

Technological Innovation and Strategic Analysis on the Smart Grids of Cisco

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General technology overview

What is the Smart Grid?

The term 'smart grid' has been trending in the media for the last decade, but not everyone knows what is a grid and by what definition, it is called smart. We can think of smart grid as smart phones. In the term 'smartphones', a phone is the device that enables voice or video communications between users when they are not in the same vicinity. Therefore, to add the 'smart' characteristic, smartphones enable more functions than only telecommunications. Smartphones would have touchscreen interface, Internet access, app download, and game console [1]. Likewise, 'the grid' is the electric grid that contains a network of transmission lines, substations, transformers, and more equipment that deliver power system from the power plants to the power plug-in at your home or business. Now the question will rise that what makes a grid 'smart'. The official website of smart grid provides a clear answer to this question:

In short, the digital technology that allows for two-way communication between the utility and its customers, and the sensing along the transmission lines is what makes the grid smart. Like the Internet, the Smart Grid will consist of controls, computers, automation, and new technologies and equipment working together, but in this case, these technologies will work with the electrical grid to respond digitally to our quickly changing electric demand [2].

According to Professor Chandler, an adjacent Electrical Engineering professor at Portland State University, "society is now connected to the Internet" [3]. Chandler's comment was in response to the smart grid technology development stage. Therefore, in the case of smartphones, the Internet is the main driver to develop this product. Likewise, Internet is a technology leaning on the Internet. Smart grid will allow interoperability between different firms in the power system such as interoperability between electric utilities and the households.

Advanced Metering Infrastructure (AMI)

The paper highlights the Advanced Metering Infrastructure (AMI) section because the AMI implements the communication network of the smart grid network. The AMI is the middle layer of the smart grid infrastructure and the smart meters. In this intellectual layer, the functions performed in this layer are measuring, collecting, analyzing, and controlling the distributed energy being produced and consumed. In addition to the energy control functionality, AMI allows dynamic tariffs, and remote meter configuration. This bidirectional communication network achieves the smart function with the help of the advance energy distribution automation device such as monitoring and controlling devices. AMI [4].

Electricity service providers such as electric utilities and operation centers perform the energy production function, and the energy consumption is performed by end-users such





as households and businesses. Thus, the bidirectional communication network of the AMI would allow collection and distribution of information between the electricity service providers and the end-users. In this way, the two sectors, along with other sectors in the power system network that are not in the scope of this study, would participate in the demand and response solution. The demand response solutions will be introduced in the next section.

Smart meter is the upgrade of the conventional analog meters. The smart meter plays a major role in the functionality of what makes a grid 'Smart'. It allows an active role in the functioning of the electricity market for the end-users, and functioning of the electricity system for the electricity service providers [4]. Smart meters can be described as an interface for the end-users to access the power grid. Therefore, smart meters would allow users to perform the demand response solution such as power delivery prescheduling.

Demand Response

Demand response is a smart grid's feature to manage, and control the power consumption between electricity service providers and end-users in response in response to real-time supply conditions [5]. Therefore, demand response allows both ends of the smart grid power line to contribute in controlling the power consumption. As described in the AMI section, the electricity service provider to will be able to control the electricity power system, and the end-user will be able to control the electricity market. In this case, the end-users would reduce their electricity during critical (peak) time in response to high market prices. For example, end-users would tend to not demand electricity to dry their clothes at 5:00 P.M. due to the high load price at that time as shown in the daily daily-hour load price in figure 1. Thus, understanding the daily power curve and the load price and applying the demand response smart grid's feature would benefit electric utilities as well as end-users.



Figure1: The daily-Hour Power Load Price

Smart Grid Application

Smart grid can be applied to many applications in the power system industry. SmartGrid.Gov lists six types of applications that can be within the smart grid scope [2].





These applications are the Smart Home, Renewable Energy, Consumer Engagement, Operation Centers, Distribution Intelligence, and Plug-In Electric Vehicles [2]. However, for the sake of the scope of the paper, the focus will only be on the Smart Home and Operation Centers to represent the end-user and the electricity service providers.

According to the U.S. Energy Information Administration, the residential sector, enduser, in the U.S. has the highest retail sales, revenue, and retail price. The residential sector tops the commercial (Hospitals), industrial (factories), and transportation sectors [6]. Thus, homes have a very high demand from the total power system capacity. Therefore, smart grid has applied its technology to serve the high power residential demand. The smart homes would have the smart grid technology such as the smart appliance, and the smart meters. These smart devices would only perform if the users use them accordingly. Thus, the smart home and smart meters would allow interactive relationship between electricity service providers and households. Moreover, the smart home would minimize the appliance use under stress of high demand of the power grid. The power grid stress can be refer to the peak period of 4:00 P.M. to 6:00 P.M. in figure 1. Moreover, as described earlier the smart home, and the smart appliances can shift the power use to a lower load price [2].

Operation centers face many controlling the whole power system due to their limited control of the power used [7]. In the conventional power grid, the communication is one direction such that the service providers would deliver electricity at a standard Wattage amount according to the type of served sectors. In addition, ideally, the power generated and delivered should equal the consumed power. If this relation is not satisfied, AC power would travel back (power oscillation) in the transmission line, which would generate a great amount of heat. This incident could cause the transmission line to create a fault, which would open the circuit breakers. Thus, blackouts would occur especially if the fault occurred at the main line due to the high load demand. Thus, smart grid has a solution for this problem that is the Phasor Measurement Units (PMU) [2]. The PMU would allow easy detection of the power oscillation in transmission lines, which would allow more control for operation centers over the power delivery system.

Related Policy Concerns

The Federal Energy Regulatory Commission (FERC) has issued a "Smart Grid Policy" that addressed different aspects of the smart grid functions, and provide guidance for the development of each key standard [8]. The policy report addressed seven key standards [8]:

- System Security;
- Communication and Coordination Across Inter-System Interfaces;
- Wide-Area Situational Awareness;
- Demand Response;
- Electric Storage;
- Electrical Vehicles;
- Additional Priorities Suggested by Commenters.





The focus will only be on the system security and demand response because of the direct relation to the focus of this paper. FERC, in this policy, recommended extra attention to the cybersecurity due to complexity of the Smart Grid Infrastructure. The first recommendation the security system should fulfill is preventing non-disruptive events. The cybersecurity of the power system should insure continuity of the operation. The other recommendation is to inhibit unauthorized access to critical system. This policy states that electricity service providers and end-users would have the right to permit any third party to have access to critical data systems, which can also be private information related to end-users. Preventing information leakage is another recommendation from FERC's commenters. This policy recommends reinforcement of not just the cybersecurity, but even the in-house personnel, and the physical security. In addition, the cybersecurity should allow system compromise to allow interoperability between different sectors in the power system [8].

The other focus of this paper would be demand response. The demand response feature would address the bulk-power system challenges of integrating variable generation sources to the electric grid. As described earlier operation centers would gain more control over the power system in general with the assist of the demand response. Moreover, FERC recommendations are crucial in regard to the demand response development of smart grid. FERC recommends demand response to support dynamic pricing, allow appropriate national interoperability, and assure measurement and verification. Smart grid network is serving the whole country, which consists of different power system's sectors, which may be expended to more sub-sectors. As a result, the complexity of the smart grid system would increase. Thus, appropriate national interoperability needs to be allowed. Moreover, in order to not allow inappropriate use of demand response, measurements and verification of the demand requests needs to be verified before responding from the operation center's end.

Customer Perspective

According to Professor Chandler, 2015, smart grid is considered a radical innovation [3]. Smart grid would change the daily activities of customers in term of their awareness of the power use. Furthermore, the electricity market is by very few people. This is a result of the one directional communication in the conventional power grid. End-users are not aware of the load stress and the electricity market, so they can respond, accordingly. According to Daniel and Kirschen and Goran Strbac in their book "Fundamentals of Power System Economics", "Everyone is participating in the electrical energy market, they just do not want to realize" [9]. They claim that households do not benefit much from the electrical energy market [9]. In addition, end-users do not have the capabilities and access to the electricity market. Thus, smart grid technology would induce the awareness of the electricity market. For example, the smart meters is the gateway to understand the real-time situation of the load stress.

Furthermore, privacy might be a huge issue to end-users. With the smart meters and smart appliances, end-users private information and data will be revealed to electricity





service providers. Examples of the private information are end-user's daily schedules, financial situations, use of specific medical equipment [10]. Electric service providers can identify the financial situations if the end-users turn on their plasma TV, or did their laundry at the off-peak time of the daily load curve, figure 1.

Value Propositions

Smart grid technology implies many compelling reasons for customers to support, and adopt the smart grid. According to Professor Chandler, lowering the electricity bills is the most important value proposition [3]. Smart grid lowers the electricity bills for customers using the demand response feature [11]. End-users would turn on their washer at an off-peak time of the daily load curve, figure 1. The other value proposition is increasing the operation center's control over the power consumption. This value driver is also served by the demand response. In addition, according to Odom 34,000 deaths a year are caused by the power plant pollution [11]. With the reduction of the load demand through demand response less power will be generated. Moreover, the smart grid applications are the renewable energy, and the Plug-In Electric Vehicles. Thus, smart grid is expected to reduce air pollution from the power system sectors as much as 30% by 2030. Moreover, the blackout prevention is another important value proposition as described in the operation centers smart grid application. This value is served by demand response and the Phasor Measurement Units. Even though, end-users perceive privacy as a concern, the Department of Energy thinks that privacy policy is value driver to smart grid. The policy standards in developing smart grid would assure the security as described in the related policy concerns section. In addition to policy standards, trusted and communication network companies such as CISCO would insure the security system of the private information.

Current Stage of Smart Grid implementation, adoption and land scope

For the current stage of smart grid technology itself, it had crossed the chasm and began to the 'early adoption' stage. Every major players of the electricity consumption market had been put huge efforts on pushing the smart grid projects, associating with the developments on their evolutional power supply system developments, energy-efficient society, renewable energy system, reduction of greenhouse gas emission, and internet of things. Power and energy projects that are related to smart grid technology and related adoptions is carrying out all over the world, including the major markets in U.S., China, European Union, India, Brazil, South Korea and Japan.

For U.S. market, according to the "2014 Smart Grid System Report" from the United States Department of Energy in the August 2014, there is "in part due to the \$9 billion public-private investment in smart grid projects committed through 2015 under the American Recovery and Reinvestment Act of 2009 [6] The adoption of smart grid technologies had across the nation. The largest U.S. Smart Grid demo project is the Pacific Northwest Smart Grid Demonstration Project, with a \$178 million in funding from the U.S. Department of Energy and began at February 2010 [12]. It was planned as estimated 65 million smart meters installed nationally by 2015; publicprivate ARRA investments in synchrophasor technology would result in more than 1,000





networked phasor measurement units deployed by 2015; and other infrastructures as customerbased system, advanced metering infrastructure (AMI) and new utility distribution systems were adopted and built up all over the nation [6]. The development of smart grid is relatively fast in U.S. market, however, the development process should still under the regulations of energy policies and U.S. Smart-grid Policy.

For Chinese market, which had been forecasted as the second increasingly electricity consumption country all over the world with an increasing rate of estimate 250% from 2007 to 2050 [13], adopting smart grid system would be beneficial for Chinese evolution on the power supply system, energy-saving society, renewable energy adoption and reduction of the greenhouse effects. Chinese government is showing a confidence and dedication on develop smart-grid system with a sound support on funding and policy-making for the projects. According to the special report by Zpryme [14], China is considering as the largest market of smart grid technology all over the world, and Chinese government is willing to spend estimate \$61.4 billion on smart grid equipment and technology marketing by the year of 2015 [14]. As been claimed by People's Daily Online, "The Smart Grid system is the top priority in China's [Internet of Things] development."

For European Union market, as one of the earliest market adopters for smart grid technology, also shows a great effort on pushing the smart grid system over the European Union. From the forecasts of Pike Research, during the period from 2010 to 2020, cumulative European investment in Smart Grid technologies will reach \in 56.5 billion, with transmission counting for 37% of the total amount; by 2020, there might be almost 240 million smart meters that have been deployed in Europe [15]. There would be still growing demand from European market as well.

For India, Brazil, South Korea and Japan, they all planning on building up a more constantly working Smart Grid Network which could cover as broad as they could for the end-users and the public infrastructures. Millions of smart meters will be installed, billions of dollars will be invested, and they were all planning on adopting Smart Grid technology on their own energy problems, as India, they were willing to use Smart Grid system to reduce their transmission power loss (averaging 26% and with a highest losing rate of 62%); Brazil is dealing with the power theft and too-frequent power outages; South Korea is working on increasing the energy efficiencies; and Japan is willing to adopt Smart Grid technology also working for their new energy projects [16].







Figure 2: International Snapshot of Emerging Smart Grid Global Competition [17]

Strategic Analysis

Overview of Cisco's Smart Grid

As one of the major industry solution providers all over the world, Cisco also stepped into the Smart Grid technology market. From the previous development, Cisco have the capability to integrate their network and communication products together, and building up the Smart Grid System as "a combination of products, technologies, services, and ecosystem partners that optimize communications, improve resilience, and reduce the operational cost and complexity of the energy grid [18].

The basic idea of Cisco Smart Grid system is to integrate their communication solutions with the electrical grid, improving the communication among all parties of stakeholders within the electricity network, in order to increase the efficiency of the energy network and build up the technology ecosystem. By making information and electricity going through the network smoothly and effectively, the whole Smart Grid System would be able to working even smarter in the future.

The solutions Cisco are providing to the users including: Grid Blocks Architecture (A forward-looking view on how to integrate the electrical grid with a digital communications network); Connected Grid Services (Working with utilities to plan and design reliable, highly secure network architectures); Field Area Network (Multiservice platform for the area network solution); Transmission and Substation (Using routers and switches to handle the most demanding substation environments); Grid Security and Grid Operations [18]. Cisco had place Smart Grid technology development as one of their major technology innovation strategic planning objects.







Figure 3: Cisco Smart Grid Solution [18]

Market Trend of Cisco Smart Grid

From the Pike Research the Smart Grid segmentation for North American market in the year of 2014 are majorly in the areas of transmission upgrades (44%), distribution automation (24%), Advanced Metering Infrastructure (AMI, 11%), and demand response (11%) as the following figure [15]. From this market segment distribution, comparing with Cisco's solution provided, they could be capable enough to cover all of the major segments, especially on AMI, transmission upgrades, and demand response. When the Smart Grid market goes into different segments, the solution providers may get more opportunities to be able to get into their advanced segments and gain the market share and making profits out of that.



Figure 4: Smart Grid Segmentation, North America: 2014 [15]





Globally speaking, there is also a clear evidence showing that the market size and revenue space of Smart Grid Market would have a continuously increasing trend [19], which is also giving Cisco a lot of opportunities on gaining more potential market shares in the global market area as well.

Also, the innovation trend of Smart Grid technology now "is focused on smart grid analytics – collecting data, integrating systems and data analysis to achieve visibility across the grid [20]. As one of the major telecommunication solution providers, Cisco has a solid innovation capability on the innovations of data processing, which could also bring more market share for Cisco.

Cisco Smart Grid Innovation Strategy

The vision of Cisco Smart Grid is "For information network technology enabling end-toend highly secured Smart Grid, to help utilities to manage their energy system as an integrated framework [18]." Leading from this vision, Cisco was be able to integrate their capabilities on network and information technology to not only help the utility companies to use a smarter system to manage their energy distribution and optimize the operation costs; help the infrastructures to improving the energy efficiency; but also help the end-users to lower their electricity bills and using their energy capabilities smarter than before. By looking into Cisco's development path on Smart Grid projects, Cisco certainly got great market opportunities on Smart Grid. By making related stakeholders communication with each other, Cisco would change the way of electricity system, and making utility companies to deal with a lower cost and lower pollution system.

SWOT Analysis

• Strengths:

- 1. Cisco has their own capabilities and leading place on information network solutions, industry communication system solutions and the technology ecosystem, which would be easily to build up the network frame for smart grid system.
- 2. The unique selling point for Cisco's Smart Grid solution would be using the integrated information technology to provide the communication platform, making the communication among utility companies, infrastructures, and end users under the same protocol, and building up a smart business energy management system.
- 3. Cisco was planning to step into the Smart Grid market earlier than other communication technology companies. With the experiences on marrying utility companies with information technology well, Cisco would be considered as a major player in the field.
- 4. Cisco has a major value of innovation culture. Innovative thinking is encouraged, which could serve the highly innovation degree of communication technologies.
- 5. Cisco has planned multiple solutions for different Smart Grid market segments, especially, which also is showing a great capability on gaining market shares.
- Weaknesses:





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- 1. Comparing with other major competitors such as IBM or Siemens, Cisco has less brand recognition, or customer receptions among individual users or device end-users; and Cisco may not have advantages on data mining and analysis solutions as well.
- 2. The high-pricing of Cisco's product and solutions may lead to some disadvantages from the overall market share perspective, especially if Smart Grid had got its own standards.
- 3. A highly saturation of Cisco's skilled professionals and their divided innovation organization may cause an over-featured innovation system, and may also limited their management and operation innovations as well.

• **Opportunities:**

- 1. The major regions, which are adopting Smart Grid technologies as U.S., China, European Union, Brazil, Japan and South Korea, have all dedicated on supporting Smart Grid projects. Their supports including policy support, funding support, and national strategic planning support. These all brought Cisco a lot of potential market opportunities and participate into the projects.
- 2. The current situation of environment pollutions (as CO₂ emission and other greenhouse gases, PM2.5, etc.), renewable energies and inefficient power distribution systems were calling for advanced solutions, which could be provided by Smart Grid system.
- 3. The raising of Internet of Things (IoT) also providing great opportunities for the development of Smart Grid technology.
- 4. There is not a constant Smart Grid standard yet. As Cisco, which had set a lot of communication and network standards, there would be a great opportunity for Cisco to use their network technology capabilities, set the standard, and becoming the market leader.
- Threats:
- 1. The data access and privacy issues are always a major concern of the end users, which is also catching some attentions from the energy policy makers. For example, in U.S., "the NBP (National Broadband Plan) recommended that DOE (Department of Energy) evaluate the overall communications needs of the Smart Grid, consider consumer-data-accessibility policies when evaluating Smart Grid grand applications [10]."
- 2. The lack of customer education on the Smart Grid using would restraint to the development of Cisco's Smart Grid solutions.
- 3. The competitive threats on software development, individual smart devices and service packages from the competitors in the Smart Grid would have a negatively impact on Cisco's Smart Grid projects, since Cisco's major advantage is mostly on hardware development.
- 4. Cisco does not really hold as many patents on Smart Grid as its competitors.

Major Competitors

• ABB:

ABB is playing a fundamental role in the evolution of power systems [21]. As the No.1 leading company in the field, ABB not only has its vast selection of the intelligent electronic hardware, but also have the associated software portfolio to support the hardware solutions, especially on the distribution network and for end users, commercial and residential users. ABB has been selected by China's leading power utility, State Grid of China Corporation (SGCC), to supply





high-voltage products for its 220-kilocolt smart substation demonstration project, aimed at deploying and integrating intelligent solutions to enhance the efficiency and reliability of the electricity network [22]. And also, ABB is holding 1085 Smart Grid related patents until the year of 2014, which is the highest number among the industry [23]. The major market segments of ABB Smart Grid are: power generation, power transmission, power distribution, grid automation, renewable integration, energy storage solutions, electric vehicle charging, and smart home and buildings [21].

• IBM:

IBM tackles the smart grid from all angles [24]. Not only patrolling the physical grid, IBM also provided the analytics to insure the smart grid security. By applying their great capabilities on data analyzing, IBM is aiming to achieve a large scale and is working to provide support to make bigger grids a safer reality. The market segments that IBM is providing for Smart Grid solutions are: customer operations transformation; IBM intelligent utility network solution; power generation optimization; and the IBM solution architecture for energy and utilities framework [25].

• Siemens:

Siemens also providing data-processing based information protection solution for the Smart Grid system. Empowering with the data analytics, Siemens is aiming to ensure smart grids run safely, protected and produce data that can be analyzed and used to improve service and efficiency [24]. Furthermore, Siemens also holds as many as 526 patents related to Smart Grid technology until the year of 2014, which makes Siemens becoming a major player in the Smart Grid industry and offers a range of Smart Grid solutions, from monitoring centers to security [23].

Cisco Smart Grid Global Adoption Projects

- In U.S., several major Smart Grid projects selected Cisco as one of the major contributors, such as: LADWP (Los Angeles Department of Water & Power) Smart Grid demonstration project, which is supported by U.S. Department of Energy's American Recovery and Reinvestment Act funding, using Cisco GridBlocks architecture to operate over an integrated cellular and multi-application IPv6 communications network for the smart meters [26]. For the Southern California Edison Smart Grid project, Cisco also supported on setting of use cases to encompass the breadth of the smart grid [27]; with other partners of IBM, Enernex, Quanta and EPRI.
- In China, Cisco had become the partnership with State Grid of China Corporation (SGCC) to support Chinese Smart Grid development, associate with Chinese Smart City developments. Cisco Connected Grid Design Suite provides an interface that could allow engineers to dynamically design, secure, model and test the LAN both before and after [28]. There had been successful cases with Cisco Services that created the Yunhui 220 kV for Hangzhou Electric Power Company with the tool that being used to test and simulate the communication network





in real time in the new substations. The goal of building 5000 new substations and retrofitting 2000 more by 2016.

• In European region, especially in Germany, Cisco is working together with the energy company called Yello Strom, to do a pilot energy-saving Smart Grid project. The smart grid pilot is aiming to create an intelligent energy system that allows customers to measure and control the power consumption of their electrical appliances, enabling them to reduce their monthly bills as well as carbon emissions and significantly cutting down on peak-period demand [29].

Potential Longer Innovation Strategic Planning for Cisco Smart Grid

Cisco had been worked with several projects with major Smart Grid adopted regions, which brought Cisco the market. By learning the SWOT analysis of Cisco Smart Grid, the potential innovation strategic planning could also be detected through the analysis. By adopting TOWS analysis, some potential plan could be made.

- Strength-Opportunity: Maxi-Maxi Strategy:
- 1. With the raising trend of IoT in the market regions, Cisco could develop more on the integrated Smart Grid technology innovations and solution portfolio, to participate the whole project of Smart Cities.
- 2. Cisco had still held most of the telecommunication protocol standards, especially on the IP based communication systems. If Cisco could also set a constant standard on the communication protocols for the stakeholders within Smart Grid industry, Cisco would be more capable to hold the leading place in the market and gain more market shares based on the B2B business model.
- Strength-Threats: Maxi-Mini Strategy:
- 1. Cisco has a great capability on data security solutions, and had already worked on building a more secured business management platform for utility companies and end-users. Comparing with IBM and Siemens, Cisco would still need to do more on software side to deal with the data-access issues and privacy issues that related to Smart Grids, in order to integrate with the hardware frameworks.
- 2. Cisco could also use its leading place in the telecommunication industry, to build up the strategic alien together with the companies that holding patents that related to Smart Grid, or getting some licensing from the patent holders, which could also be helpful to explore Cisco's advantages better. On the contrary, Cisco should also encourage more on the Smart Grid innovations, especially on the communication part and the data analysis part.
- Weakness-Opportunity: Mini-Maxi Strategy:
- 1. Cisco could associate more with the local engineers and technicians with the Smart Grid projects, especially for the foreign projects. By doing projects together with the local genies, there would be more ideas from outside of the company, or even from the unprofessional perspectives, so that the creative thinking could be motivated to a higher stage.
- 2. Cisco maybe could adjust their price flexible with different market segments or market regions. Even though the nations or companies are willing to invest on Smart Grid development, the pricing could still be one of the competitive issues for the major players.





- 3. Promote more for Cisco's brand recognition to end-users whenever they are doing the Smart Grid projects. That would also increase customers' perception of Smart Grid technology as well by accept their system, device and operation models. By integrating with social network media platforms might be a further option to promote the customers and users.
- Weakness-Threats: Mini-Mini Strategy:
- 1. Working on designing the customer education plans on Smart Grid application through Cisco. Smart Grid means a change of end users' behaviors, together with some needed technology introduction to the users. In that way, the brand recognition would be increased, and also could help the end-users to know more about Smart Grid technology.
- 2. Integrating the innovation divisions more to serve the Smart Grid projects from multiple perspectives, in order to get more possible solutions and ideas.

Lessons Learned

Through the analysis on Cisco's Smart Grid technology case, even for Cisco, the innovation strategy management should still be really important. Smart Grid, as one of the most important changing innovations to the world and one of the important steps to develop more on Internet of Things, attacked many high-tech companies to get into the field. The competition from the market place is also relatively high. If Cisco would like to hold the leading place tightly in the industry, they would still need to work on improve their innovation strategies. The market challenges and complains that is faced by Cisco is also faced by other companies; furthermore, the current problems with Smart Grid technologies and products are also the common problems that would need to be considered with most of the IoT products, since they are behavior-changes to the customers and end-users. More awareness from the customers and users would be helpful and compelling to the customers. From the research report from Zpryme, there is evidence showing that the European region, as the earliest adopter of Smart Grid, is suffering with a "sleep stage" of the existed Smart Grid projects, which was showing a negative market reflection from the customers [14]. Also in U.S., one of the biggest Smart Grid adoption project in the nation, which is serving the Northern California utility Pacific Gas & Electric, had to face a lawsuit accusing it of false advertising on Smart Grid devices and meters [30]. The major complains were that the users did not really have a lower electricity bill after using the smart meters. As one of the most important motivation factor to the customers, if the smart meter could not really help them to save money on the electricity bills, they will definitely doubt about the real value of Smart Grid, and also will think the advertising of Smart Grid is false advertising. But the major problem in here is actually the lack of customer awareness on Smart Grid.

By addressing these general situations, there are several important lessons learnt from this study:

1. Market Challenges of the radical innovations - Motivation of "Smart Everything".

As a life-changing innovation, Smart Grid has the capability on changing the utility using behaviors of the utility companies, infrastructures, and the residence users. The whole new idea on the energy efficiency, energy storage and interactive distribution channels of electricity will change the traditional way of thinking on electricity usages. It is a real market challenge





on promotes the innovation to the commercialization. And this is not only for Smart Grid, but also for "Smart everything". Even though there is a trend on the development of Internet of Things and technology ecosystems, and there is clear evidence on the demand of IoT products, the motivation is still a problem that needs to be fixed.

Additionally, the privacy issues of Smart Grid are also bringing market challenges. The privacy concerns should never be ignored.

- 2. Customer Education Crossing the Chasm to Commercialization.
 - Associated with the market challenges on life-changing radical innovation as Smart Grid, how to really bring it to cross the chasm and step into the majority of innovation lifecycle would give out a view on how fast that Smart Grid could get into the major development stage. Technically speaking, based on the existed Smart Grid projects, and the existed number of smart meters, Smart Grid technology itself had already stepped into the early majority of the technology innovation lifecycle. However, from the marketing perspective, especially from the accept degree of customers, the real position of Smart Grid in the lifecycle should be only considered as in the early adoption stage. "Getting Consumers to Cross the Smart Grid Chasm [31]" had been suggested from the Smart Grid experts. It also states that the real status of "crossing the chasm" should not only be the technology itself, but also the whole update on the marketplace and the customers' acceptations.

The major problem had been addressed here that the major holding back adoption here is the customer education on Smart Grids. The suggestions also been addressed by the experts that the communications through customer education on Smart Grid applications, and a new-designed final reward model to motivate customers might be helpful [31]. "The negative press surrounding smart meters was part of the impetus for the recent formation of the Smart Grid Consumer Coalition, which is charged with educating consumers about all things Smart Grid in the hopes of engaging them in modernizing the grid and using energy more efficiently [30]." More marketing innovation may needed for Cisco in the following steps.

3. Extending the market regions or market segments.

Even though Smart Grid market regions had covered the major parts of the world, especially for the highly electricity costing regions, there would still be potential extending on the market regions. The Australian had been involved into the Smart Grid adoptions lately; Brazil now is the only active Smart Grid region in the whole South American region while the inefficient power distribution problem should still be fixed for the whole area; African region, and Middle East areas haven't been really activated into the Smart Grid market. All of these regions could still be considered in the future.

On the other hand, there would be more market segments to be developed for Smart Grids, especially on developing the business models or the storage and distribution models. For example, let the end-users getting more engaged into the electricity commercialization, making everyone could becoming one spot of the whole network, and being both users and providers of the electricity, so that there would be more distribution options and more business models.

4. Integrations on innovation planning – both on technology integration and management integration.

Cisco has a great capability on integrate the technologies and related products into their platform and make them working within the same technology ecosystem. It works really well.





On the other hand, the innovation organization and management model should also becoming more integrated. One of the major concepts and visions of Internet of Things is the "ecosystem", which means we may not satisfied the customers' demands with only one product, one technology or even one single product series. The whole set of "solutions" that integrated all the capable technologies and products together to save the same purpose. In order to achieve this vision, the innovation management should also being integrated from different divisions. Cisco may also be considered to integrate the different innovation divisions so that they could be more productive and being less over-featured.

5. Related Political Issues.

Conclusion and Future Researches:

Smart Grid is a great radical innovation that could being the game-changer of the next generation electricity system. Cisco and other companies made a decision to step into the market, they would need to associate with customer behaviors, policy issues and data analysis. Additionally, associated with technology innovation, market innovation and process innovation should also serve as an ecosystem, in order to serve the purpose well. How to compelling customers and educate customers to accept the behavior-changing innovation is the general problem that faced to the companies and industry.

In a long run of the future research, a new product development model or solution should also be provided for IoT (Internet of Things) innovations, which could make them more efficient into the market and be accepted by the customers easier.





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