The Business Solution for Smart Home Building Automation Technology

A Major Qualifying Project Report

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by

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Abstract

Smart control plays an increasingly important role in a smart home with wide-spread penetration of Internet of Things. Siemens has been one of the leading companies in building automation, and provides a portfolio on the smart control of the HVAC system and blinds and shutters. However, since the products are expensive and hard to use, Siemens is using a Business to Business model, and considering to change the model toward a customers oriented business model. This project delivers an analysis of the current model and offers a possible business solution.

Acknowledgement

We would like to start off by thanking our sponsors at Siemens, specifically Mr. Liu Yan, who has provided us with much guidance and information to help us reach our project goals. We were given a great opportunity to work with such a well-known company on a timely issue in today's modern society during the beginning stages of the development of their new business plans. The seven weeks this summer have given us a great deal of experience in learning how such a large company is operated within the Chinese market. This project has also expanded our knowledge and experience in working in a diverse group, working in a different culture, and constructive work ethics that will surely help us advance in the future of our careers.

Next, we would like to thank our advisors, WPI professors Amy Zeng and Jianyu Liang, for providing us with much feedback and guidance throughout the course of this project.

Lastly, we would like to thank the volunteers at Beijing University of Chemical Technology for collaborating with WPI's Beijing Project Center and for providing housing. We are especially grateful to the voluntary students for their tremendous help and assistance that have made this experience more convenient and enjoyable and for introducing us to the Chinese cultural activities.

Executive Summary

Siemens is a very well-known, multinational company that we were very excited to work with this summer. This project has given us a great opportunity and much experience in learning the engineering and business fields in China. Also, this project stood out to us because it deals with the future of Smart Home technology, which is a growing industry we are very interested in. Another reason we chose this project is that we considered this project to be wonderful opportunity for us to not only learn the culture, but also see how we could apply our knowledge and skills in our disciplinary studies to provide some inputs to Siemen's new business plans.

The topic offers opportunities for many professions. Since this is somewhat a new technology, many building automation solutions are created to satisfy the customer's needs. Currently the most popular solution for a smart home is a customer oriented business model, where customer can purchase different smart home products from different manufacturers to create a smart network for the house. However, Siemens strives to focus on the solution which creates ONE smart platform for the whole house. This solution, although offers various smart control devices from one manufacturer, has some constraints including the business aspect and the design aspect. We applied Industrial Engineering methods and Civil Engineering concepts to analyze the current building automation solution offered by Siemens. Our findings provide a foundation for switching to a different business model, and a possible design for the future smart homes.

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1. Introduction

1.1.About Siemens

Siemens is largest industrial manufacturing company in Germany founded in 1847. The main divisions of the company are automation, building technologies, drive technology, energy, healthcare, mobility, financing, consumer products and services. Siemens Building Technology division offers energy efficient, safe and secure buildings and infrastructures. The Siemens Building Technology have five divisions; performance and advisory services, automation and control, HVAC, fire safety and security. The performance and advisory services division offers for the management of buildings. Siemens offer specifically focused service to improving sustainability, ensuring business continuity, optimizing energy supply and operation efficiency, managing risks and costs, increasing efficiency and protecting the investments for the buildings. Also, they offer integrated solutions for specialized areas such as airports, data centers, etc. The building automation and control systems are optimally matched for energy saving and to minimize installation and operating costs. The HVAC products they make is, for example valves, actuators, sensors and thermostats. All these products have high quality standards. Energy efficient, easy-use and long lifecycles are the essential features of the products. These days fire safety requires comprehensive understanding of safety needs and solutions. As a leading fire safety technology, they provide unique protections, such as early and reliable fire detection, clear and fast alarming and evacuation processes and intelligent extinguishing tailored to each room's requirements. All these elements are important for fire safety solution. Security is one of the most important element. Siemens provides innovative solution for building to optimize the cost and minimize the security risks.

1.2. Internet of Things

1.2.1. Definition of Smart Home

In recent years, many people start wondering what Internet of Things (IoT) is and how IoT can help to enhance people's lives. The short definition for IoT is that it is a virtual network of things or objects around us, which allows objects to communicate with each other. This idea was started back in 1999, when Kevin Ashton, an assistant brand manager at Procter & Gamble described how adding sensors and radio-frequency identification to everyday objects can create an Internet of Things (Didio, 2015). Current technology developments have shown that Ashton's vision is right since most of technological products and devices have been implemented with Internet, either Ethernet or Wi-Fi, which open opportunities for IoT implementations. In IoT, devices having sensors can collect and exchange data with each other, study the behaviors of each other and provide real time data and notifications on different applications. The most successful and widespread application of IoT is smartphones. Nowadays, this common object can provide information about people's health, calculate how many kilometers the user walk per day, notice the user when to wake up and go to work, remind the user what the schedule is for today, and serve the user through voice control, etc. However, the application of IoT is not limited to the use of smartphones. Instead, IoT has a vast area of applications: smart cities, smart vehicles, smart grid and smart buildings. All these products can connect and speak to each other within the existed Internet environment.

1.2.2. Smart Home

With the growth of technology in recent years, the demand for a smart home increases due to the need of a house with safer security system, more sufficient in using energy and self-

sustainable. A smart home is where all the smart devices are connected through the central hub that creates an Internet environment for them to communicate and exchange information. Later in this paper, we will discuss what a central hub is and how it can create an IoT based environment to make a house smarter. Currently, a smart home only contains individual smart modules that make them smart, not a smart system as a whole. All these devices can be controlled remotely through a smartphone, or through a web based where all the appliances in the house are monitored. While the appearance of a smart home starts to get exposed to customers, the penetration rate of installing a smart home is still low due to some major concerns of awareness, security and values added. Although this promises a bright future for the smart home's market, it is also a challenge for smart home's companies to market their products and shape the experience of living in a smart home for customers.

Based on our research, a smart home has three main information flows: human flows, energy flows and information flows (Spoor, 2016). The human flows help the devices to learn about their user. For example, what time the user goes to work, what time the user gets home, how long the user spends sleeping or sitting in the living room, etc. All this information is categorized as the human flows. The energy flows show how the energy in the house is being used, how often the light turns on, how much energy is being used running the air-conditioner. The information flows detect the user's needs in daily life such as grocery, shopping list and notifications on many other applications. Next, we will discuss the basic applications of a smart home and how it can help to enhance people's lives.

1.3. Application of Smart Home

The following table describes basic applications of a smart home. Each application comes with an example of use case.

Applications	Use case
Take care of the house	Set up sensors to detect whether the house is occupied or vacant. Once the house is occupied, the lights turn on and the AC is ready to use, etc.
Reduce the consumption of energy	Smart thermostats that can calculate the difference between outside temperature and inside temperature so the temperature of the house can adjust, or all the AC is off when everybody is leaving the house.
Improve security system	Surveillance camera with motion sensor that can detect dangers from strangers, face recognition to detect strangers.
Fulfil user's needs	Notice the user when to do shopping on groceries, or control remotely through voice control system.
Entertainment purposes	Connected lights system and sound system with home theater.

2. Proposal

In this part, we will discuss the problem that the sponsor is facing when enter a customer-oriented business market. Base on the problem statement and the skills we have learned at WPI, the project goals are set to satisfy Siemens's requirements: benchmarking, marketing plan and business model. Among these requirements, Siemens hope that we can at least reach the first goal, which is benchmarking the differences between Siemens's portfolio and portfolio from other countries.

2.1. Problem Statement

Siemens Building Technology Division is focusing on Building Automation Systems (Heating, Ventilation and Air-conditioning-HVAC), Lightning Controls, Security Systems (CCTV, Access Control), Fire safety related business. The business is going quite successfully all over the world and Siemens becomes a big name in China. Currently, the focusing vertical market is office buildings, shopping malls, data centers, hotels, hospitals, infrastructures like metro, airport, arena, theatre, etc. However, to continue growing the business, Siemens is planning to attack on the customer-oriented business. As the company considers to enter the market for customer-oriented business, Siemens confronts some big challenges. Their portfolio is over-functional, complex which makes it complicated for the customer to use as well as to maintain the devices. Since the price of the products is quite high, the company is focusing on a Business-to-Business model (B2B) where they have partners or contractors to help them bring the products to end customers. Siemens also has a quite limited marketing plan. In this paper, we will provide our findings to help Siemens decide which business model would fit them the most.

2.2. Project Goals

Smart home is a growing business in China and in the world. Siemens is definitely one of the leading company in China for this market. However, their portfolio has some challenges in the technology aspects as well as the marketing aspects. For the first goal of this project, we will provide our researches to point out the gap between the China's smart home market and other markets in the world. Specifically, we will focus on the gap between China's market and Korea's market since Korea is one of the leading technology countries in Asia. The biggest company in Korea, Samsung, is renowned for manufacturing smart devices like Samsung smartphones or Samsung smart TVs. Recently, the company has a rumored of purchasing smart home startup SmartThings for $200 millions (Swisher, 2014). Therefore, comparing the two markets will help Siemens to have a better of what's going on in the smart home's market.

The second goals of this project would be a brief business plan for Siemens to enter the customer-oriented market. We will provide our findings about the customer behavior in China to figure out the current trend in China's smart home market. A SWOT analysis will also be provided to point out the strengths, weaknesses, opportunities and threats that Siemens will face while entering the market. Last but not least, a marketing plan will also be provided to help Siemens promote their products better.

3. Methodology

This part will explain the methods, research tools and our assumptions to reach the goals of the project. The first part will be an overview of the China's market for HVAC and smart control systems. We need to understand the customer's behaviors toward this market to determine the current trend of technology. This will be valuable for us to benchmark the

differences between China and foreign markets. Next, we will demonstrate a smart home system using AutoCAD.

3.1. Industrial Engineering Method

The team approaches the project goal by using Industrial Engineering methods. To identify the problem that the company faces, the team draw a fishbone diagram which shows all the causes and effects of the objectives. A SWOT analysis is also provided to identify the strength and weaknesses of the company. The team chose to do a SWOT analysis because it helps to create a possible business plan. This is more like a SWOT-action analysis. For example, using the strength of the company to diminish the weaknesses. Also, the opportunities that Siemens has can reduce the threats they face from other competitors.

Next, the current business model is mapped out to be analyzed. In order to deliver a new possible business plan, the team identifies all the causes mentioned in the SWOT analysis and the fishbone diagram.

3.2. Civil Engineering Methods

3.2.1. AutoCAD Design

AutoCAD is used primarily to design floor plans for any type of building and is the standard for most large companies in the United States. The floor plans will be designed to exemplify a typical suburban home, consisting of two levels. Once this is done, locations for implementing Siemens' smart home technology can be strategically placed, taking in consideration their most esteemed products.

3.2.2. Revit

Revit is used to model any building structure in three dimensions, incorporating materials and site plans surrounding the building. This also attests to be the most common three-dimensional building modeling software used in most large companies in the United States. Using the floor plans from the AutoCAD design, a Revit design can be created using the same dimensions and layout. Furthermore, the United States' national standards will be factored into the three-dimensional model for safety and design codes.

3.2.3. Efficiency/Cost Savings

The use of Siemens' smart home technology will enhance the daily efficiency of the power used in a home. This can provide a reduction in fossil fuels burned and be beneficial for the environment and society on both small and large scales. Consuming less energy, in turn, will provide cost savings per month on energy. From here, yearly annual savings can be estimated. After a certain amount of years, the products will be paid back in cost savings and can also be estimated.

3.3. Timeline
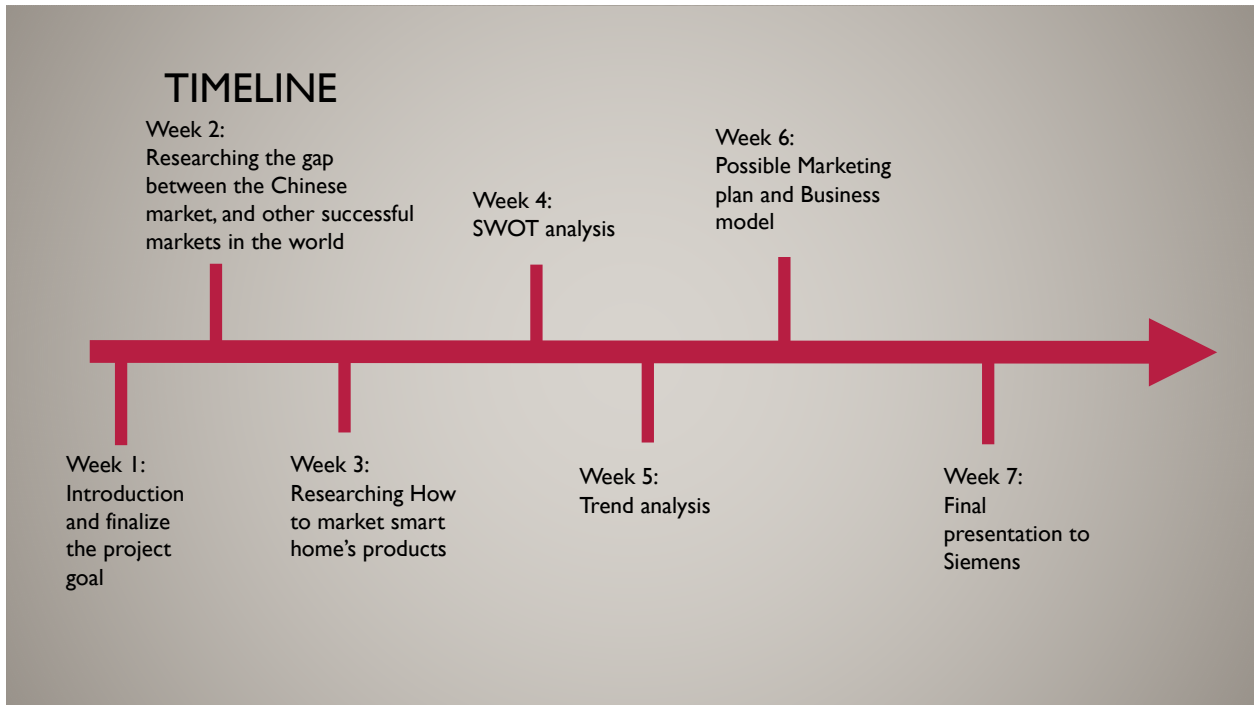
Figure 1. Timeline for Smart Home Project

In order to complete the project, the team created a first timeline when arrived in Beijing. In the first week, the team went to visit Siemens Beijing Building Automation department. Mr. Liu Yan, a products manager of the company and the advisor/instructor for this project, gave the team a tour in the showroom of the products. In the showroom, there are different types of control board, each has a new updated version. For example, the first model of control board is just a simple on/off button, the new model is a more complex control board, which has user interface allows controls over not just the HVAC, but also the blinds and shutters. After the visit, the team finalizes the project goal and makes project proposal. Due to the distance, and the schedule of Yan, the team has set up meeting 2 times per week, either at the company, or through skype and email. At the end of every milestone, the team gives Mr. Liu Yan a brief presentation of the results.

In the second week, the team researched on the first milestone –benchmarking the different between Chinese market and one of the leading countries in IoT technology, Korea. A presentation of the result is attached in the Appendix. In the third week, the team worked on methods to marketing smart home products. In week four, the team went to Siemens to meet with Mr. Liu Yan, who provides the strengths and weaknesses of Siemens in Chinese market. The team takes note and create a SWOT analysis. In the fifth week, the team looks back to the first milestone and gives out the trend of IoT technology in smart home. In week six, the team maps out the current business model, and provides a possible business plan. In week seven, the team goes to Siemens to give a final presentation of the project, suggesting the company to stick with the B2B business model.

4. An overview of Chinese market for HVAC and smart control systems

4.1.Chinese market

According to our research, China is one of the countries that has largest HVAC market in the world in term of the market value due to the terrain's size of the country which covers a lot of climate zones (Yu, 2014). Among this market, residential or room air conditioner, comprised about 65% of the expenditure (Yu, 2014). The chart below shows the market value for HVAC in China, which has a compound annual growth rate of 20%.
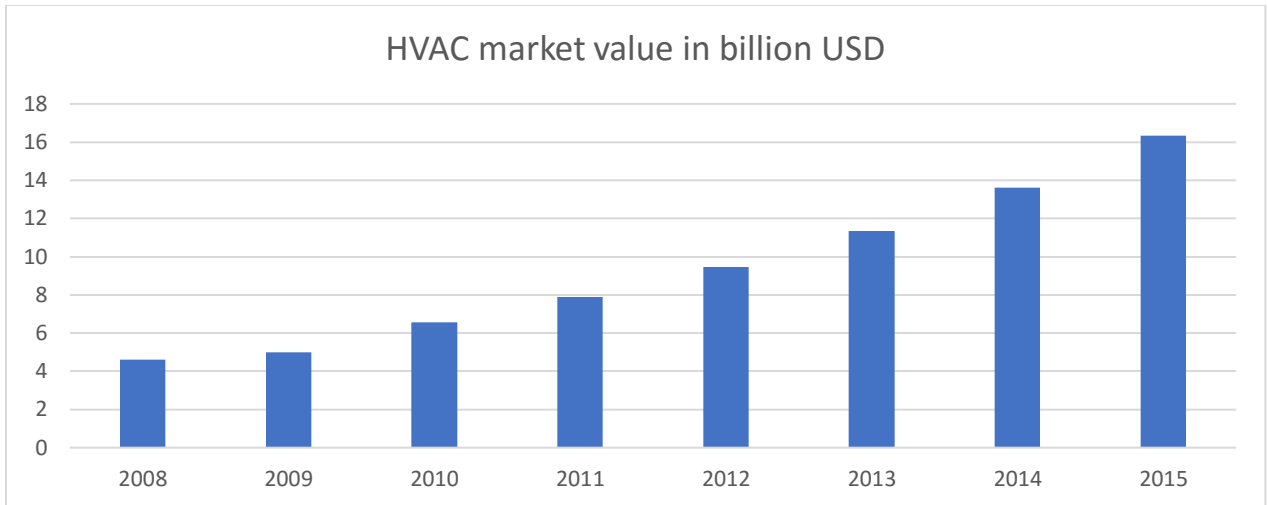
Figure 2. The growth of Chinese HVAC market

China is also the largest HVAC manufacturer in the world with 19 major air-conditioner brands, about 100 suppliers and over 9,500 different products models (Hoffman, 2016). The top manufacturers are Haier, Hisense, Chonghong and Midea, etc. The hi-end market for HVAC in China is driven by foreign companies with advanced technologies. Due to the government's promotion of energy efficient home appliances, high performance HVAC is now preferred by the customer. This opens up a huge opportunity for the HVAC market with smart controls. Control, or building automation system, is a centralize control with integrated networks built-ins software that allows users to monitor and control the system of HVAC. The use of building automation system can bring comfortable to users, as well and manage the energy use sufficiently. With enhanced technologies, the classic on/off controls are now evolved to monitor and remote control which has a friendlier interface.

Figure 3. User interface of a Siemens smart control

More than that, the control system now can help the users to analyze data, coordinate and control the temperature, humidity as well as air quality in each different room of the building easier. Many commercial buildings have installed a building automation system control to manage the energy better. For example, a large company with many rooms need to maintain a certain temperature for every room the whole day, a shopping mall that needs to make sure that the customers feel comfortable anywhere inside the mall, or simply a house that needs an easy control to satisfy the owners of the house, etc.

In the next part, we will provide an overview of the lightning market, and the important role of the building automation system in lightning controls.

Similar to the HVAC market, the lights, blinds and shutters market have also been change due to government's promotion of energy efficient. Again, the building automation control system plays an important role to manage the usage of lights, blinds and shutters sufficiently. For

example, a big company with many meeting rooms will need comfortable controls of the lights, blinds and shutters to make sure that the meetings are not affected by the time wasting turn off the lights or close the shutters. A big house would need a lightning control for the house in order to save energy easier, etc.

In fact, the graph below shows that the revenue for building automation system market in China has a compound annual growth rate of 13.7% in the past 5 years.
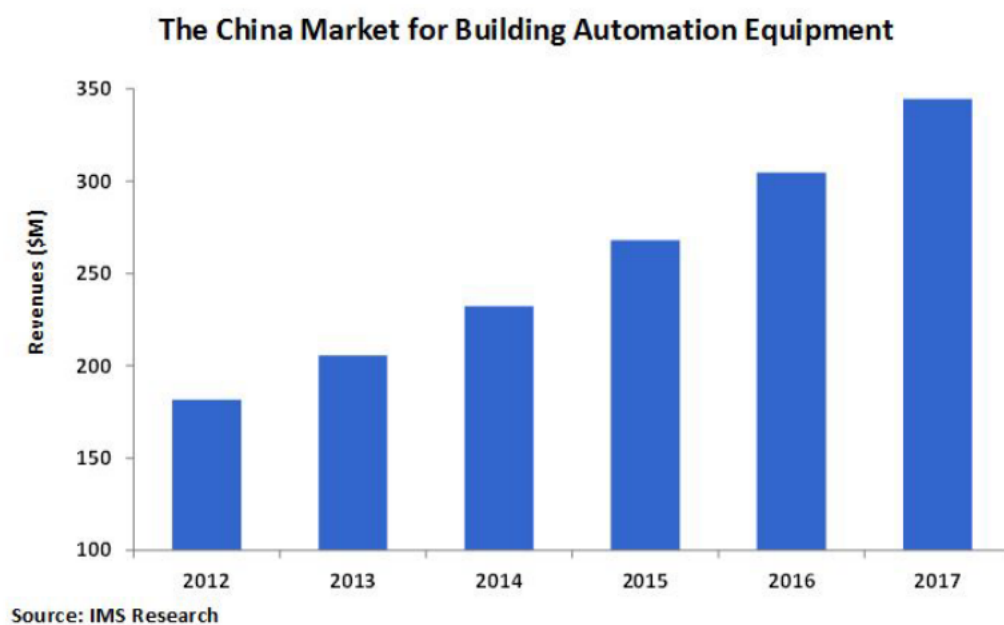
Figure 4. Revenue for China Market for Building Automation Equipment taken from IMS

In the next part, we will discuss the current adaptation as well as penetration of technology in China. Researching on this part would help to decide whether Internet of Things is the current trend in smart home technology in China.

With the rise of domestic technology companies, China is growing rapidly in technology, which brings noticeable changes in economics. Huawei has impressed the world when 40% of its 170,000 staff are working on pure research to create 5G internet around the whole China by 2020

(Dodwell, 2017). The growth in mobile technology changes Chinese people lives nowadays since QR code technology becomes widely used in daily life. People can pay almost everything with Alipay or Wechat pay, and can even get access to bike sharing, car service or other services without switching to another app. This opens up a large opportunity for tech developers to use a smartphone as a controlling device for the smart home system.

4.2. Differences between Chinese market and Korean market for smart home

In this part, we assume the common elements of a smart home as following: home automation, security, home entertainment, ambient assisted living and energy management.

4.2.1. Home Automation

Home Automation is the central control and communication units that process the smart home.
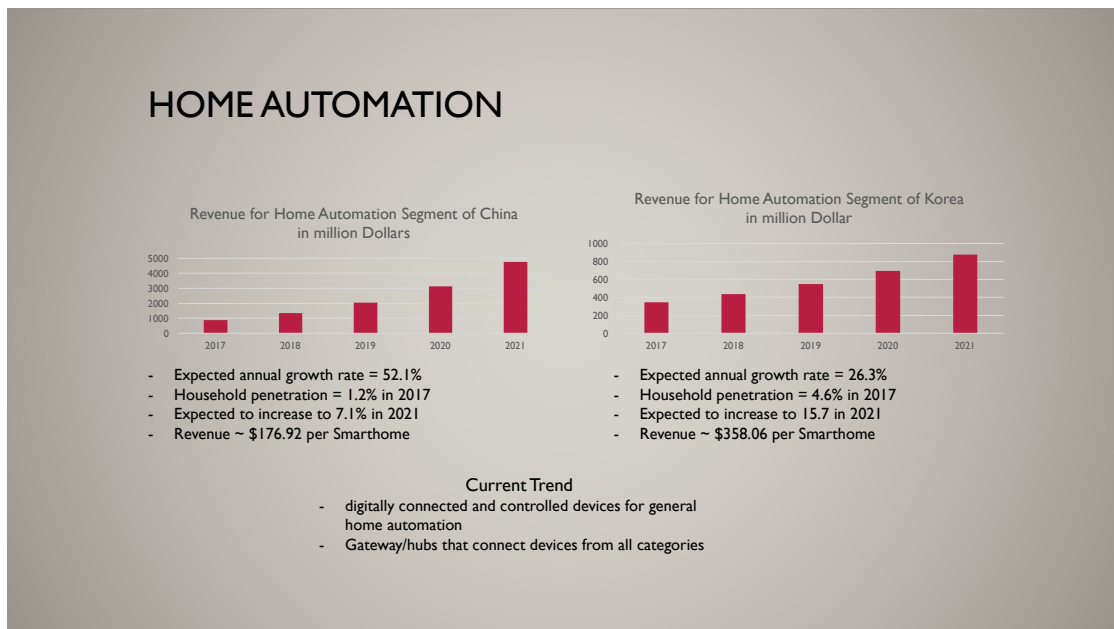
Figure 5. Benchmarking differences between China and Korea for Home Automation segment

The expected annual growth rate of Chinese market for this segment is about 52.7%, compares to 26.3% for Korean market. However, the penetration rate of Chinese household is only 1.2%, compare to 4.6% for Korean market. In the future, the penetration rate for China is expected to increase since the uses of technology continues to grow rapidly. The current trend for home automation technology includes a gateway or a control hub that can connect all the smart devices within the system.

4.2.2. Security

Security is one of the important elements in a smart home. However, it is also the reason holding customers back from buying a smart home. This segment includes the sale of devices and services for network access control and management.
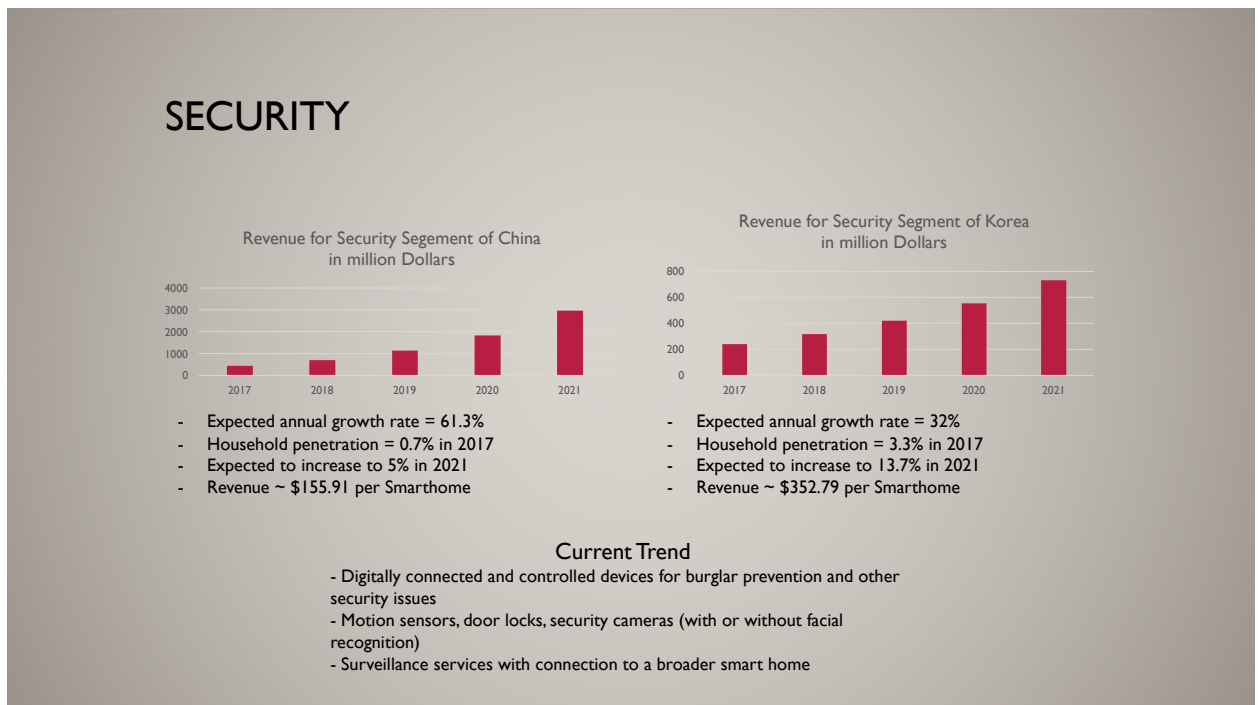
Figure 6. Benchmarking differences between China and Korea for Security segment

Again, we see the same trend with the home automation segment. The Chinese market is more potential despite the fact that the penetration rate is very low. This happens for a couple of reasons. The first reason is people do not feel the need of a smart security system. However, with raising awareness of residents, the use of surveillance security system will be widely spread. We can see the United States of America as an example, where "the emergence of new market entrants, such as telecommunications companies, is expected to increase end-user awareness of home management systems, which combine traditional home security products with innovative home automation technology" (Knott, 2013). In 2016, Asia is forecast to account for 68 percent of the installed base of security cameras, driven primarily by unit shipment growth in China (Jenkins, 2015).

4.2.3. Home Entertainment

The home entertainment segment includes the devices supporting entertainment in a smart home. Nowadays, it is easy to find a house with an entertainment system, including a television and a surrounding sound system. In a smart home, all this system should be connected to enhance to experience of entertaining.
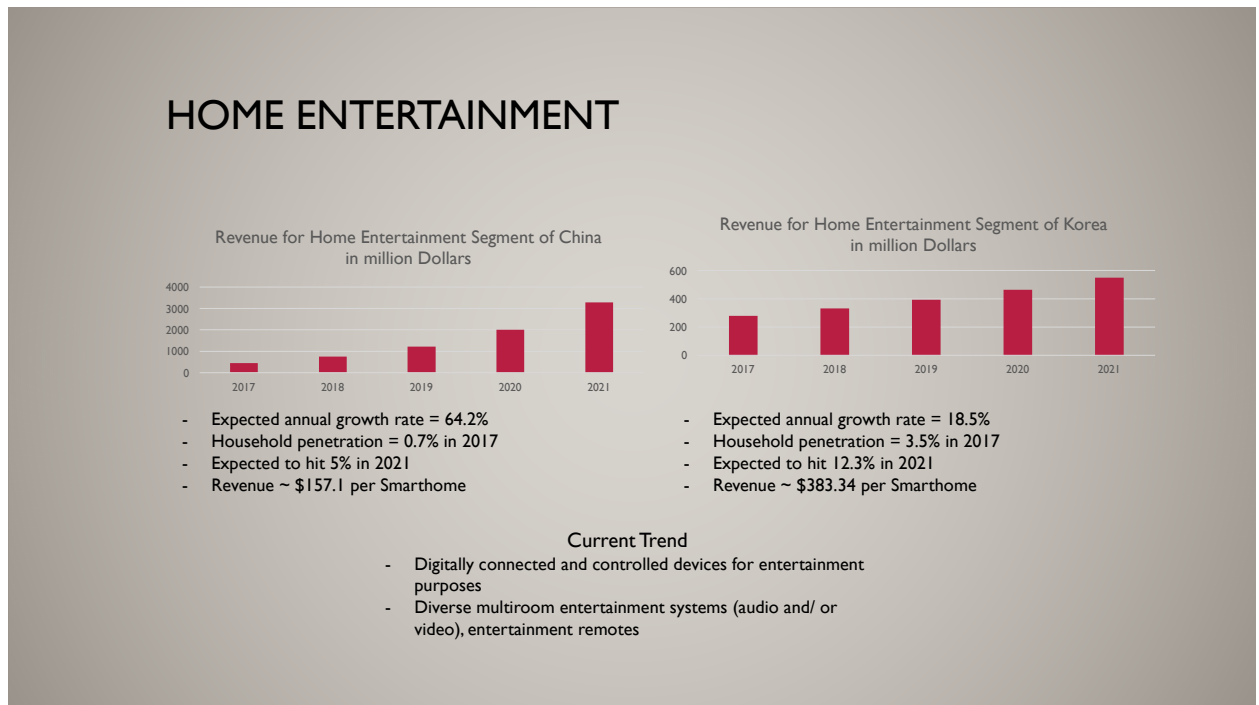
Figure 7. Benchmarking differences between China and Korea for Home Entertainment segment

4.2.4. Ambient Assisted Living

The Smart Home segment "Ambient Assisted Living" includes products and services for networked emergency alarms, accident detection (e.g. pressure mats), activity monitoring (by means of sensors) and comparable connected products that are aimed to support independent living for the elderly (Statisca, 2016). The most frequently used ambient assisted living nowadays is Siri or any other phone assistants. In fact, many smart home products have been released to the market like Amazon Echo, Google Home or Samsung SmartThings all have the ambient assisted living, where you can communicate to your home. In China, many cheaper options are available to replace the products. One of the leading company in this technology is Xiaomi. Xiaomi offers many smart home components to build a smart home.
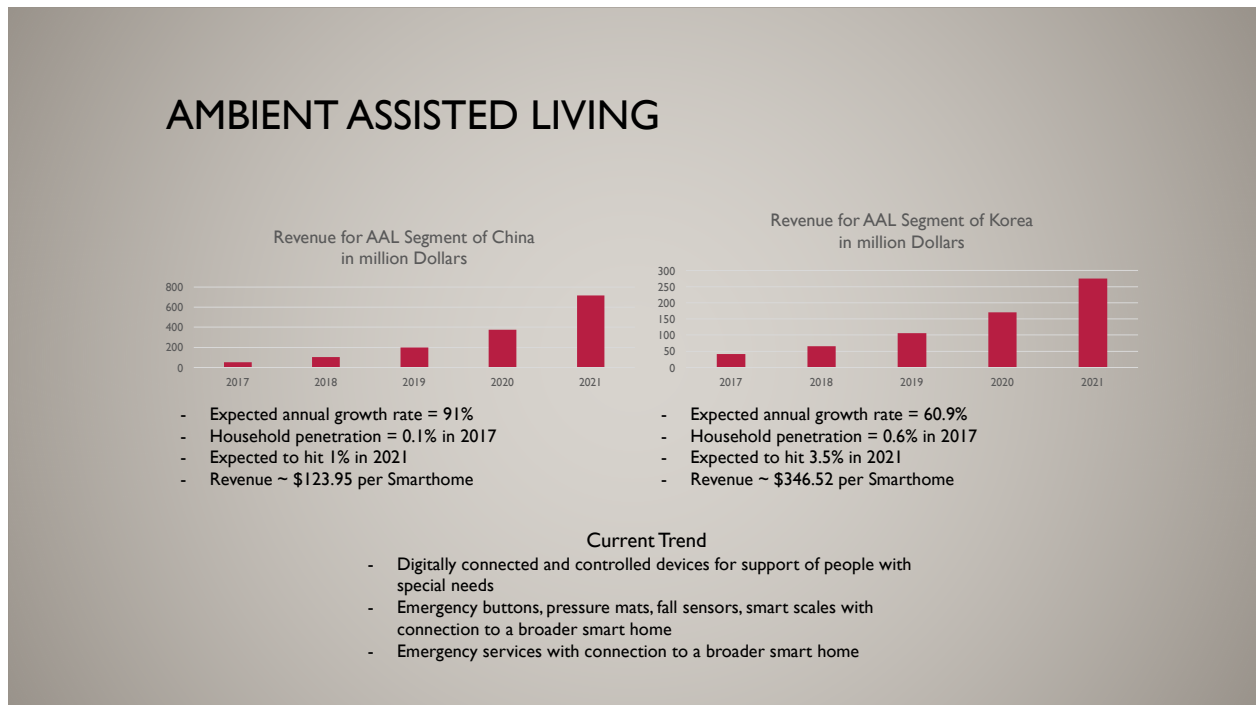
Figure 8. Benchmarking differences between China and Korea for Ambient Assisted Living segment

4.2.5. Energy Management

The Smart Home segment "Energy Management" contains the sale of products and services for the control, and reduction, of energy use (e.g. socket inserts, automated heating control, and timers) as well as connected sensors (e.g. temperature, sunlight, and precipitation sensors). The trend for this segment is a controlled and monitored process of energy management. For example, the amount of energy saved or energy saving mode will be showed on the monitor. Also, if worked with an ambient assisted living system, users can get daily weather forecast before getting out of house.

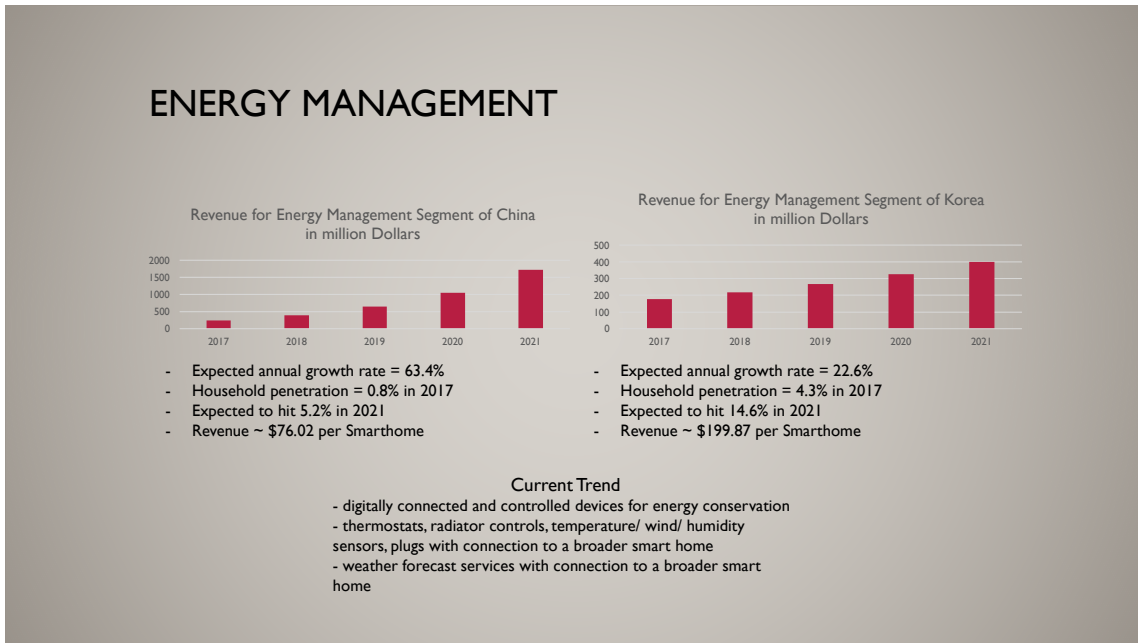*Figure 9. Benchmarking differences between China and Korea for Energy Management segment*

5. Results

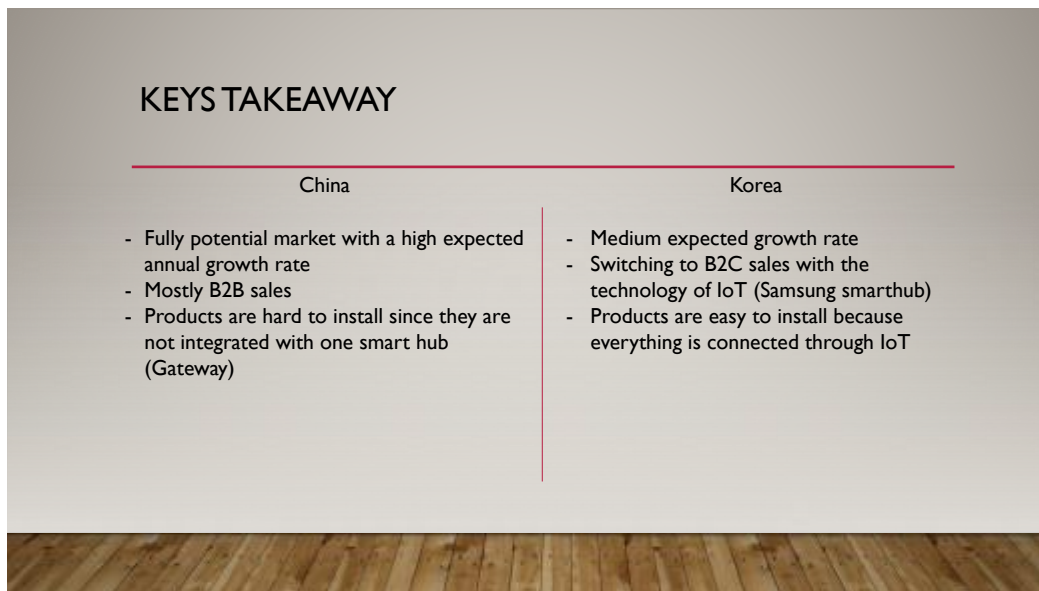### 5.1. Keys takeaway from benchmarking

Figure 10. Summary of the differences between Chinese and Korean market for smart home

Based on the research, the Chinese smart home market is closing the gap with the Korean market. Currently, Siemens smart home solution adopts a B2B business model. Since Siemens offers a smart system as a whole, rather than separated parts and components, the company only focuses on the target like commercial or big buildings in China. Many smart home products from Xiaomi such as surveillance camera, Xiaomi wifi, Xiaomi smart lights, etc. are offered at an affordable price. Like Samsung SmartThings, Xiaomi also develops a smart hub that can connect all of the devices together through Internet. The company uses a Z-wave connection to connect the devices. Z-wave product's manufacturing cost is not expensive, so the products are attractive toward a customers oriented business solution.

Also, in general, the penetration rate of smart products in Korea is higher than in China. Korea with Samsung, one of the leading companies in the world, has develop smart products long time ago. However, the differences in population between the two countries is quite large. Therefore, China is expected to be a potential market for smart products. Current studies have shown that China is the leading country in the field of machine learning, due to the amount of data generated every day. The adoption rate of IoT in China is increasing since many "cloud cities" created across China. This means that the internet can be faster, and more data can be transferred on the cloud. The fast-growing technology in China can help to increase the penetration rate of smart home products.

5.2. Siemens portfolio and current trend

In the beginning of the project, the sponsor gives us a video to describe the Siemens smart home concept. After doing researches on current trend of technology and watching Siemens video about smart home, the team comes up with some of the main points. The first point is that Siemens serves different targets from other companies adopting IoT technology. The

reason for this is Siemens provides a smart home solution as a whole, not individual smart elements of the house. This also the reason why the company is still using a B2B business model. Commercial buildings like offices and hospitals most likely to install the smart home concepts as a whole platform, instead of using different smart devices since the amount of data requires a larger bandwidth.

The second point we come up with is the technology Siemens using is not falling behind the trend. Instead, the technology that the company using, which is KNX connection, can be compatible with the current technology. KNX connection is also a solution preferred by large building since it provides a platform with high security.

In the next part, we will discuss about KNX technology and the pros and cons between KNX connection and other IoT connection (ZigBee and Z-wave).

5.2.1. ZigBee

ZigBee and Z-wave is both short-range wireless technologies used for remote monitoring and control. These two technologies are already widely used in home automation system (Rosencrance, 2017). However, the specifications and applications different.

ZigBee is a wireless network standard developed for remote control and sensor application. ZigBee was established in the late 1990s as an alternative to Wi-Fi and Bluetooth for some application. The technology is based on the Institute of Electrical and Electronics Engineers (IEEE) standards 802.15 protocol which defines the physical and MAC layers (Poole, n.d). It is low cost and low power consumption, which is suitable for sensors and battery-operated devices. However, ZigBee devices often have difficulty communicating with devices made by other manufacturers. Also, it is local area network, so it cannot directly connect devices to user without help of Ethernet or Wi-Fi.

Z-wave is another kind of wireless network standard developed for communication among devices used for home automation. It uses radio frequency for signaling and control the device. Z-wave operates 908.42 MHz in the US using mesh topology, which improves range, reliability, and provides less interference from Wi-Fi and other wireless technologies in the 2.4 GHz range such as Bluetooth and ZigBee. Z-wave have lower price range for the products. It supports full mesh networks and can control up to 232 devices (Sciacca, 2013). It also uses simple protocol which makes it faster to transfer data. Also, it consumes extremely low energy for operation. However, Z-wave has limited data rates to 100kbit/s.

ZigBee and Z-wave are both radio frequency home automation technologies. ZigBee and z-wave target the same general applications. Both technologies are interesting as they allow for battery-powered devices to be deployed wirelessly and run automatically for years without replacing the batteries. ZigBee is more versatile; therefore, it can be configured for any short-range wireless task. On the other hand, the protocol of ZigBee is far more complex, resulting in longer development time. Z-wave uses much simpler protocol; therefore, development time can be much shorter. However, Z-wave is more adopted internationally and has an average price of 50 USD for each sensors or actuators. ZigBee also have some penetration in the US, is now becoming interesting due to vendors like SmartThings, but still doesn't have as many vendors as Z-wave and as the standard is only for lower level communication many ZigBee products are not compatible among each other.

5.2.2. KNX

KNX is an international standard for intelligent building and automation. It has been around world for more than 20 years and now offers more than 10000 KNX approved products manufactured by around 300 companies (Fry, 2013). KNX is a well adopted standard for

building automation using a specific communication wire. KNX is complex and expensive, mostly used in business. The KNX standard can be used to integrate wide range of control applications, including lighting, HVAC, blinds, solar control, hot water heating control, automatic window control, energy management and control, metering, monitoring applications and visualization. Combining this complex technology with and easy user interface, KNX installations offers simple visualization, monitoring and control to make energy used more efficiently. KNX is more suitable for bigger business for example automation for buildings, hotels, hospitals etc.

The system does not operate from a central unit, which means that other parts have freedom to work on their own. This leads to the advantage that if one unit falls, other units can still operate normally without relying on that broken unit since each unit is a smart unit itself. As KNX certified products must follow EN-50941 (HBES/BACS) which has requirements for various safety areas: electrical safety, environmental safety, functional safety, EMC (electromagnetic compatibility), reliability, and performance, KNX products are extremely secured and guarantee the best performance (Smart Home..More, 2017).

5.3. SWOT analysis
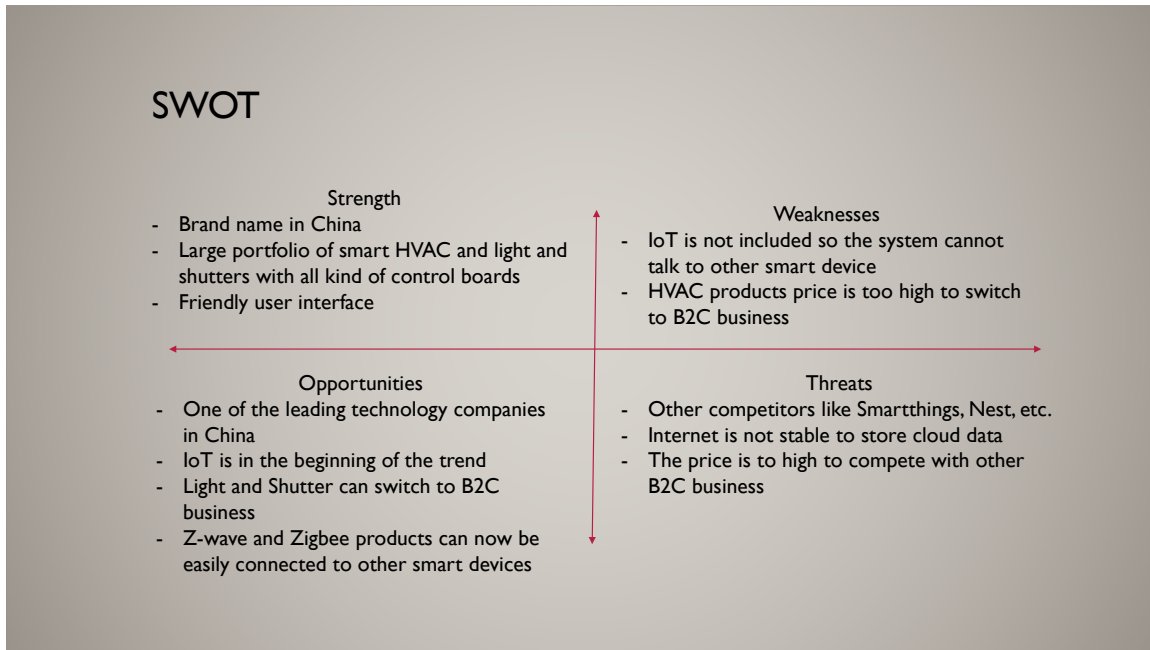
Figure 11. SWOT analysis for Siemens in smart home market

The advantage for Siemens is the popularity of the company in China and in the world. The newest development shows that Siemens offers a large portfolio on HVAC system and controls for the smart system with a friendly user interface. Another group of WPI students are doing a project on designing the interface of a smart control board. Also, the company is one of the best IT companies in the world. Last year, a KNX-city was started in Singapore. The vision of the company is set on building technology.

However, the company has some weaknesses. The technology they are using is only connected through Ethernet. This gives a larger bandwidth to transfer the data; however, IoT is not included so the machines cannot talk to each other. However, each element in the system is already smart itself. The company cannot develop the B2C business model since the products are over complex and the price is high. One method to rid of this weakness is keep focusing on the

larger market for commercial buildings since the company has proved that their solution fits in large buildings like hotels, hospitals, etc.

The company has a lot of opportunities to develop the smart home solution since IoT is only in the beginning of the trend. Z-wave and ZigBee connected products are not usually compatible with each other. KNX is building the KNX-IOT which can solve the problem above. The technology is being used by Siemens to develop smart cities. Base on the price and the simplicity of products, Siemens light and shutter system can switch to a B2C business through online ordering. The company should focus on making the control board that can control all the lights and HVAC within the system. In other words, the control board can be a hub itself.

The threats of the company come from other competitors from B2C markets. Companies like Xiaomi and Huawei are mostly selling small smart home products like smart cam, smart locks, and smart lights. However, the sale of those products is impressive.

6. Recommendations

6.1.How to market smart home

Since people do not have much interactions with smart home products in China, the company should focus on how to market their smart home solution to customer. In this case, the company should still keep their focuses on the commercial buildings. The three main problems for marketing are identified as: awareness, concerns, and value evaluation.

Mostly, people have not heard of smart home products and they don't know how they can help them with their daily life. However, with the growth of media, and increasing adoption rate of new technology, the problem will be solved in the near future. In fact, many of the products

from Xiaomi or Huawei have successfully exported to foreign countries. Xiaomi products are a better option for countries around China where the technology has not picked up the pace yet.

People who already knows about the products have other concerns. Currently, there is no standard of how a smart home should work. The company should show the customers how to work with smart home products and how they can enhance daily life, not just in a single use case. In order to do that, the team suggests Siemens to make the showroom available for the customers to visit and get a better idea of the smart home solution. For people who feel like they don't need a smart home product in their house, the company should not focus too much on this segment.

6.2.Business Plan

6.2.1. Current business model

Current Business Model

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITIONS	CUSTOMER RELATIONSHIPS	CUSTOMER SEGMENTS
- Contractors who help to promote and bring Siemens products to end customers	- R&D - Manufacture Smart Controls	- Providing smart control for big buildings - Energy sufficient, safe and secure	- Limited promotion and customer services	- Real estates, hospitals, shopping malls, hotels, data centers, etc.
	KEY RESOURCES - Talented engineers to develop new products		**CHANNELS** - Distribute through contractors - Online platform	

COST STRUCTURE	REVENUE STREAMS
- Cost of Manufacturing - Marketing and Sales	- Sales to contractors - Online sales

Figure 12. Current Business Model of Siemens

The current business model for the building automation segment of Siemens is mostly a B2B business model. The customer segments of the company are mostly commercial buildings like real estates, hospitals, shopping malls, hotels and data centers, etc. In order to reach out to these customer segments, Siemens Beijing has partnership with contractors who help to promote and bring Siemens products to the end customers. The key activities in this plan is the manufacturing of smart controls, as well and review and improve the products. Siemens has

talented engineers who can help the company to develop and enhance the new products. These products provide smart control over the HVAC system, as well as the blinds and shutters for big commercial building. The portfolio also provides a solution for energy sufficient, safe and secured system of smart home.

In this model, the revenue comes from sales to contractors who will sell the products to the end users. The company also sells small controllers through online order. These controllers are small and easy to install. Revenue from the online segment is going quite well, which means that the process is in stable state. The cost structure only includes cost of manufacturing, marketing and sales plan. The current model is good and suitable with the company's goal. However, the team offers a possible business plan, which enhance the relationship between the company and the customer. In the next part, we will present the new plan.

6.2.2. Suggested business model

New Business Plan

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITIONS	CUSTOMER RELATIONSHIPS	CUSTOMER SEGMENTS
- Contractors who help to promote and bring Siemens products to end customers - Customers who have used Siemens automation system before	- R&D - Manufacture Smart Controls - Provide Smart Home services, recommendation - Analyze customer's feedbacks	- Providing smart control for big buildings - Energy sufficient, safe and secure - Customizable control to fulfill customer's needs - Open data exchange via KNX bus, irrespective of suppliers	- Limited promotion and customer services - Advertisement video - Recommendation of installation for customers - Monthly or yearly maintenance for membership	- Real estates, hospitals, shopping malls, hotels, data centers, etc. - People moving to new houses - New buildings in China
	KEY RESOURCES - Talented engineers to develop new products - Server system for HomeControl App		**CHANNELS** - Distribute through contractors - Online platform - Direct sales to customer segments	

COST STRUCTURE	REVENUE STREAMS
- Cost of Manufacturing - Marketing and Sales	- Sales to contractors - Online sales - Application platform on smartphones - Membership subscription

Figure 13. Suggested new business plan for Siemens

This new business plan is developed from the current business plan. Since from last part, the team suggests that Siemens Beijing should keep focusing on the market for large commercial buildings, this new business plan is created to cover the missing customer segments from the previous B2B business model. The advantage of this business plan is it takes in account the customers who have used the service from Siemens Beijing before.

Therefore, the team believes that customers who have used Siemens automation system before should become one of the key customers. In addition to current activities in the company, the team suggests that the company should give customers the choice to customize their smart

home. This makes sense because Siemens provides the smart home solutions as the whole system, not just individual element. Siemens also should take customer's feedbacks periodically. These feedbacks would be helpful for the company as Siemens can analyze the feedbacks to see what the customers like about the smart system, or which part needs to be improved. Because of this activity, Siemens now has another value proposition, which is to fulfill customer's needs with a customizable control. In the future, when the KNX-IoT technology develops, the company can also open data exchange through KNX bus, irrespective of suppliers, which means that the system can connect devices from other brands too.

In the original business plan, Siemens has limited promotion and customer service, which is a weakness in customer relationship. The team suggests Siemens to promote the walk-through video of the portfolio. This will help the customers to get a better sense of what a smart home system looks like. The company should send engineers to recommend the customers what they need in a system. With this step, Siemens should also provide quarterly or annually maintenance for the customers who subscribe to Siemens maintenance program. For the segment of newcomers to Beijing, or new buildings built, the company can apply direct sales to those customers, who are in seek of a system for their new houses. The company should also run a server for the Home Control App on smartphones, which can control the smart system anytime, anywhere. The revenue stream now can come from the membership subscription, and the online platform for Home Control App.
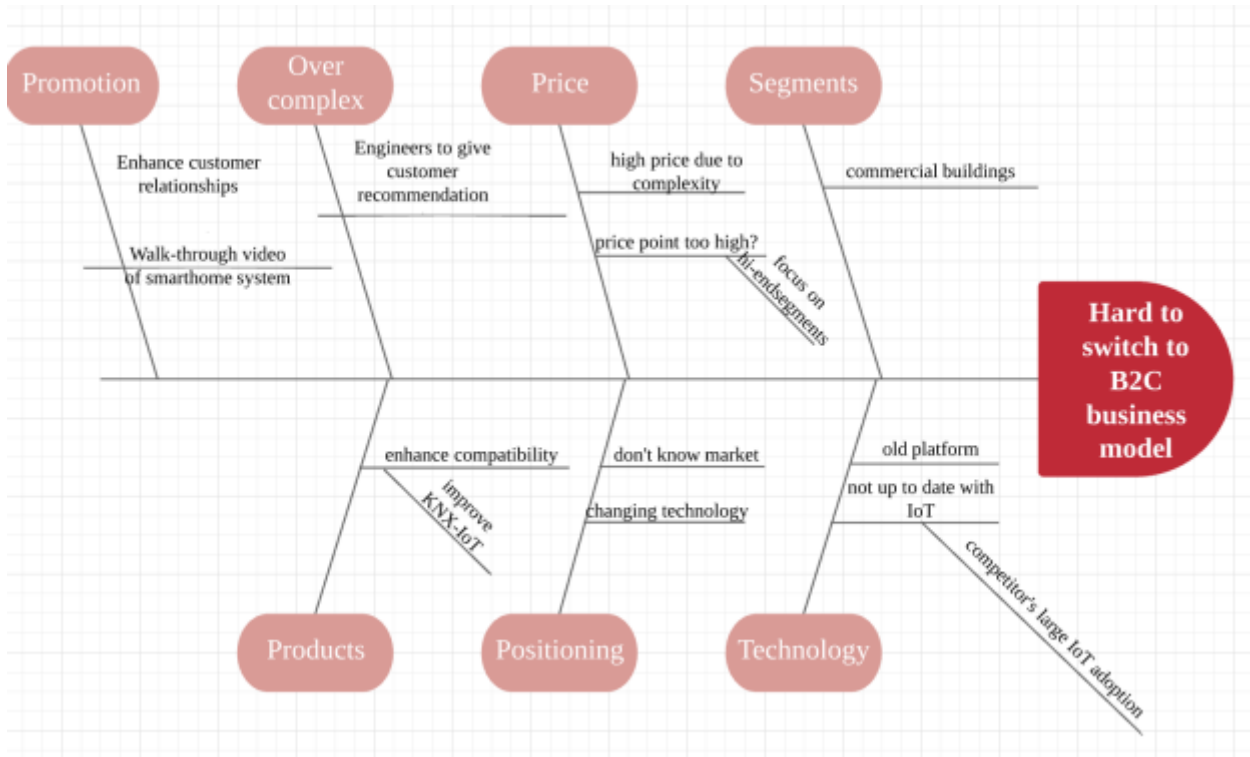
6.3.Fishbone diagram

Figure 14. Fishbone Diagram for causes and effects of the objective

This fishbone diagram shows the main problem the company is facing now, which is hard to switch to a customers oriented platform. The team identifies six causes for this problem: promotion, over complexity, price, segments, products, positioning and technology.

The first cause is that the company has limited promotion on the smart home system. The problem can be solved by enhancing customer relationship. A walk-through video also should be provided to raise awareness for customers. Second, the system is over complex as stated in the problem statement. Since the price is too high, the customer segment of Siemens mainly focuses on commercial buildings. As explained before, this B2B business plan is suitable for the company, so the team does not suggest the company to change the platform. Siemens has a large

opportunity to enhance the compatibility of the products. KNX-IoT technology allows all the devices connected to KNX bus connect to other IoT platform too. Also, Siemens does not have experience in the customer oriented platform and the technology is changing, so IoT is just in the beginning of trend. The next part which includes the possible business plan will explain these causes and effects in more details.

7. Design

In this section, the design process for creating a smart home will be discussed and prepared with the use of common computer software packages. Also, the benefit to the consumer will be analyzed through energy and cost savings over a period of time.

7.1.Initial AutoCAD

To begin this design process, it is necessary to know the specifications of a home that is already built. For this AutoCAD design, a suburban home was measured in Long Island, New York for proper guidelines. The home was first dimensioned from the exterior walls in order to begin the external layout on AutoCAD. Using the general dimensions for both external wall thickness (10 inches) and internal wall thickness (5 inches), the frame of the structure was created for both the first floor and basement floor. Next the interior rooms of the home were measured and thus creating the interior partitions within each floor. The final step in the AutoCAD design was measuring the locations and dimensions of all windows, doors, and stairs. These features were created into blocks on AutoCAD and placed at the locations specified by the exemplary building. The results from dimensioning and implementation are shown in the figures below of both the first-floor plan, then the basement floor plan.
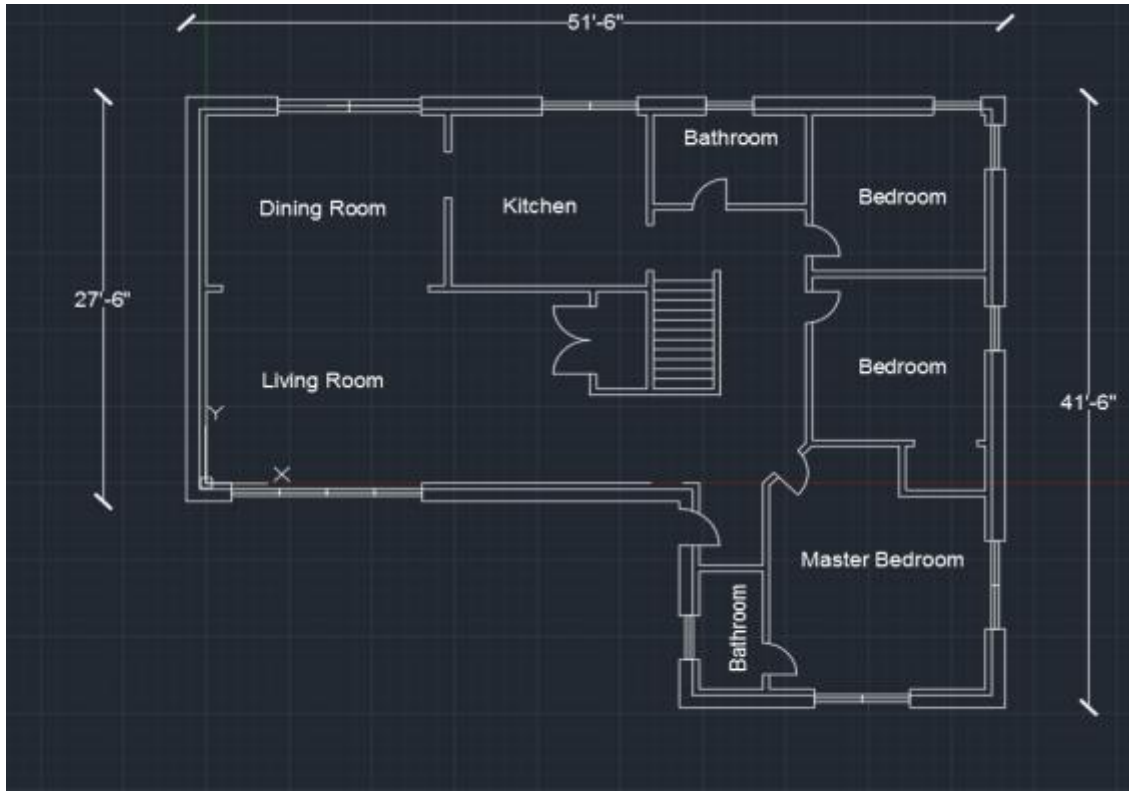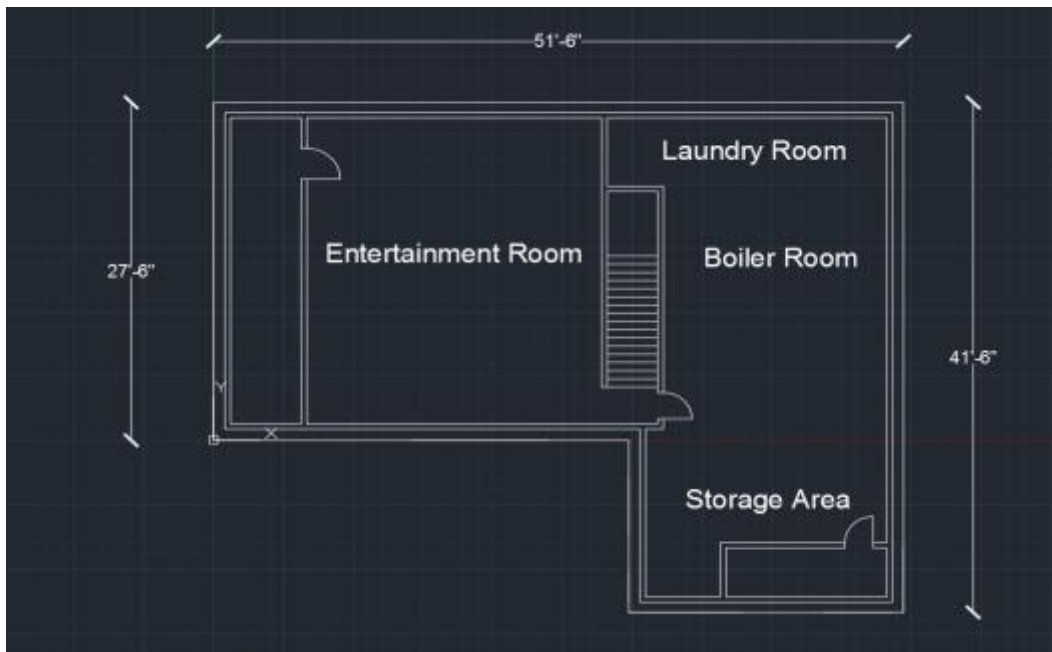
Figure 15. AutoCAD First Floor Plan

Figure 16. AutoCAD Basement Floor Plan

The following steps on AutoCAD are to simulate potential locations of Siemens' smart home technology. When analyzing the different types of home automation and security devices that Siemens can potentially offer to their customers, it was clear which categories of devices should be applied to the AutoCAD floors plans. In the figures below, the types of devices are clearly labeled into three separate entities; home automation devices (as green squares), security cameras (as red circles), and smart locks (as yellow circles), all which are connected to the Internet of Things within the house. This can represent a good visualization for customers and show how easy implementing smart home devices can be in any household.

Figure 17. AutoCAD First Floor Plan with Devices

Figure 18. AutoCAD Basement Floor Plan with Devices

7.1.1. Cost Calculation

In this initial design, there are a total of three home automation devices, four security cameras, and six smart locks. Each home automation device is around $700 in the United States, the security cameras are around $200 each, and the smart locks are about $50 per unit. The total cost for these devices adds up to be around $3,200 for the devices alone. The design will be reconsidered to save money by removing some devices.
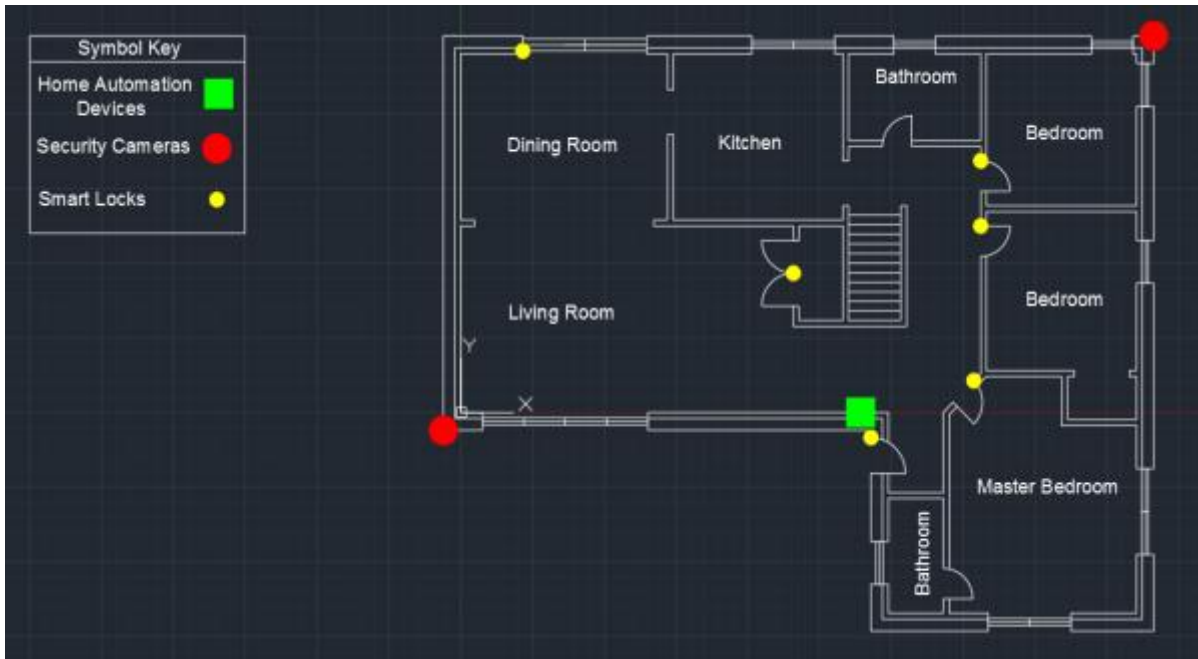
7.2.Final AutoCAD Design

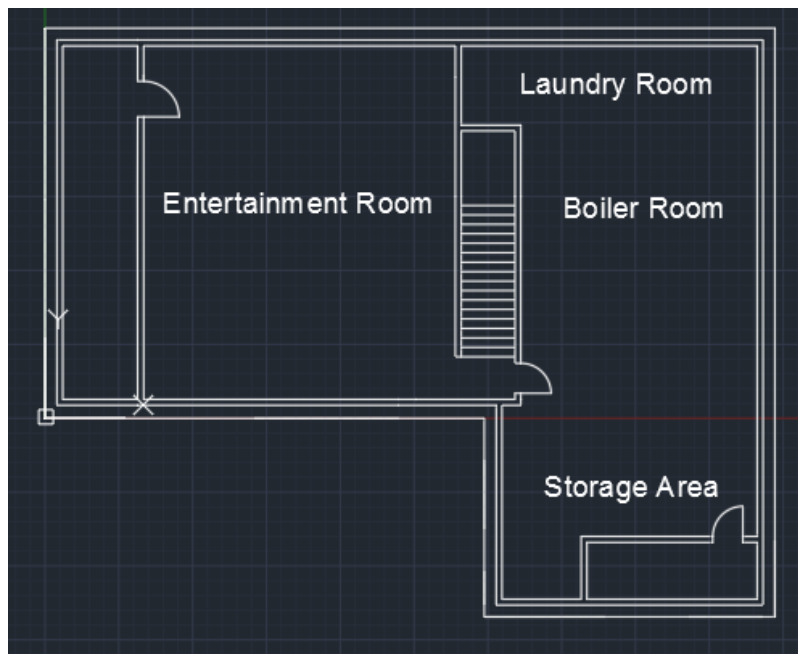*Figure 19. First AutoCAD floor plant design*

Figure 20. Floor plan

From the first design, there seemed to be extra, unneeded devices. Two security cameras were removed from the first-floor plans in order to save money. From the two security cameras that are still in place in the final design, the same area is covered for security. Also, one home automation device was removed for the same reasoning. For the basement floor plans, the one home automation device was deemed unnecessary as well. Only one of these devices are needed per household because these controls can be accessed through the phone application anywhere in the house.

7.2.1. Final Cost Calculation

Now that some devices have been removed, a new cost estimate is needed. In the final design, we have a total of one home automation device, two security cameras, and still six smart locks. The final estimated cost is around $1,400. From this new design, $1,800 is saved and the same necessary functions are present.

Through research, it was found that the average smart home can save up to 15% on utility bills each year. This is equivalent to around $150 of savings every year. From this, the devices will pay for themselves in less than 10 years. Although this may not be a persuadable selling point, the option for a smart home can also save up to 15% on gas emissions and electrical usage. Each home that implements these devices is one step closer to a smart city and will decrease the negative impact on the environment.

7.3. Revit

The next step in the design process for turning a common home into a smart home rendering was to transfer the AutoCAD drawing files of the two floors plans into a Revit file. From here, the process of creating a three-dimensional representation can begin.

Revit has several default settings for wall construction. In order to achieve the correct structural properties, starting with the Generic 8" wall is ideal. From here, the structure needs to be a total of 10 inches, as specified from the AutoCAD design, as well as changing the layers of the wall construction. For this home, from interior to exterior, the structure is composed of 1" of cherry wood, 1/32" of an air filtration barrier, 1" plywood sheathing, 6" of wood studs, ½" of vapor retarder, 1" of gypsum wallboard, and 15/32" of clapboard siding for a total of 10 inches. The figure below shows the material property design by layer for the exterior walls for the first floor.

Figure 21. Interior side dimensions

For the exterior walls of the basement floor, a generic 10-inch concrete design is sufficient. The figure below shows the material property design for the exterior walls of the basement level.

Figure 22. Material Layers for Ext Walls for Basement

For the interior walls, Revit has a default setting for standard interior partition and finishing. The interior wall structure is a follows; a 2 ½" metal stud between two 1 ¼" of gypsum wall board layers. The figure below shows the material property design for the interior walls throughout both levels of the building.

Figure 23. Material Layers for Interior Walls

For the flooring design, both the first floor and basement floor are the same. The floor structure is as follows; ¾" of oak flooring finish stacked on top of ¾" plywood, then finally 9 ¼" of concrete. The figure below shows the material property design for the flooring for both levels of the building.

	Function	Material	Thickness	Wraps	Structural Material	Variable
1	Finish 1 [4]	Oak Floorin	0' 0 3/4"	☐	☐	☐
2	**Core Bounda**	**Layers Above**	**0' 0"**			
3	Structure [1]	Plywood, S	0' 0 3/4"	☐	☐	☐
4	Structure [1]	Concrete, C	0' 9 1/4"	☐	☑	☐
5	**Core Bounda**	**Layers Below**	**0' 0"**			

Insert	Delete	Up	Down

Figure 24. Material Layers for Flooring

After the exterior and interior walls and flooring design are established and executed, the interior floor plans of each level are in focus. By using the predesigned elements in Revit, windows, doors, and furniture can be added to the floor plans on the Revit file. The windows and doors are placed as specified in the AutoCAD file. Then the furniture is placed using the same predesigned elements in Revit. The type of furniture and location is approximated based on the actual interior of the exemplary building.

Once this is finished, the ceiling for each level can be put into place. The ceilings for both levels is consistent and is designed as being 1 5/8" of plywood, finished with 5/8" acoustic ceiling. The figure below shows the material properties of the ceilings throughout the building.

Figure 25. Material Layers for Ceilings

Now that the floor plans are designed and finalized they can be placed into a standard title block for 11"x17" horizontal printing paper for presentation and distribution. The title block template was edited to have Siemens' company name and other necessary items for completion. The two figures below show the concluded floor plans for the first floor and basement floor respectively, including all designs for exterior and interior walls, floorings, door, windows, furniture, and ceilings.
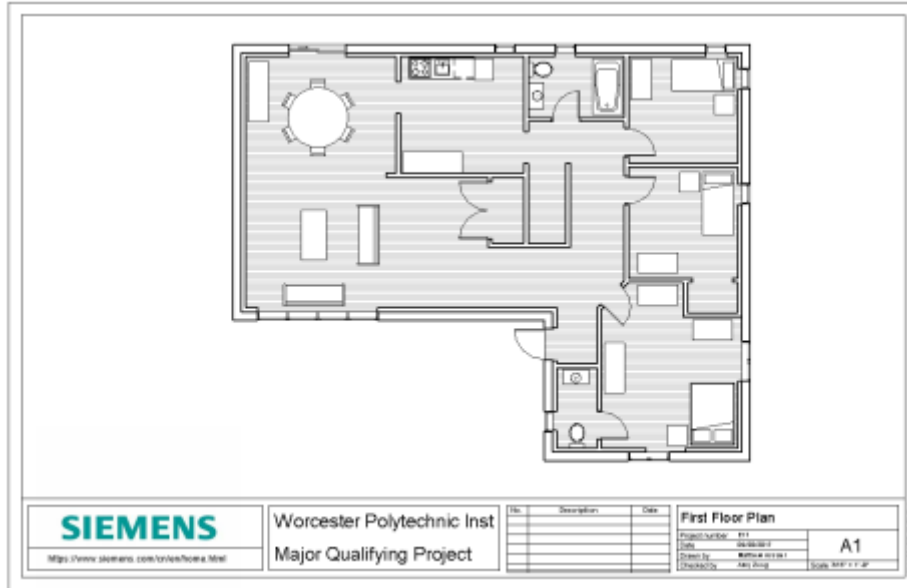
Figure 26. Revit First Floor Plan
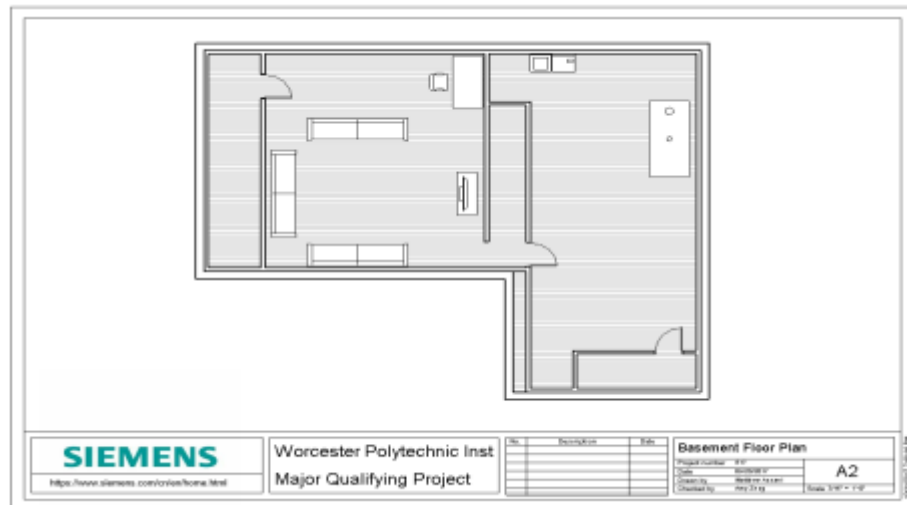
Figure 27. Basement Floor Plan

The final stage of structural design needed now is the foundation level. The foundation level begins 4 feet below the basement level and extends to the basement floor to support the buildings weight within the soil. The foundation level consists of 5 blocks of concrete 3'x3' in length and width, with a height of 4'.
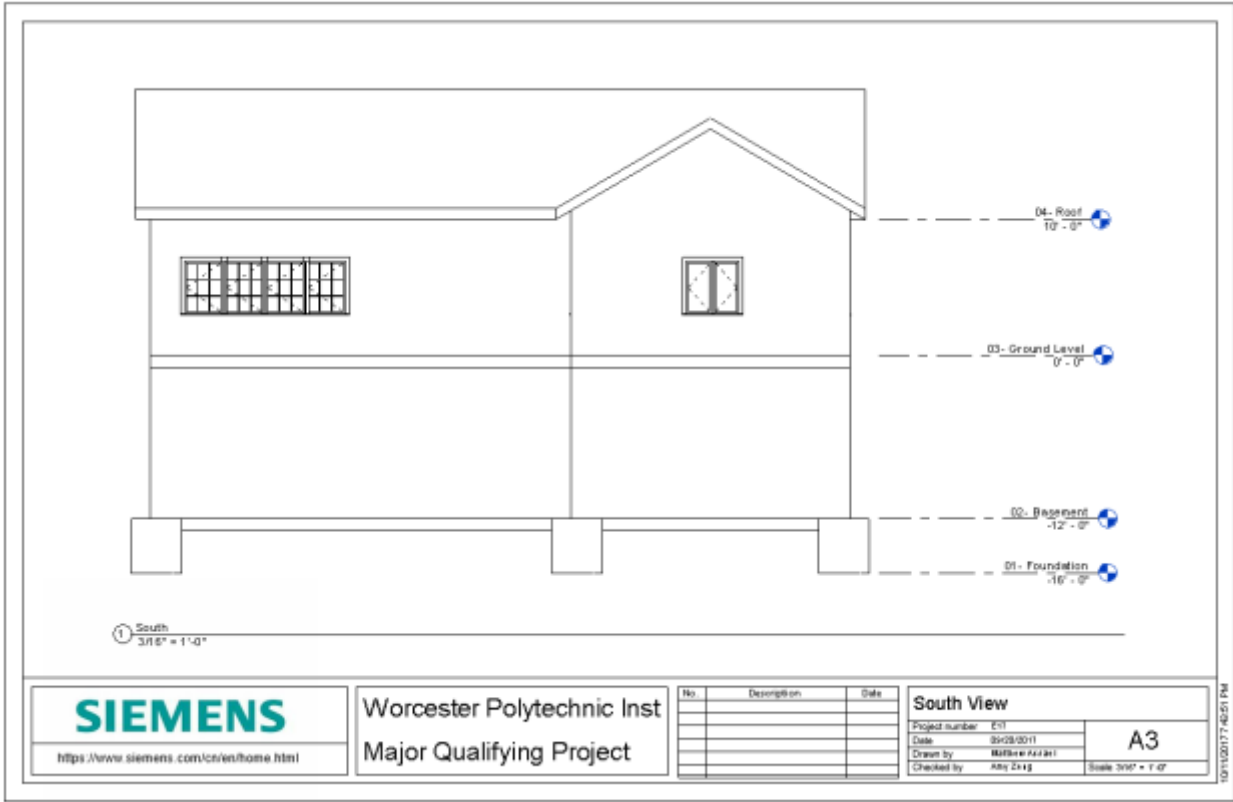
Figure 28. Revit 3D Model, South View
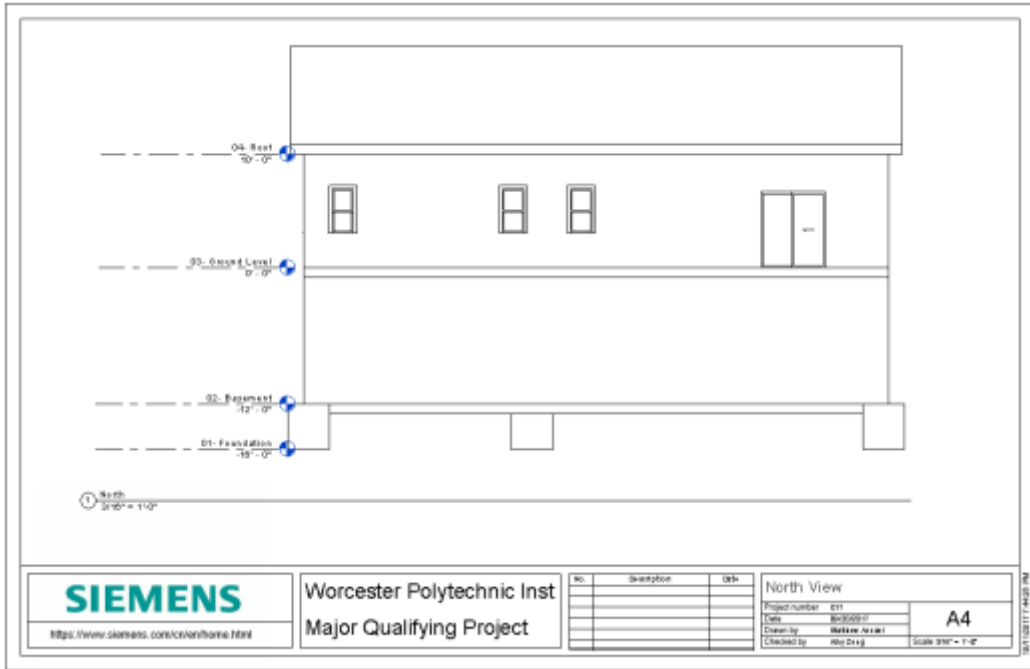
Figure 29. Revit 3D Model, North View
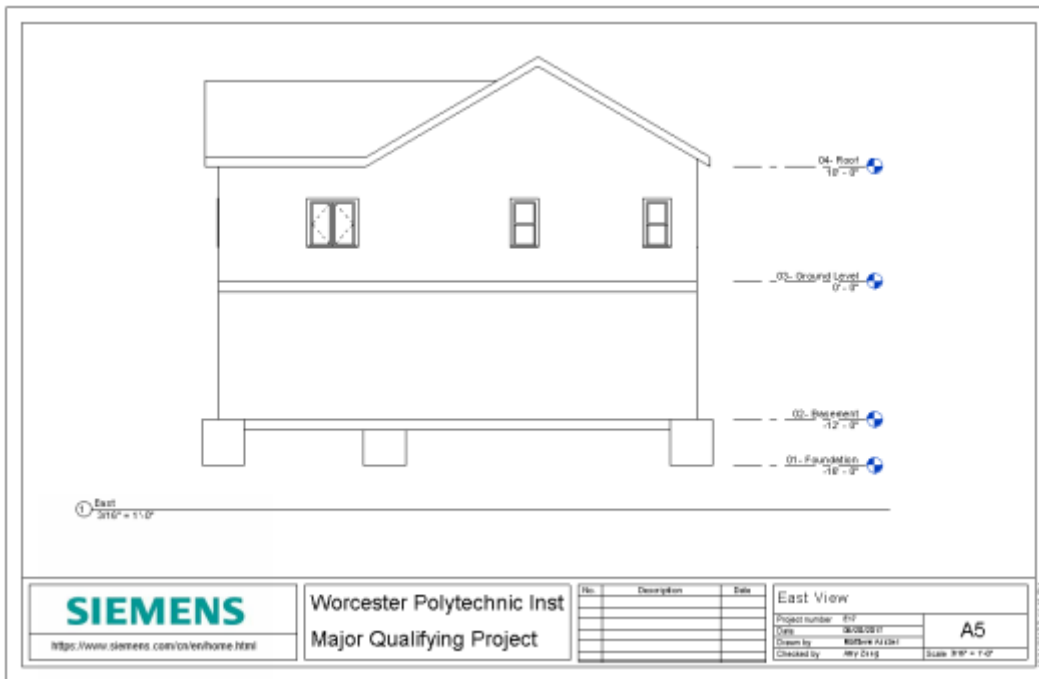
Figure 30. Revit 3D Model, East View
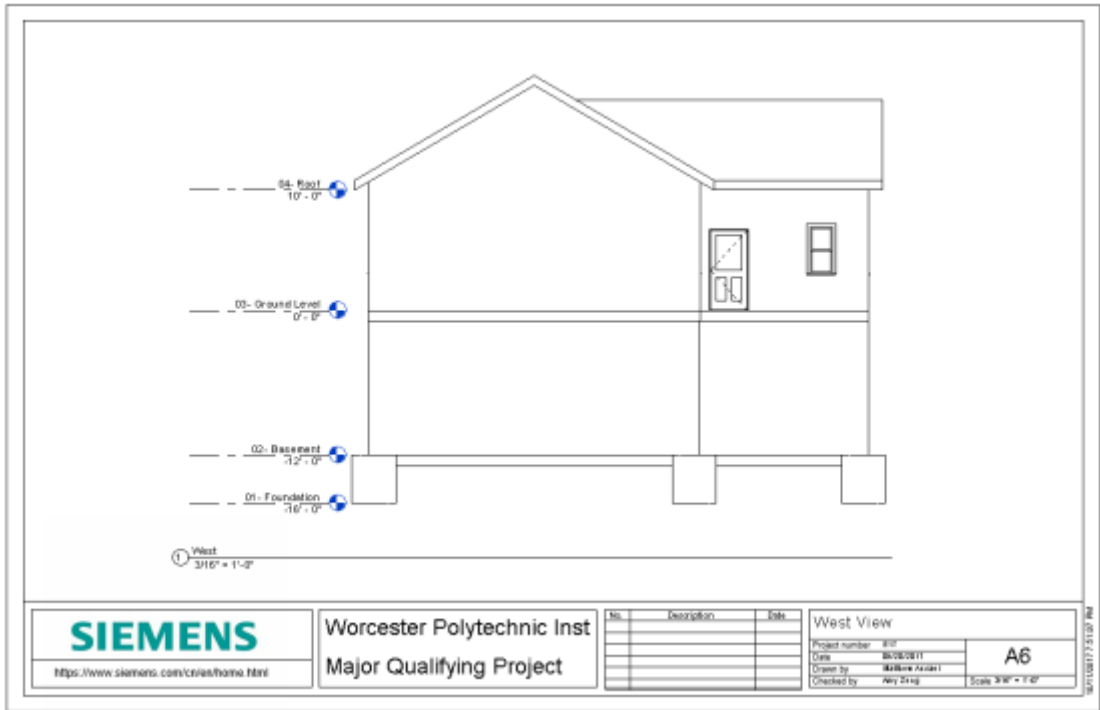
Figure 31. Revit 3D Model, West View

Figure 32. Revit 3D Rendering

8. Conclusion

8.1.Recommendation for Future Projects

With the growth of the industry, a lot of new ideas and new projects can be generated since smart home is already a big market. From this project, the company now has understandings about the trend of modern technologies in a smart home. However, we recommend future students from WPI to come and work at this aspect of the project again, because the technology is changing every day. Earlier in this paper, we discussed the limitations of current market for smart home. The other limitation that is not considered in this project is people's worries about security. The future projects should work on this aspect since people's awareness about AI and machine learning are rising. With this in mind, it is necessary to understand that Siemens products are building solutions for commercial buildings since the company's portfolio focuses on developing the cloud data within the building itself, not a shared cloud of data with other buildings.

8.2. Discussion of the Design

For this project, there are two main designs: the feasible business model, and the feasible floor plan design.

In order to come up with a feasible business model, many analyzing techniques have been used. Most of them are Industrial Engineering techniques. First, the team benchmarked the differences between the current solution from Siemens, and other solutions from foreign companies to determine where the current solution stands in the market. Then, a SWOT analysis was provided to point out the general weaknesses and opportunities of the current solution. The SWOT analysis was used to create a SWOT-actions analysis which gives the main problems

keeping the company from achieving the goal. We took these problems to create a fishbone diagram to see the reasons for these problems and offered possible solutions. The current business model is mapped out. The team focused on the factors that are non-value added in the value proposition section of the business model and pointed out the problems mentioned in the fishbone diagram. The team then discussed with the sponsor about the possible solutions for the current model, and finalized the decisions. The new feasible business model takes all the possible solutions generated from the fishbone diagram.

8.3.Constraints

This project requires a large amount of literature review and researches on the market. Before going to Beijing, the team did intensive reviews on what IoT is and how it is implemented in a smart home system. The main problem the team faces is the lack of understandings in Chinese market. Due to the government regulations, some of the research tools are not accessible, thus make the progress of researching longer. Also, some of the information is confidential such as the cost basis of the products, so the team faces some obstacles to do the original project goals, which is to provide an optimization method to enhance the business plan.

Although all the team members, and the sponsor are from different countries, the team does not see language as a big problem. The communication between the team and the sponsor was in good shape. In total, there are four presentations delivered to the sponsor. All are combined into a final presentation attached in the appendix. The distance between the company and the hotel prevent the team to visit Siemens often.

8.4.Learning Experiences

This project gives the team a big opportunity to work with one of the greatest company in the field of technology. The project also allows the team to work in a new environment. Most of the team member have an internship in a different country before, so working in China gives us a lot experiences. The team gains a lot of experiences on work ethics and project management. Working on this project teaches us a lot of lessons about how to work in a real-life project. The first lesson the team takes away is how to make milestones timeline and method to deliver the milestone results to the sponsor. Mr. Liu Yan has taught the team how to give a professional presentation of the results to the sponsor. The project also inspires the team to continue learning about the adoption of IoT technology in building automation. Ideas about the current technology and developments motivates the team to invest time researching the subject. Besides the project, the team also has the chance to explore the culture of China.

8.4.1. Nguyen's learnings

From the project, the team also had the chance to learn about how to work across disciplines. Each member learned about different aspects of this. For me, I have learned a lot about leadership from Mr. Liu Yan. Yan always gives the team the freedom to generate ideas without being biased toward his perspective. I have learned that everyone should be the leader in the team to control the flow of the project. Other than creating the milestones for the sponsor, I also created smaller milestones for each team member in order to follow the timeline. Throughout the project, I have learned how to keep the team motivated when difficulties are faced. This project gives me the chance to experiment what I have studied in Industrial Engineer courses.

8.4.2. Won Ik's learnings

After the project, I have learned a lot about responsibilities from the sponsor and my teammates. Each of the member faced obstacles to achieve the first few milestones of the project, but I'm glad that we were able to remove those obstacles. When one does not finish his/her own milestone, the whole team progress will be slowed down. I learned a lot from one of the team members about how to control the progress of the project. Whenever one of the team member fails to finish his milestone, the team would meet and solve the problem together. This not only gives me the chance to get to know my teammates better, but also gives me the opportunities to learn about our professions too. I have seen a lot of these concepts from my classes, but have not used them in a real-life project before.

8.4.3. Matt's learnings

Before this project, I did not really know how to apply the techniques I have learned from classes to a real-life problem. After the project, I have learned how to break down the process: understand the problem, brainstorm possible solutions, execute the solutions, get feedbacks from other team members, and finalize the solution. I feel like I understand more clearly why I took the classes in the coursework. A lot of concepts from this project were proven in my project management classes. This project is really valuable for me in term of the experience I had working in a different country, with teammates from different professions.

8.5. Interdisciplinary Aspect

We realize that the topic for this project is broad, and it covers many fields of profession. In this specific topic, Industrial Engineering techniques and Civil Engineering techniques are blended together to give out the final result. The industrial engineering students analyze the

model and offer possible business solution. The civil engineering student takes the analysis from the industrial engineering students and creates an AutoCAD design to map out the solution visually. We believe that more disciplines from other professions will help to enhance the outcome of the project. For example, another team of mechanical engineering students also work with the sponsor. Their job was to create the interface of the smart controls. If this part is also included in this project, the reader will have a better idea on the information technology aspect of the project.

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Appendix

First Presentation

This presentation was presented at Siemens Beijing in front of the representative from the sponsor, Liu Yan. The presentation covers the analyzing phase of the project, which includes literature review, benchmarking the differences between the Korean Market and the Chinese Market, and the analysis of the current solution.

Analysis of Trend In China's Smart Home Market
Wonik Chang, Nguyen Le, Matthew Assael

WPI · **SIEMENS** *Ingenuity for life*

Problem Statement

- Siemens Beijing holds a portfolio in high-technology HVAC and Light/Shutter control, however the portfolio does not seem to match the demand in China. Therefore, the company is considering switching from a B2B business to a B2C business.
- Our analysis will determine which business model would help Siemens to earn the most profit.
- The method used will predict the trend in demand of customers, as well as the cost-benefit analysis of the two business models.

Current Conditions and Demand

- Currently, the focusing vertical market is office buildings, shopping malls, data center, hotels, hospitals, infrastructures like metro, airport, arena, theatre for environment comfort control fire safety and security related business.
- Also, Siemens Beijing is selling products to third party (contractors), instead of directly to end-customers. Therefore, the final price to end-customers is really high.
- The questions now are should they include new technologies to the products to make them more stand out, and what the business plan looks like if they want to switch to B2C.

Demand for Smarthome in Hundred Thousands of Yuan

Goal

- To find a business plan that would fit Siemens the most
- To point out the gaps between Siemens's products and American smarthome's products

Analysis

- The problem-analysis tool used will be cost-benefit analysis, excel solver and market research.

Proposal

- To construct a profit analysis of current sales of Siemens, and forecast the sales of Siemens if they switch to the customer-oriented business model.

Plan

- The data needed to do analysis:
  - The cost of making the products
  - The sales price, and sale volume of the products
  - Other competitions of Siemens on the field
- With this method:
  - Figure out which products from Siemens are most profitable, so Siemens can focus on the products
  - Target customers based on the current competitive market
- A brief research on the gap between American products and Siemens products will also be provided.
- Excel Solver will determined the optimized sales of the forecasting business model.

Alternatives and Scenarios

- The analysis will point out which business model (B2B or customer-oriented) would more likely to optimize the sales of Siemens.
- An alternative is to point out the gap between the current Siemens products and other competitors in the market of China, then decide if the company should include new technologies to improve the products and what risks they will confront when those technologies are added.

ELEMENTS OF SMARTHOME MARKET

- Home Automation
- Security
- Home Entertainment
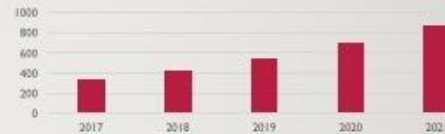- Ambient Assisted Living
- Energy Management

HOME AUTOMATION

Revenue for Home Automation Segment of China
in million Dollars

Revenue for Home Automation Segment of Korea
in million Dollar

- Expected annual growth rate = 52.1%
- Household penetration = 1.2% in 2017
- Expected to increase to 7.1% in 2021
- Revenue ~ $176.92 per Smarthome

- Expected annual growth rate = 26.3%
- Household penetration = 4.6% in 2017
- Expected to increase to 15.7 in 2021
- Revenue ~ $358.06 per Smarthome

Current Trend
- digitally connected and controlled devices for general home automation
- Gateway/hubs that connect devices from all categories

SECURITY

Revenue for Security Segement of China
in million Dollars

Revenue for Security Segment of Korea
in million Dollars

- Expected annual growth rate = 61.3%
- Household penetration = 0.7% in 2017
- Expected to increase to 5% in 2021
- Revenue ~ $155.91 per Smarthome
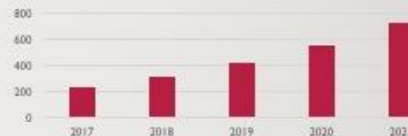
- Expected annual growth rate = 32%
- Household penetration = 3.3% in 2017
- Expected to increase to 13.7% in 2021
- Revenue ~ $352.79 per Smarthome

Current Trend
- Digitally connected and controlled devices for burglar prevention and other security issues
- Motion sensors, door locks, security cameras (with or without facial recognition)
- Surveillance services with connection to a broader smart home

HOME ENTERTAINMENT

Revenue for Home Entertainment Segment of China in million Dollars

Revenue for Home Entertainment Segment of Korea in million Dollars

- Expected annual growth rate = 64.2%
- Household penetration = 0.7% in 2017
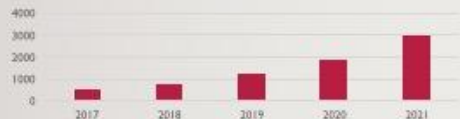- Expected to hit 5% in 2021
- Revenue ~ $157.1 per Smarthome

- Expected annual growth rate = 18.5%
- Household penetration = 3.5% in 2017
- Expected to hit 12.3% in 2021
- Revenue ~ $383.34 per Smarthome

Current Trend
- Digitally connected and controlled devices for entertainment purposes
- Diverse multiroom entertainment systems (audio and/ or video), entertainment remotes

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AMBIENT ASSISTED LIVING

Revenue for AAL Segment of China in million Dollars
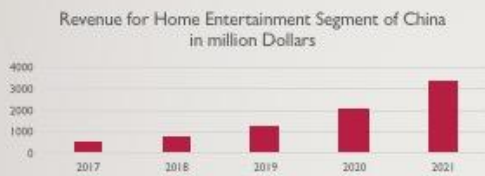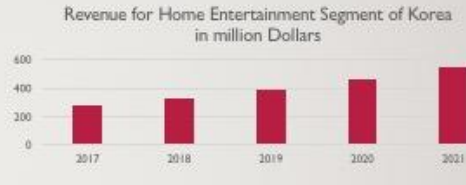
Revenue for AAL Segment of Korea in million Dollars

- Expected annual growth rate = 91%
- Household penetration = 0.1% in 2017
- Expected to hit 1% in 2021
- Revenue ~ $123.95 per Smarthome

- Expected annual growth rate = 60.9%
- Household penetration = 0.6% in 2017
- Expected to hit 3.5% in 2021
- Revenue ~ $346.52 per Smarthome

Current Trend
- Digitally connected and controlled devices for support of people with special needs
- Emergency buttons, pressure mats, fall sensors, smart scales with connection to a broader smart home
- Emergency services with connection to a broader smart home

ENERGY MANAGEMENT

Revenue for Energy Management Segment of China in million Dollars

Revenue for Energy Management Segment of Korea in million Dollars

- Expected annual growth rate = 63.4%
- Household penetration = 0.8% in 2017
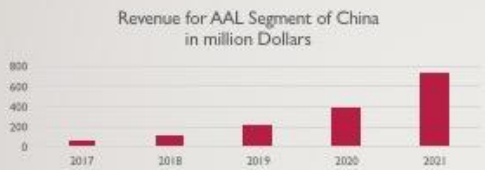- Expected to hit 5.2% in 2021
- Revenue ~ $76.02 per Smarthome

- Expected annual growth rate = 22.6%
- Household penetration = 4.3% in 2017
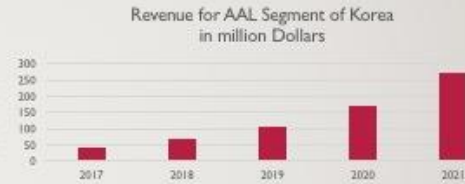- Expected to hit 14.6% in 2021
- Revenue ~ $199.87 per Smarthome

Current Trend
- digitally connected and controlled devices for energy conservation
- thermostats, radiator controls, temperature/ wind/ humidity sensors, plugs with connection to a broader smart home
- weather forecast services with connection to a broader smart home

KEYS TAKEAWAY

China

- Fully potential market with a high expected annual growth rate
- Mostly B2B sales
- Products are hard to install since they are not integrated with one smart hub (Gateway)

Korea

- Medium expected growth rate
- Switching to B2C sales with the technology of IoT (Samsung smarthub)
- Products are easy to install because everything is connected through IoT

POPULAR PRODUCTS IN THE USA

Nest Cam IQ: £299, Nest

Nest Learning Thermostat: £279, Nest

Amazon Echo: £149.99, Amazon

MARKETING DIFFICULTIES

- 3 main problems
- Awareness
- Consumer concerns
- Value evaluation

CREATING VALUE FOR SMART PRODUCTS

- What the experience can be, not what the experience should be!

SWOT

Strength
- Brand name in China
- Large portfolio of smart HVAC and light and shutters with all kind of control boards
- Friendly user interface

Weaknesses
- IoT is not included so the system cannot talk to other smart device
- HVAC products price is too high to switch to B2C business

Opportunities
- One of the leading technology companies in China
- IoT is in the beginning of the trend
- Light and Shutter can switch to B2C business
- Z-wave and Zigbee products can now be easily connected to other smart devices

Threats
- Other competitors like Smartthings, Nest, etc.
- Internet is not stable to store cloud data
- The price is to high to compete with other B2C business

POSSIBLE SOLUTION

- Enhance the controlling by smart phones

- Sell smaller smart products within the portfolio

- Create a video on how to install light and shutter portfolio

TIMELINE

Week 2:
Researching the gap between the Chinese market, and other successful markets in the world

Week 4:
SWOT analysis

Week 6:
Possible Marketing plan and Business model

Week 1:
Introduction and finalize the project goal

Week 3:
Researching How to market smart home's products

Week 5:
Trend analysis

Week 7:
Final presentation to Siemens
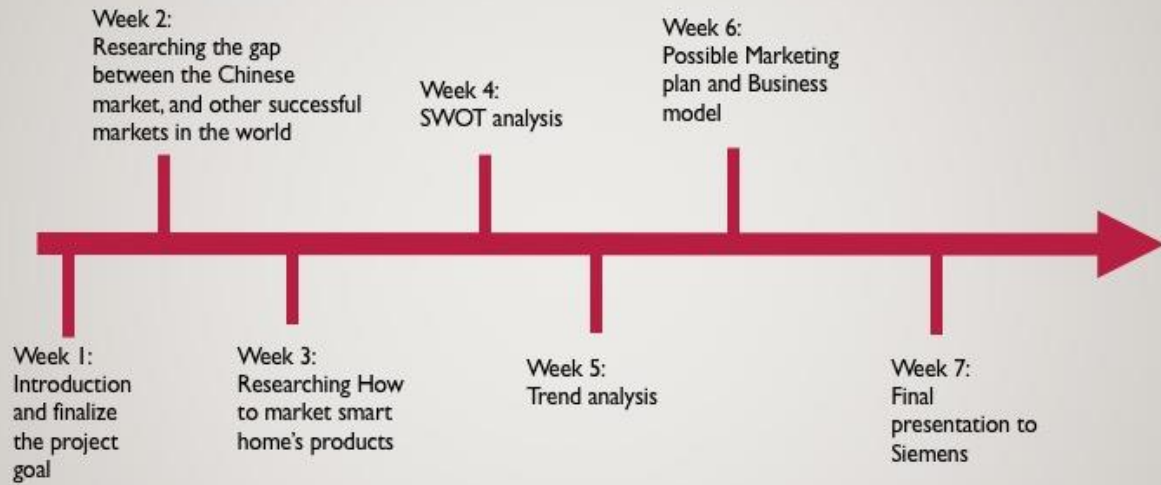
PLAN FOR NEXT WEEK

- Research on customer behavior in China
- Business and marketing plan
- Continue writing our report

Final Presentation

   The final presentation was presented at the company in front of Mr. Liu Yan. This

presentation includes the marketing and business plan for the current portfolio.

SIEMENS

MARKETING AND BUSINESS PLAN FOR SMART CONTROLS

Nguyen Le, Wonik Chang, Matthew Assael

Quick Overview of Findings

- Literature reviews of the gap between China's market and Korea's market
- Marketing difficulties
- Current Business Model

Differences in market

China

- Fully potential market with a high expected annual growth rate
- Low penetration rate
- Z-wave IoT connection is in the beginning of trend

Korea

- Medium expected growth rate but a much more mature market
- Higher penetration rate
- Z-wave IoT connection is already in trend

Marketing Difficulties

- 3 main problems:
  - Awareness
  - Consumer concerns
  - Value evaluation

Creating value for smart products

- What the experience can be, not what the experience should be!

Current Business Model

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITIONS	CUSTOMER RELATIONSHIPS	CUSTOMER SEGMENTS
- Contractors who help to promote and bring Siemens products to end customers	- R&D - Manufacture Smart Controls	- Providing smart control for big buildings - Energy sufficient, safe and secure	- Limited promotion and customer services	- Real estates, hospitals, shopping malls, hotels, data centers, etc.
	KEY RESOURCES - Talented engineers to develop new products		**CHANNELS** - Distribute through contractors - Online platform	

COST STRUCTURE	REVENUE STREAMS
- Cost of Manufacturing - Marketing and Sales	- Sales to contractors - Online sales

Focused Products

- Room Automation with KNX
- Home Automation with Synco living.

Consumer's Needs

Table 1. Ownership of surveyed household appliances per 100 households (2012)

Item (Unit)	Full sample	Urban	Rural
Refrigerator	101.10	101.14	100.92
Washing machine	102.17	102.23	101.90
TV	122.32	123.16	118.86
PC	131.02	133.60	106.74
AC	179.23	186.06	128.83
Water heater	109.71	110.71	102.90

Source: http://aceee.org/files/proceedings/2016/data/papers/9_76.pdf

Opportunities

Satisfaction of space heating and space cooling from customers

Source:
http://www.sciencedirect.com/science/article/pii/S037877881631533X#bib0110
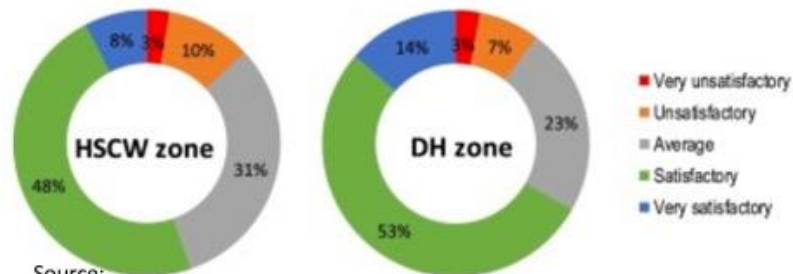
Value Proposition

- Easily integrated to optimally meet customer's needs
- Flexibility to adding components
- Energy efficiency
- Letting customer knows how much energy they are using on the HomeControl App
- Green Leaf symbol to show energy saving mode.

KNX vs. Zigbee and Z-wave

- Z-wave:
  - Low-bandwidth: 8 bits
  - Wireless protocol which operates in a mesh network
  - uses a device to relay a signal to other devices, strengthening and expanding the network
- Zigbee:
  - Same with Z-wave but with bigger bandwidth which enhance the speed of data exchange

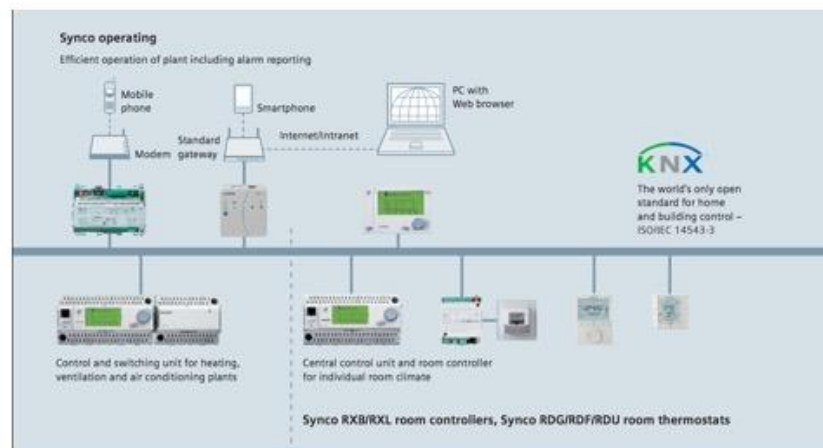# KNX vs. Zigbee and Z-wave (cont.)

- KNX:
  - Unlimited bandwidth
  - The most popular protocols for building automation
  - The system does not operate from a central unit
  - Convenience and reliability
  - Requirements for various safety areas: electrical safety, environmental safety, functional safety, EMC (electromagnetic compatibility), reliability, and performance.
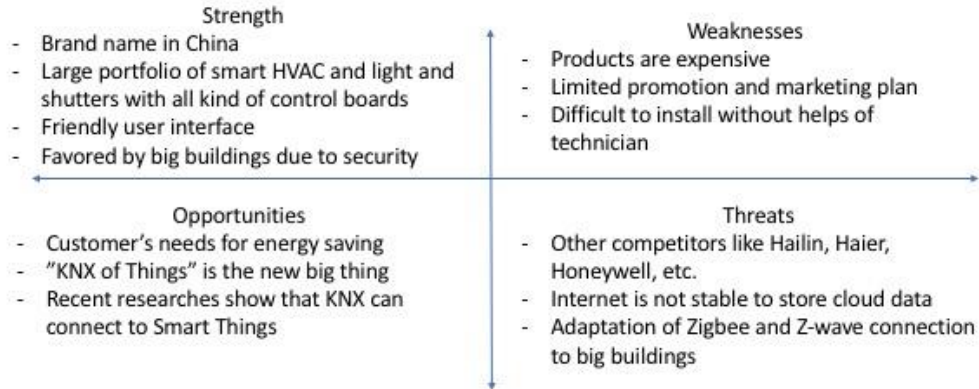
How about the price?

• KNX is not cheap -> production cost is high

KNX is the IoT

SWOT

Strength
- Brand name in China
- Large portfolio of smart HVAC and light and shutters with all kind of control boards
- Friendly user interface
- Favored by big buildings due to security

Weaknesses
- Products are expensive
- Limited promotion and marketing plan
- Difficult to install without helps of technician

Opportunities
- Customer's needs for energy saving
- "KNX of Things" is the new big thing
- Recent researches show that KNX can connect to Smart Things

Threats
- Other competitors like Hailin, Haier, Honeywell, etc.
- Internet is not stable to store cloud data
- Adaptation of Zigbee and Z-wave connection to big buildings

Customer Selection

- More than 50% customers are not happy -> make them happy
- Focus on new buildings
- Continue growing the business with hospitals, hotels, etc.
- People with medium income moving to new houses

New Business Plan

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITIONS	CUSTOMER RELATIONSHIPS	CUSTOMER SEGMENTS
- Contractors who help to promote and bring Siemens products to end customers - Customers who have used Siemens automation system before	- R&D - Manufacture Smart Controls - Provide Smart Home services, recommendation - Analyze customer's feedbacks	- Providing smart control for big buildings - Energy sufficient, safe and secure - Customizable control to fulfill customer's needs - Open data exchange via KNX bus, irrespective of suppliers	- Limited promotion and customer services - Advertisement video - Recommendation of installation for customers - Monthly or yearly maintenance for membership	- Real estates, hospitals, shopping malls, hotels, data centers, etc. - People moving to new houses - New buildings in China
	KEY RESOURCES - Talented engineers to develop new products - Server system for HomeControl App		**CHANNELS** - Distribute through contractors - Online platform - Direct sales to customer segments	

COST STRUCTURE	REVENUE STREAMS
- Cost of Manufacturing - Marketing and Sales	- Sales to contractors - Online sales - Application platform on smartphones - Membership subscription

Smart Home Floor Plant
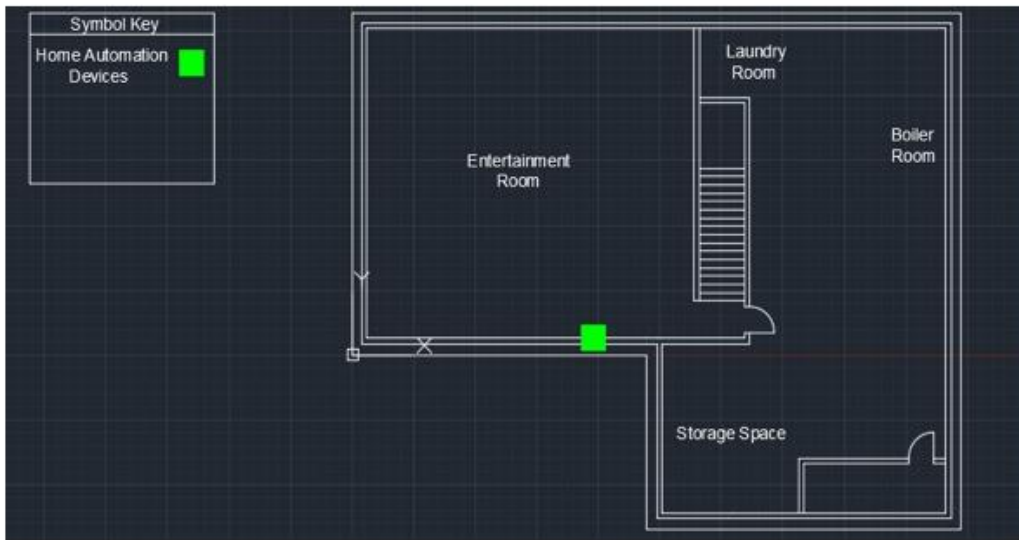
Acknowledgements

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- Advisor - Amy Zeng

Questions and Recommendations