

Mr Jared McKee
2018 Powers Ferry Road
Atlanta GA 30339
United States

5th October 2011

Mr Simon Bartlett
Chairperson
ES Cornwall Scholarship Advisory Committee
PO Box 1193
Virginia QLD 4014
Australia

Dear Mr Bartlett,

**ES Cornwall Memorial Industry Scholar – Jared McKee
First Quarterly Report**

Please find enclosed the first quarterly report for the ES Cornwall Memorial Industry Scholarship which is a requirement set out in the scholarship rules.

This quarter, my responsibilities have included:

- Assisting in the development of customer segmentation for Meralco (the largest electricity distributor in the Philippines)
- Writing the user personas for the next version of GE's DRMS (Demand Response Management System)
- Developing the short-term load forecasting algorithm for GE's DRMS in collaboration with the GE GRC (Global Research Center) team in Schenectady, New York and GE Projects team in Melbourne, Florida

Some details have been omitted to avoid revealing certain intellectual property of the host organizations.

I would welcome the committee's feedback and advice on the report, particularly concerning my proposed goals for the next quarter and placement.

Yours faithfully,

Jared McKee

Introduction

My tenure of the ES Cornwall Memorial Industry Scholarship commenced in July 2011 and continues until April 2012. My program is aimed at gaining exposure to projects which involve understanding and influencing customer behavior in the electricity supply industry.

The program consists of two placements:

- GE Energy, Atlanta GA USA – July 2011 to November 2011
- CE Electric UK, Leeds UK – December 2011 to April 2012

Work Experience

My current placement is with GE Energy in Atlanta, Georgia, USA. So far I have worked on both the Marketing team and the New Product Initiatives team. My responsibilities have included:

- Assisting in the development of customer segmentation for Meralco (the largest electricity distributor in the Philippines)
- Writing the user personas for the next version of GE's DRMS (Demand Response Management System)
- Developing the short-term load forecasting algorithm for GE's DRMS in collaboration with the GE GRC (Global Research Center) team in Schenectady, New York and GE Projects team in Melbourne, Florida

My first responsibility was to assist in the development of customer segmentation for Meralco. Meralco decided to investigate the use of prepaid electricity to solve the problem of customer delinquency (failure to pay electricity bill). GE's role in this was to segment customers based on their prepaid offering preferences and, thereby, help determine what the offerings should be and how they should be targeted to customers.

The methodology used to segment customers involved three main steps:

- Focus groups – in-person group interviews conducted by a facilitator to help qualitatively understand the various attributes that are important to customers the offering
- Conjoint analysis¹ – internet surveys which ask customers to trade off the various attributes to quantitatively determine which attributes are most important to each customer
- Customer segmentation – cluster customers into segments based the attributes that are most important to them

¹ <http://www.sawtoothsoftware.com/download/techpap/manconj.pdf>

This segmentation is known as “needs-based” segmentation. It is important to distinguish this from demographic segmentation, consumption segmentation, and other common utility segmentation approaches. Needs-based segmentation acknowledges the fact that customers may have the same needs but different demographics and consumption behaviors, or they may have different needs but the same demographic and consumption behaviors. The customers need or preference is not necessarily correlated with their demographic or consumption behaviors.

My second responsibility was to write the user personas for the next version of GE’s DRMS (Demand Response Management System). The current version of DRMS is called DR1000². The basic idea of DRMS is to enable the utility to:

1. Design and deploy various DLC (direct load control), CPP (critical peak pricing) and TOU (time of use) programs
2. Provide a portal which enables customers to sign their devices up to appropriate programs
3. Forecast the effects of running a certain type of event by selecting the who will participate and which programs will be used
4. Schedule an event and send the appropriate signals to the devices
5. Determine which customers participated in the event and how they changed their behavior
6. Learn from past events in order to forecast future events more accurately

The user personas are produced to help the developers understand who the end-user is and hopefully develop an application which is more suited to their needs. Personas differ from user requirements in that they do not attempt to describe *what the user wants*, but rather *who the user is*.

Some of the things described in personas include responsibilities, education, past experience, job conditions, potential consequences of poor decisions, culture, attitude toward new technology/processes, dependency on other roles, and work environment.

My third and final responsibility was to help develop the short-term load forecasting algorithm for GE’s DRMS in collaboration with the GE GRC (Global Research Center) team in Schenectady, New York and GE Projects team in Melbourne, Florida.

The purpose of the short-term load forecasting algorithm is to:

- Forecast the demand for a certain group of customers up to one week in advance based on various environmental factors like temperature
- Predict what the demand reduction will be based on nominated event parameters (start, end, selected demand response programs, etc.)

² <http://www.gedigitalenergy.com/demandopt/catalog/dr1000.htm>

- Continuously learn from new data as it arrives and improve the forecasting/prediction accuracy over time

A complimentary algorithm is planned for development which will determine the customers that should participate in an event and how long the event should run based on a desired demand reduction.

Short-Term Visits

I have had the chance to visit two utilities so far:

- BC Hydro in Vancouver, Canada
- APS (Arizona Public Service) in Phoenix, Arizona, USA

The group I visited at BC Hydro was the Load Analysis Group. The following is a description of what they do:

The Load Analysis Group studies patterns of electricity use over time, with the interval durations ranging from minutes to decades, across different customer types. They collect data from several sources such as CCS (the billing system) DAD (the GIS system) and others, as well as 1,400 of their load research recorders installed at customer sites. In the future they will be collecting data and analysis from the SMI (smart meter) system as well.

BC Hydro is working on a project to meter all appliances for a sample of customers. At the moment, they seem to be focused on successfully deploying the technology necessary to collect interval meter data about the customers and their appliances. So far they only have a small sample of BC Hydro staff members, but they plan to expand this sample in the near future. By individually metering appliances in the participating houses they can start to develop ways of understanding consumer behavior at an appliance level. Unfortunately, until the sample size is increased and includes a representative sample of the whole population, the findings probably cannot be generalized. This project will have all sorts of potential future applications such as growth modeling, understanding customers' response to demand management events, and more.

APS had an interesting initiative called "Solar Gardens". Many retailers are currently offering customers the choice to have a certain percentage of their power come from renewable sources. Customers who opt-in to these schemes do not get to physically see the result of their investment. "Solar Gardens" is different because customers are informed that their solar investment is going towards specific solar panels on a school for example. The customers can actually drive past and see their investment.

Insights

A summary of the insights gleaned so far in this placement include:

- We should use needs-based segmentation to effectively design and target our programs
- We should increase data sharing and collaboration – particularly with smart meter data
- We should use hypotheses when conducting demand response trials
- We should focus on changing internal culture surrounding demand response such that people treat it as equally as dependable as the “big red button” (direct load control)

Needs-based segmentation acknowledges the fact that customers may have the same needs but different demographics and consumption behaviors. Needs-based segmentation is a new source of customer insight which many utilities have yet to leverage. The likely reason many utilities are not using needs-based segmentation is because they have not yet realized how it differs from demographic and consumption segmentation. Utility projects which require the willing participation of customers in a program will benefit from needs-based segmentation because it will help determine what the attributes of the offering should be and how to target the offering such that the program gets the highest uptake possible.

Significant gains in our ability to predict customer behavior/demand could be achieved if there were greater data sharing and/or collaboration between the power industry players. At the moment, many players in the power industry are attempting to develop methods of understanding and predicting customer behavior – particularly with the help of smart meter data. Many of these players, by themselves, do not have enough data to successfully validate their approach.

The idea behind DRMS is that a utility should be able to predict how much demand reduction they are able to get, schedule that reduction, and then measure how much reduction they actually achieved. This approach has many parallels to science experimentation methodology that we are taught in high school – write your hypothesis, design your experiment, conduct your experiment, test your results. The approach sounds simple enough; however, it would seem that many utilities are not producing hypotheses when conducting demand response trials. The idea of producing hypotheses is that they can be tested for success. A hypothesis could be “there will be an X kilowatt reduction for Y event”. After the event is run, the hypothesis should then be tested. This may be an exaggeration but many utilities are currently treating demand response trials as “take what we can get” – firing off events and then seeing what happened after the fact without developing targets/predictions/hypotheses.

Hypotheses are important to demand response for two main reasons:

1. People in the utility will begin to expect demand reduction predictions to be correct and will start relying on them. This will change the current culture of preferring the “big red button” (direct load control). Operators may start to view things like Time-of-Use Pricing and Critical Peak Pricing as usable alternatives to the “big red button”.

2. Ultimately, operators will need to be able to rely on demand response for a specific demand reduction. Hypotheses will put us in the mindset of improving the accuracy and reliability of demand reduction predictions.

Investment in the likes of a DRMS right now should be about changing the culture surrounding demand response viability. The accuracy of prediction algorithms and the availability of data will improve over time and will eventually become the focus as confidence in demand response increases.

Looking Forward

I will be speaking at the Predictive Analytics World conference in London, UK on behalf of ENERGEX and Deloitte Analytics on 30 November 2011. The abstract of the presentation is as follows:

With the help of external resources, ENERGEX developed a spatial simulation which forecasts 20 years of electricity demand growth in South East Queensland, Australia. Techniques such as agent-based urban simulation, machine learning and customer segmentation were employed to forecast over 250 variables to a 400x400m grid level. The spatial simulation developed will likely form part of ENERGEX's next regulatory submission which determines ENERGEX's funding. In this session, Jared will talk more about the modeling approach and how ENERGEX is using the simulation.

I will be commencing my second placement with CE Electric UK in December 2011. In this placement, I will be concentrating on areas of customer flexibility and willingness to actively engage and change behaviors in support of the low-carbon agenda. I will be involved in the CLNR (Customer-Led Network Revolution) project which will have progressed to the following stages by the time I join them:

- Customer-side technology for demand-response mechanisms will have been specified and procured in partnership with British Gas
- Customer socio-economic attributes by different segmentation will have been defined by Durham University for the trial test cells
- Customer propositions and time of use and direct control tariffs will have been designed and put in place
- Initial customer-side monitoring will be underway for existing electricity-usage profiles
- Customers will have been recruited and monitoring and intervention related technology (where appropriate) will have been installed at customers' premises
- Engagement will have commenced with Industrial & Commercial customers plus Aggregators in relation to demand response