional groups and individuals.

US exports of wood products continued their strong growth through the first half of 2014 (Table 1). In fact, US wood exports have demonstrated strong year on year growth every year since 2009, with the exception of 2011-2012 when they grew by just 0.2% Table 2). In the first half of 2014, US exports increased to every major market with the singular exception of Canada, where they dropped by 1.7%. Despite the drop, Canada remained the second largest export market for US wood products. Exports increased by double digits in many of these markets including China, the UK, Vietnam, Italy and Taiwan. The primary products being exported from the US during the first half of 2014 were lumber (36.4%) followed by logs (28.7%). Wood chips (8%) builders' joinery (4.5%) and plywood (3.9%). The mix of products being exported varied by country of destination (Table 1) although renewable energy mandates within Europe have driven wood chip exports to record levels, particularly from the southeastern states. The largest growth since 2009 has been consistently seen in exports to China although strong export growth has also occurred in Japan, Mexico, the UK and Vietnam. The state of Washington remains the dominant exporter within the US, with a 21% share of US exports in the first half of 2014. The total value of wood exports from Washington state are more than three time those of the #2 state (Oregon) and more than 4 times greater than those of the #3 state, California. Through June 2014, Washington exports of wood products totaled $1.03 billion compared to $331 million for Oregon and $276 million for California. Together, the three west coast states represented almost one-third of total US wood exports (32.8%) during the first half of 2014. Forest product exports remain an important component of the economies of the western states, ranking as the #5 export sector in Washington state, the #6 export sector in Oregon and the #11 export sector in California. CINTRAFOR research suggests that a number of factors should help to support the growth of wood products from the western US including, the Lacey Act, the approval of US Douglas-fir lumber as a local species in Japan, the closure of the nuclear power plants in Japan and the increased dependence on biomass energy and the continued growth of the wood manufacturing sectors in both China and Vietnam, which together account for almost 64.3% of total US imports of wooden furniture and parts (valued at $6.95 billion through June 2014). Both China and Vietnam are increasingly looking to the US to supply the raw material required by their wood furniture manufacturing sectors, and this is unlikely to change in the near future.

Peace Corps Masters International Update

The 2013-2014 group of Peace Corps Masters International students have all received their Peace Corps assignments. Zak Williams has already departed for the Philippines where he has started his work as a Coastal Management volunteer. Soon Jordan Bunch and Jake Dunton will be departing for their assignments in Senegal where the UW SEFS contingent of volunteers will grow from the current 5 volunteers to 7 volunteers. Senegal remains our single largest country for volunteer assignments. Tabatha Rood and her husband Cameron will be departing for their assignment in Ghana in early October, while Michael Tomco leaves for Zambia in February 2015. The remaining PCMI student, Ian Hash, will continue his recovery from shoulder surgery and should receive his PCMI assignment towards the end of the year. In the meantime, a group of our current PCMI students has been working hard to update and enhance the SEFS PCMI website by improving its usability and making it more informative and entertaining. The new PCMI website can be seen at: http://depts.washington.edu/sefspcmi/

Table 1. US wood exports by major trading partner and product mix, $ millions

	2009	2010	2011	2012	2013	2013-2014	2014 Product Share
World	$5,216	$6,786	$7,593	$7,609	$8,685	14.3%	
WA Share	***16.4%***	***19.2%***	***22.6%***	***18.8%***	***22.1%***	***21.0%***	
China	$545	$1,163	$1,915	$1,640	$2,349	37.9%	Logs 49.1%, lumber 46.3%
Canada	$1,752	$2,102	$2,117	$2,187	$2,227	-1.7%	Lumber 23.6%, Logs 14.4%, Builder's joinery 12.8%, Fiberboard 7.2%
Japan	$517	$634	$734	$730	$850	3.0%	Logs 55.5%, Lumber 27.2%, Chips 9.7%
Mexico	$412	$482	$514	$582	$604	4.6%	Lumber 44.4%, Millwork 14.1%, Particleboard 7 3%, Plywood 7.1%
UK	$179	$212	$212	$306	$431	29.4%	Chips 58.1%, Lumber 16%, Barrels and Casks 14.7%
Vietnam	$107	$156	$150	$187	$211	19.5%	Lumber 76.4%, Logs 20.9%
S Korea	$195	$203	$206	$164	$194	1.8%	Logs 56.8%, Lumber 14.4%, Chips 7.6%
Italy	$139	$188	$161	$113	$160	11.3%	Lumber 43.2%, Logs 30.4%, Chips 16.1%
Germany	$123	$149	$135	$123	$106	4.8%	Lumber 39%, Veneer 21.3%, Logs 17.9%, Chips 7.4%
Australia	$56	$87	$111	$110	$99	2.0%	Plywood 48.4%, Millwork 22%, Lumber 13.6%
Taiwan	$52	$70	$73	$76	$84	15.3%	Lumber 77.6%, Logs 16.4%

Source: Global Trade Atlas, 2014. (http://www.gtis.com/GTA/)

Table 2. US export growth year on year 2009-2013.

2009-2010	2010-2011	2011-2012	2012-2013%
30.1%	11.9%	0.2%	14.1%

Source: WISERTrade database, 2014. (http://www.wisertrade.org/home/portal/index.jsp)

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population). Further, it is expected that the number of Chinese seniors, which is increasing at a rate of about 3% per annum, will reach 248 million by 2020 and 437 million by 2050, when seniors will comprise over 25% of the total Chinese population (Figure 1). In 2050, the number of senior citizens in China would exceed the total populations of every country in the world with the exception of India and the US. China's National Committee on Aging estimates that half of the senior citizens live alone without children and less than 30% are covered by the current pension system. It is estimated that there are approximately 21.3 million senior citizens in China who are 80 years of age or older. As a result, Chinese government officials at all levels have recognized the urgent need to greatly expand the number of senior centers and nursing homes in China.

The One-Child Policy, which was introduced in 1978 and applied to first-born children in 1979, has been credited with preventing the birth of approximately 400 million children in China. Along the way, it has fundamentally changed the demographic profile of China over the past 30 years, Figures 2a & 2b. In the course of just a few generations, China will transition from the traditional population structure of a developing country where a large number of younger workers supports a small number of older, retired workers (Figure 2a) to an inverted

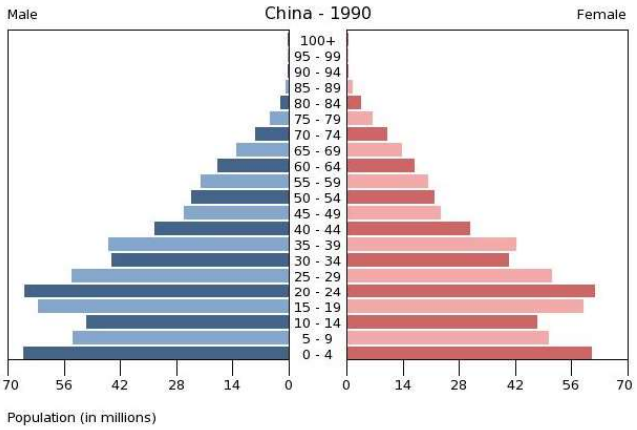

Figure 2a. China population pyramid: 1990

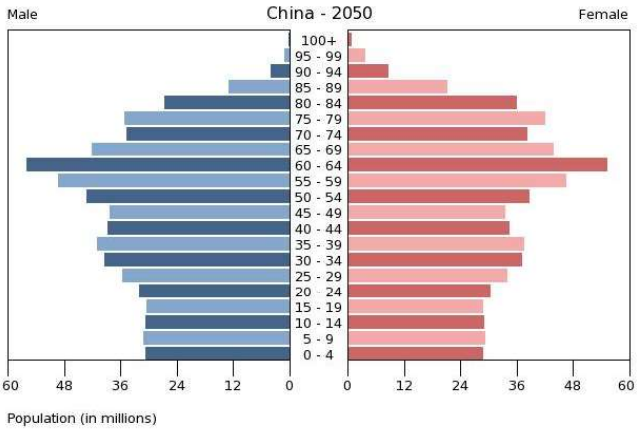

Figure 2b. China population pyramid 2050

Source: http://www.census.gov/ipc/www/idb/informationGateway.php

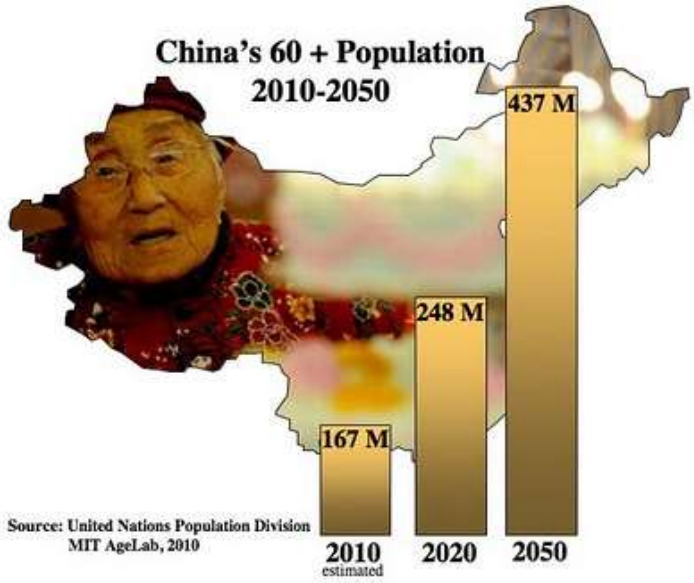

Figure 1. China's aging population is growing rapidly *(Source: MIT 2010)*

population structure where a relatively small number of younger workers supports a large number of older, retired workers (Figure 2b). The unique aspect of this demographic transformation is not so much the speed with which it is occurring, but the fact that at the end of the process, China will still be considered a developing country.

As China's largest city, Shanghai is already facing the challenge of responding to an aging population. With one in four people being over the age of 60, Shanghai ranks first in terms of China's aging population. In 2012, the city's total population was 14.3 million, of whom 3.7 million (25.7%) were over the age of 60. The Shanghai Aging Research Center predicts that the number of senior citizens in Shanghai will exceed 4 million by 2020, and represent almost 30% of the population of the city. However, Shanghai currently has only 105,215 beds in 631 senior care facilities (mainly public), indicating a great shortage of senior housing facilities and providing an opportunity for the development of a senior care industry.

Increasing affluence increases discretionary spending

China is currently experiencing a wave of economic growth that is driving a rapid expansion of the middle class and lifting a huge segment of the Chinese population out of poverty. It has been estimated that 93% of Chinese households were poor in 1995 (household income less than ¥25,000 or $3,676 at an exchange rate of ¥6.8 yuan per US dollar). However, a recent report suggests that almost half of the Chinese population (49.7%) will have an income that places them in the lower middle class by 2015 (income between ¥25,001-¥40,000 or $3,677-$5,882), while 6% of the population will be classified as affluent (income over ¥100,000 or $14,706). While these amounts may seem low by western standards, it should be noted that based on purchasing price parity, a household income of ¥100,000 corresponds to an income of $40,000

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in US. However, there is still a relatively large difference between urban household incomes (¥10,493 or $1,643) and household incomes in rural areas of China (¥3,268 or $481).

The average annual disposable income of the top 10% of the population is ¥28,766 ($4,230); although a recent study of the "grey market" in China suggests that the average disposable income of the top 10% of the population is closer to ¥101,310 and the size of this population group is 10 million households. The total size of the "grey market" is substantial, and while not officially included in the economic numbers in China, it is estimated to be approximately 24% of GDP.

The urban affluent currently account for 25% of Chinese household savings and this is expected to increase to 60% by 2025. Approximately 6% of seniors in large cities (8.6 million retirees) belong to a cohort that can afford high end senior housing and about half of these (4.3 million retirees) may actually opt for senior housing over aging in their homes.

Changing cultural norms

Relations between children and parents are generally guided by the principle of Chinese Xiao, and this sense of filial piety remains a strong component of Chinese society. Chinese Xiao is defined in a Confucian classic treatise giving advice on filial piety. The treatise:

> "was composed sometime between the Qin and Han Dynasties, with some scholars attributing it to Confucius. The book deals with the sole subject of filial piety, holding that filial piety is a sign of natural law, a behavioral standard of human beings and the foundation of national politics. …filial piety is mainly demonstrated through supporting and waiting upon one's parents. In other words, one is supposed to care for their parents still living and in good health with heart and soul."
>
> *The Classic of Filial Piety* (危机)
> *http://history.cultural-china.com/en/37History864.html*

Prior to the implementation of the One-Child Policy and the subsequent transition to a market-based economy, children were viewed as a sort of social security policy with the oldest child being responsible for taking care of their parents with help from their siblings. However, the implementation of the One-Child Policy, the transition to a market-based economy and the subsequent migration of large numbers of younger people into the cities in search of jobs along with the increase in life expectancy from 46 years in 1960 to almost 79 years in 2010 has begun to strain the old cultural norms (MIT 2010). The responsibility of taking care of two sets of parents as well as a child, while simultaneously trying to establish their professional careers, is often overwhelming for young Chinese couples, particularly those living in first-tier cities. Many Chinese couples (and unmarried single people) who have parents who live far away have begun to hire someone to provide meals and daily assistance for their parents. Complicating the situation is the fact that young couples often rely on their parents to take care of their young children full time while they work to establish their careers. One unofficial estimate suggests that up to 30% of young professionals in Shanghai have sent their child to live with their parents.

With this in mind, China implemented a policy in 1996 relating to elderly people called the "Law of the People's Republic of China on Protection of the Rights and Interests of the Elderly". In addition, a pending amendment to China's Elder law is currently being considered that would require children to take care of their parent's physical and mental needs, including requiring children to visit their parents regularly. If a parent felt neglected, the new amendment would allow them to file a court case against their child to claim their legal right to be cared for.

As mentioned previously, it is important to recognize that these problems are much more prevalent in first-tier cities such as Beijing and Shanghai. When considering rural areas as well as second and third tier cities, it is still the norm that young peoples and married couples either live with their parents or provide support for them so that they can age in place.

Types of senior housing, market and role of subsidies

China still does not have a comprehensive social security program in place that covers all people in China. As a result, the savings rate in China is much higher than that observed in western countries with a more comprehensive set of social programs. Chinese families often deposit between 20%-25% of their after income tax earnings into their banks in order to fund their retirement and health care in old age.

For those seniors looking to retire in a senior community or nursing home, there are few affordable options. A recent report by the Ministry of Civil Affairs estimated that while there are 160 million seniors over 60 years of age in China, there are only 2.5 million beds within the entire country. Given that the global average in developed countries is one bed for every 20 seniors, by this standard China would need to expand their supply of nursing home beds from the current 2.5 million to 8 million.

Currently there are four types of senior housing facilities that exist in China based on the type of senior citizen they serve: 1) Senior Apartments/ Independent Living, 2) Assisted Living, 3) Skilled Nursing and 4) Acute Care. These facilities can exist as separate units serving a specific segment of the senior market or grouped together within a senior community arrangement. In addition, senior housing facilities can be considered by their type of ownership, which ranges from state owned to privately owned. Using the ownership criteria, there are three basic types of senior facilities in China: 1) Government welfare senior housing, 2) Non-profit, non-governmental senior housing and 3) For-profit senior housing.

Government senior housing, also referred to as Social Welfare Institutions for the Aged, is generally less expensive than private senior housing options, although they are generally perceived to be of lower quality than private facilities. Given the dearth of

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publicly owned senior housing facilities in China, the Chinese government has recently called on the private sector to help expand the supply, particularly in first-tier cities. While the development of private senior housing facilities is relatively new, there have been some success stories, particularly with non-profit senior housing where the business model is more established and there are more subsidies being made available by the government. However, most projects are still experimenting for the right business model and few are currently profitable.

A recent interview by CINTRAFOR researchers of non-profit senior facilities in Shanghai found that the types of subsidies that can be made available from the national and local governments to non-profit organizations include:

- Income tax exemptions
- Reduced land costs
- Reduced utility rates (electricity, water, sewer and telecom)
- One-time construction/renovation cost subsidies (usually on the order of 10,000 yuan per bed)
- Monthly operation subsidies when a specific level of occupancy is reached (generally in the order of ¥100/bed/month).

It should be noted that there is a specific time frame associated with maintaining non-profit status (in this case 10 years) and if the facility is sold prior to that time then all taxes must be paid and all subsidies must be reimbursed.

The Chinese government recognizes the empty nester syndrome that has resulted from the one-child policy and the huge migration to cities among younger people. The care gap represents a huge problem for the Chinese government and something with which they are just now coming to recognize. For example, the government estimates that there is currently just 8.6 care beds per every 1,000 seniors whereas there is an average of around 50 care beds per 1,000 seniors in developed countries. It is estimated that 80 million of the 170 million seniors in China are currently living alone (MIT 2010). This situation leaves many seniors to age on their own with small pensions and an underdeveloped retirement infrastructure, both in urban and rural regions of the country. Partly in response to this growing problem, China intends to build 10 million affordable homes in 2014 and 2015 for a total of 36 million units as part of its new five-year plan for 2011-15.

While it is true that the vast majority of seniors, especially in rural areas, prefer to remain in their homes, a small but growing number of seniors are interested in living in a full service senior community. This is particularly true in urban areas where seniors have the financial means to live in a senior community. A recent study suggests that approximately 3% of seniors are willing to move to a senior community (and are able to afford it), which represents a market of about 5 million seniors. Many educated, retiring white collar workers have a strong interest in remaining active, both physically and mentally. In addition, a growing number of the children of these seniors are working overseas or have high paying positions with international companies within China and they have the financial means to help support their parents financially. Responding to this growing niche market, a number of private non-profit and for-profit groups have begun to build senior communities in some top tier cities. For example, several have been developed around Beijing (e.g., Beijing Sun City and Beijing Oriental Sun City) as well as in Shanghai (e.g., Greenland 21 City, Graceland, Cascade Emeritus, Starcastle and Cherish Yearn).

Case Study: Wuzhen International Health Ecological Park

"Wuzhen International Health Ecological Park (also called Graceland) is located at Baimadun Village, Wuzhen, Tongxiang City, Zhejiang Province. It covers an area of approximately 5,500 mu (825 acres) and upon completion the park will become the biggest rehabilitation center and retirement community in China. The core area phase occupies an area of 1,516 mu (250 acres) and the construction cost will be approximately RMB 7.5 billion. The planning concept of Graceland is to make full use of the existing natural elements and build a sustainable green community in accordance with the terrain and the present water situation. In such a community, we aim to keep a balance between the structures and the natural environment. We focus mainly on five eco-themes: sunshine, water, air, botany and animals with an emphasis on combining the green space with the residential exercising space and interspersing the architecture into the natural environment. In this way, we are forming an architectural landscape and skyline with a diverse spatial hierarchy that varies across height and distance. Graceland is positioned to be the first top-quality community with the theme of "healthcare and aged-care". Maintaining the historic water-town feature of the local communities while taking into consideration the functionalities of a senior community, Graceland will be divided into six parts: the International Rehabilitation Hospital, the University for the Aged, the Independent Retirement Residential Zone, the Nursing Homes Demonstration Zone, the Premium Resort Hotel and the Leisure Commercial Zone.

Graceland is a huge project that is still being built and is comprised of a combination of single family homes, 5 story townhouses and 10 story apartment buildings. It will be a mixed-age community that encourages both retired couples and young families with children to move in. The central idea of Graceland is life-long learning and their target demographic is a 40-70 year old white collar, affluent professional (especially professors, lawyers and doctors) who live in nearby large cities (e.g., Shanghai, Hangzhou, Suzhou and Nanjing) and who value learning as an integral component of their lifestyle. The community has been designed to provide the feeling of a college campus with a broad range of continuing education courses including hobbies and crafts. Classes will be taught in part by university professors and lecturers from the nearby city of Hongzhou and in part by the residents of the community itself. The heart of the

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Top photo: Architects conceptual drawing of the Graceland Retirement Community. Bottom photo: the University complex represents the heart of the community.

project is a group of buildings that form the core of the college (see photo). There is also an area for nursing homes with 500 beds and a first-class hospital in the area of post-operative care for stroke which will be supported by 8 stroke experts from Germany.

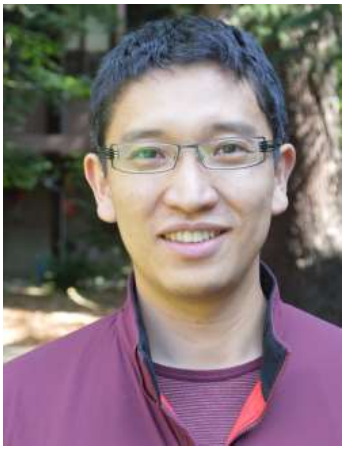
The project is currently under construction and is expected to be completed by 2020. Once completed, the community will have 5,000 housing units supporting a population of between 10,000 and 15,000 people. The business model for Graceland is based on selling the apartments and charging modest annual service/course fees. To date a total of 560 units have been completed in the first phase and over 500 of them have been sold, suggesting that there is a very strong demand for this type of community. The single family homes are approximately 180 square meters (1938 sq.ft.) and sell for between 4-5 million yuan. The apartments come in three sizes and the price is based on the size of the apartment. The smaller units are 72 square meters (775 sq.ft.) and have one bedroom and one bath and a kitchen and balcony/patio and sell for about 900,000 yuan. The middle units are 90 sq. meters (970 sq.ft.) in size and have 2 bedrooms, one bath and a kitchen and sell for approximately 1.1 million yuan. The largest apartments are 128 sq. meters (1350 sq.ft.) and include 3 bedrooms, 2 baths and a kitchen and sell for about 1.7 million yaun. Total annual course fees are 6,000 yuan per couple for unlimited access to all courses taught in the classroom buildings. There is also a modest 4,000 yuan annual management fee. Thus the maximum annual fee would be 10,000 yuan.

Strategic Observations

Our research clearly shows that there is strong growth potential and substantial opportunities for a wide variety of US building materials within the senior housing sector in China. Given the rapidly aging senior population in China, many opportunities exist to introduce new, innovative types of senior housing, especially in the wealthier eastern cities. Without a dominant model for senior housing, the opportunity exists to introduce a new business model for aging communities. Given the high cost of land, energy and utilities in China, the managers we talked with in Shanghai indicated that reducing the operating costs of senior housing was of critical importance in establishing profitability. They indicated that using products such as energy efficient windows, resource efficient plumbing fixtures and high efficiency control fixtures for HVAC systems were attractive propositions. There is a strong opportunity to expand the use of these types of resource efficient products within the senior housing sector in China, especially if US manufacturers and exporters can demonstrate the payback potential for these products over time. Given the cost sensitive nature of the Chinese market, it is imperative that US suppliers be prepared to explain the value proposition that their products represent and how these products can reduce operating costs and improve the profitability of senior facilities.

Many of the senior communities are designed to be mixed age communities and they often provide a mix of single-family, condominium and apartment buildings. Given the size of these developments, they are often located outside large urban areas where land is available. These projects often incorporate substantial outdoor parks, water features and extensive landscaping. These types of outdoors features provide a great opportunity to market treated lumber, both for decking applications and for outdoor structures (e.g., gazebos). An important consideration in marketing is to differentiate US treated wood from the locally treated variety by emphasizing product quality and long-term durability. Local treated lumber is often just dipped or is under-treated to reduce preservative retentions and thereby keep manufacturers costs low, at the expense of long-term durability. In outdoor applications it is important to differentiate the superior durability of US treated lumber, especially in terms of total lifetime maintenance and replacement costs.

New Post Docs in CINTRAFOR



Daisuke Sasatani

Daisuke Sasatani was born and raised in Osaka, Japan. He received his bachelor's degree in Botany and Entomology from the Osaka Prefecture University and his master's degree in Environmental Management from Yale University. Dr. Sasatani worked as a research assistant with CINTRAFOR at the University of Washington (UW), where he received his Ph.D. in Forest Products Marketing in 2013. He returns to CINTRAFOR as a post-doctoral Research Associate following a one year post-doctoral appointment in the School of Forestry and Wildlife Sciences (SFWS) at Auburn University in Alabama.

As an expert in the international trade of forest products, Dr. Sasatani has worked as a forest products consultant for a variety of firms and organizations based in the PNW, including TimWood, Stick Trade, Evergreen Building Products Associations, Softwood Export Council and Washington Forest Protection Association. Dr. Sasatani also served as a Fellow with the Food and Agriculture Organization of the United Nations in Rome Italy where he was tasked with performing a competitiveness study of the forest products industries in the Asia-Pacific region.

After receiving his Ph.D., Dr. Sasatani worked as a post-doctorate research associate in SFWS, where he helped conduct research on the forest products industry in the southeastern US. His research interests include evaluating the factors that influence the competitiveness and success of US forest products sawmills; understanding the factors that influence the export decision of US forest products firms, exploring consumers' willingness to pay for certification of wood products, and understanding the specification and use of wood within the Japanese wooden home building sector.

Dr. Sasatani has helped to promote the international trade of wood products from the Pacific Northwest and to help remove trade barriers for US forest products, especially in Japan. In 2013, Daisuke was a key member of the CINTRAFOR team that successfully received approval for having US Douglas-fir designated as a "local wood" species within the Wood Use Point Program in Japan. The success of this effort helped to boost exports of US Douglas-fir wood products by more than 20% in the first half of 2014.

Besides being an excellent market researcher, he is also an excellent instructor. He has taught elementary statistics courses in the Center for Quantitative Science at the UW, where he was a highly regarded teacher among his undergraduate students. In his new position, he will be mentoring graduate students at CINTRAFOR while teaching them how to apply quantitative methods to their research problems.

Daisuke can be reached at sasatani@uw.edu or 206-616-3681.

Ikechukwu Nwanashiudu

Ikechukwu (Ike: pronounced Eekay) ***Nwaneshiudu*** joined the CINTRAFOR research team as a post-doctoral research associate in 2013 after graduating from the department of chemical engineering at the University of Washington with his doctorate degree. He previously earned his Bachelor of Science degree at Haverford College in Pennsylvania in Chemistry and his Master's degree in chemical engineering at the UW. His doctoral research was primarily focused on tailoring polymer extractive phases towards enhanced optical detection in micro-environments. This technique is now being used to detect trace environmental contaminants in water, detecting liquid anesthetics in the body, and distinguishing fermentation inhibitory compounds in pretreated biomass slurries.

In addition to his doctoral research, Ike participated in the Bio-resource-Based Energy for Sustainable Societies IGERT program. This program was geared toward working with Native American tribes in the Pacific Northwest region on developing solutions for utilizing woody biomass generated during restoration activities on tribal forests. During his three years with the program, Ike participated in a full biomass assessment of the forestlands of the Yakama Nation, panel discussions with the Confederated Tribes of the Colville Reservation regarding alternative energy technologies that could complement their cogeneration energy facility, and full-scale engineering of a pyrolysis blanket technology to facilitate the cost effective conversion of woody biomass into charcoal products. This final project won third place in the UW Environmental Innovation Challenge and a patent and startup company "Carbon Cultures" arose from this research.

He is currently working with the LCA Team of the Northwest Advanced Renewable Alliance (NARA) project, which is primarily focused on converting cellulosic biomass from forest residues to bio-jet fuel. As part of the NARA life cycle assessment (LCA) team his work focuses on developing the Aspen models that will help support the environmental assessment of wood-to-jet fuel production process. In this research effort, Ike uses primary data generated from chemical engineering models as well as secondary data from vetted literature sources to help support the LCA effort.

Outside of his research endeavors, Ikechukwu also participates in service learning and community outreach activities. At Haverford he was part of the Mentoring and Student Teaching program (MAST), where he helped serve the greater Philadelphia community by teaching and mentoring junior/high school students in math and science. He also participated in an externship in Cameroon, where he helped organize and regulate the distribution of antiretroviral drugs at the provincial hospital as well as teaching HIV/AIDS awareness classes at local schools. At the University of Washington he tutored science fair projects at Bryant Elementary School in Seattle as well as helping to organize an electroplating earring-making exhibit in the UW Engineering Discovery Days program.

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