Analyzing the Prospects of the Nest Power Project Through Actor Network Theory

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

Nest, the smart home and automation company recently acquired by Google to form Google Nest, created the Nest Power Project initiative in order to "…raise awareness of the energy burden, [and] provide help to people struggling with high energy costs…." It aims to achieve this goal by "… installing one million energy- and money-saving thermostats in homes that need them most" (Nest Power Project, n.d.). Yet there is currently no understanding as to whether or not the Nest Power Project has been successful. Without understanding what factors may contribute to the vulnerability[1] of the Nest Power Project, it is impossible to ensure the success of the program, thereby compromising the ability to alleviate the high energy burdens of the low-income community. In an attempt to determine what factors may contribute to vulnerability of the Nest Power Project, I will use Actor Network Theory (ANT) to compare and contrast the project to the Weatherization Assistance Program (WAP) under the United States Department of Energy and the Energy Savings Assistance (ESA) program under Pacific Gas & Electric (PG&E). This analysis will begin by outlining pertinent information regarding the creation and structure of WAP, ESA, and the Nest Power Project, followed by a description of structure and function of ANT. I will then use ANT to outline the structure of each of the programs which will show what actors are causing the programs' success or lack thereof. Using this structure, I will explain how similarities and differences between the Nest Power Project and WAP/ESA are exposing the Nest Power Project network to vulnerability.

[1] For the purposes of this paper, "vulnerability" will refer to its context within Actor Network Theory, a science and technology studies framework. In this framework, "…vulnerability is…equal to fragility, unreliability, uncertainty…" (Verkoelen, 2014) and similar concepts of doubt that have influence over the success of a system.

Background

Energy Burden

Energy burden is defined as the percentage of household income that is allotted for energy bills. In 2011 it was found that the median energy burden across all families from the United States' 48 largest cities was 3.5%. However, when the energy burden was evaluated for low-income families in these cities, the median was 7.2%. In fact, in over a third of the cities included in the study, "…a quarter of low-income households experienced an energy burden greater than 14%" (Drehobl & Ross, 2016). These statistics articulate that the problem of a high energy burden is common throughout the low-income community in the U.S. Attempting to minimize the pressure low-income families face from high energy burdens, several programs have emerged claiming to have a solution. Three of these programs include the Nest Power Project, Weatherization Assistance Program, and Energy Savings Assistance program. Though each of these programs have the same goal of reducing the energy burden amongst the low-income community, all have approached it differently with the specifics detailed below.

Nest Power Project

The Nest Power Project was launched in 2018 with the intention of raising awareness and support for families that struggle with a high energy burden. Not only is Google Nest committed to installing one million smart thermostats in the next five years, but it has also coordinating with Fannie Mae and several non-profit organizations to provide low-income households with "…special pricing on the Nest Thermostat E so they can be given to eligible households at little or no cost" (Nest Power Project, n.d.). Through

these efforts Google Nest believes that it will make significant contributions to the low-income community by decreasing the high energy burdens they face.

Weatherization Assistance Program (WAP)

The Weatherization Assistance Program (WAP) started in 1976 as part of the Department of Energy with the intention of saving imported oil by implementing "…low cost, temporary measures such as caulking and putting plastic sheets over windows." These measures were implemented in order to reduce household energy consumption in a time of high oil prices (American Architectual Manufacturers Association, n.d.). Since 1976, the WAP has worked on implementing more permanent weatherization measures for low-income households by "…building shell improvements such as insulation and air sealing, heating, ventilation, and air conditioning…" to name a few. All weatherization recommendations are made by professionally trained crews that use advanced diagnostic equipment to determine what household improvements should be made to minimize energy waste (U.S. Department of Energy Office of Energy Efficiency & Renewable Energy, 2019). A local government, agency, or non-profit organization will then finance the weatherization improvements through the use of the funds allocated by the WAP, meaning that the financial burden does not fall on the families (U.S. Department of Labor, n.d.).

Energy Savings Assistance Program (ESA)

Founded in 1983, the Energy Savings Assistance (ESA) program has worked within 48 California counties to serve over 2 million households (Pacific Gas and Electric Company, 2019). Unlike the WAP, the ESA is sponsored by a private company: Pacific Gas and Electric (PG&E). Aside from this, it functions much like the WAP in that a professional team evaluates applicants' houses and determines what weatherization

methods should be installed to ensure "…a more comfortable and efficient home" (Pacific Gas and Electric Company). Funds for the weatherization are provided by PG&E.

Literature Review

There is limited research surrounding the impact of the Nest Power Project. Current literature either focuses on general smart home technology roll out or fails to examine the social factors affecting the Nest Power Project. More specifically, the research concerning the roll out of smart home technology does not address the adoption of the Nest Thermostat E in low-income communities. It does, however, highlight concerns about "…high upfront investment costs, a lack of product understanding, and data privacy concerns…" that customers across the world are expressing. This research also highlighted the fact that there may be a growing divide in our society concerning the adoption of smart home technology. In order "[t]o address this risk, the paper recommended the creation of grant and incentive programs focused on enabling older, low-income and rural households to adopt smart home technologies, potentially saving on their energy bills in the process" (Crisp, 2019). Yet there is no mention of any sort of programs that have this goal in mind nor how to ensure the success of such programs.

When evaluating current research on the success of the Nest Power Project, it lacks examination into the social factors affecting the project. Additionally, it solely focuses on the perceived success of the project, measured by monetary means, instead of considering the material energy savings the project creates. From the current research, which focuses on the $750,000 in donations and the numerous business partners and social media followers, it is impossible to understand the tangible impact that the Nest Power Project has had on the low-income community (WP engine, n.d.). Therefore, by evaluating the social

factors affecting the Nest Power Project through Actor Network Theory, I will comprehensively measure its success. This analysis will show how the project is being exposed to vulnerability and may not see the same level of success that current research suggests.

Actor Network Theory

Due to its focus on the interactions between human and nonhuman actors in a heterogeneous network, the science and technology studies concept of Actor Network Theory is an optimal framework for evaluating the vulnerability of the Nest Power Project. It is unique in that it incorporates the notion of nonhuman actors and acknowledges that networks are not inherently stable and can "…at any moment redefine their identity and mutual relationships…." ANT's concept of simplification, limiting a network's actors to a series of discrete entities, allows for "…the reduction of an infinitely complex…" network, making it inherently capable of evaluating complex networks such as the Nest Power Project (Callon, Society in the Making: The Study of Technology as a Tool for Sociological Analysis, 1987).

Another defining characteristic of ANT is translation, the process by which actors are assimilated into a network, which consists of four phases: problematization, interessement, enrolment, and mobilization. In problematization, a network builder – the leading actor – appears and identifies a problem and the subsequent additional human and nonhuman actors that must be recruited in order to address the problem. Interessement is the process by which the network builder actively recruits the actors it has identified into the network. Following this, the recruited actors begin to accept and act on the roles assigned to them by the network builder in enrolment. And lastly, if successful, the

network will move into the mobilization phase where all the actors work together to accomplish the goal set out by the network builder in the problematization phase. But sometimes rogue actors, actors that act contrary to the role assigned to them, appear in the enrolment phase and lead to the destabilization of the network (Callon, Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay, 1986).

In this essay I will use simplification to narrow the scope of the WAP, ESA, and Nest Power Project networks, allowing me to better examine each individual network. The process of translation will allow me to evaluate the stability of the three independent networks. Furthermore, by expanding into the phases of translation I will show why and how each of these networks was established, examine their stability, and identify if the network is or is not able to function as a unit. In particular, this analysis will allow me to identify key similarities and differences between the Nest Power Project and the WAP and ESA, providing me with the ability to define the sources of vulnerability of the Nest Power Project.

Analysis

Weatherization Assistance Program (WAP) Network

Though the original goal of the WAP was to implement temporary weatherization actions to prevent the use of foreign oil during a trying time in American history (American Architectual Manufacturers Association, n.d.), the goal has since shifted to implementing permanent weatherization measures that decrease energy consumption in low-income households (U.S. Department of Energy Office of Energy Efficiency & Renewable Energy, 2019). Despite this shift, many of the network's defining features have stayed the same,

namely the network builder and a majority of the actors in the network. Thus, the phases of problematization and interessement have changed minimally since the conception of the WAP in 1976 (American Architectual Manufacturers Association, n.d.). The U.S. Department of Energy has served as the network builder since 1976 and has identified the following as pertinent actors in its network: the local governments, agencies, or non-profit organizations that administer funds; the technology used to diagnose sources of preventable energy loss; the technology used to implement weatherization measures; the experts that perform inspections and recommendations; the low-income households eligible to be served; and the houses the families live in. A visual representation of this network can be seen in Figure 1.

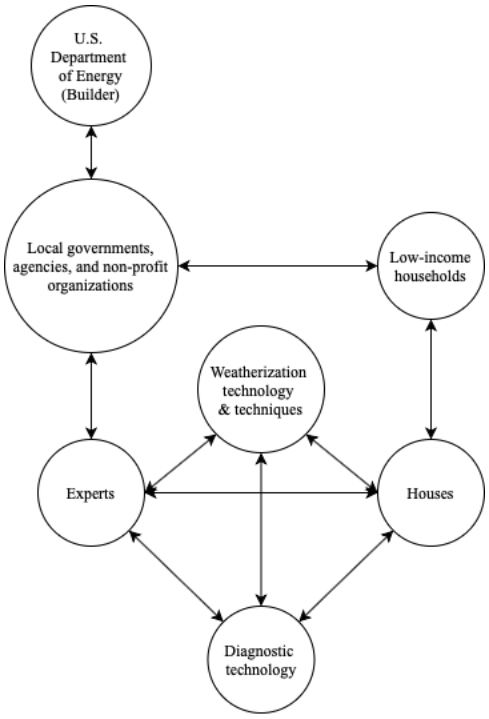

Figure 1: WAP Actor Network Diagram

Considering that this network has been established for some time now, many might assume that the network has moved successfully through the enrolment phase and has

remained in the mobilization phase. Yet research by Fowlie, Greenstone, and Wolfram (2018) suggests that the low-income families being served by the WAP are rogue actors within the network. More specifically, their research shows that very few, as low as 2% of eligible households, even apply to the WAP without any form of encouragement. An even fewer number of households are willing to follow through with audit procedures and less than 1% of all eligible households actually receive weatherization. In comparison, with active external encouragement, 13% of eligible households completed initial applications, resulting in 5% receiving weatherization treatments (Fowlie, Greenstone, & Wolfram, 2018). A network that aims to provide assistance to as many eligible participants as possible cannot be successful if those participants are not applying for the assistance, proving that eligible low-income households are serving as a rogue actor within the WAP network and are exposing it to vulnerability.

Since there is a rogue actor present within the WAP network, the network has been unable to move from enrolment to mobilization to operate as requested by the network builder. Similarly, this inability to move to the mobilization phase clarifies why the current WAP network is unable to eliminate the energy burden across all low-income households: because not all low-income households are aware of or want to be served by the network.

Energy Savings Assistance Program (ESA) Network

Pacific Gas & Electric has established the ESA program to provide necessary comfort and efficiency to low-income households in their California jurisdiction. Since the program's inception over 40 years ago, it has successfully moved through the problematization and interessement phases of translation. With PG&E serving as the

network builder, it has recruited the regional equivalents to the actors within the WAP network for the ESA network. The network architecture can be viewed in Figure 2.

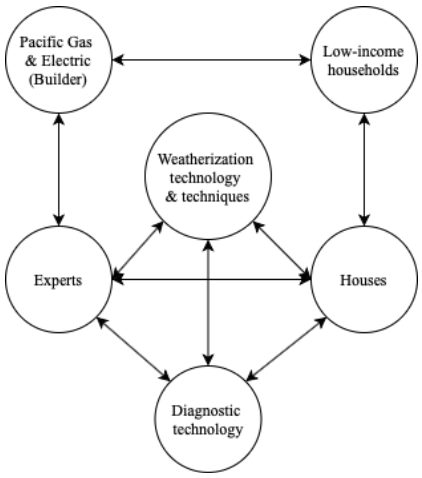

Figure 2: ESA Actor Network Diagram

In 2018 it was found that PG&E may have been acting against the goal of the network, resulting in the network's inability to be in the enrolment phase. In particular, an audit of the ESA program by the California Controller's Office found that between 2013 and 2015, PG&E was not maintaining proper expense procedures for approximately 14% of expenses, was not tracking ESA program costs appropriately, and was lacking adequate documentation for half of the contract records tested. But once these issues were brought to the attention of PG&E, they promptly implemented appropriate practices to ensure similar issues would not occur in the future (Yee, 2018). Through PG&E's eagerness to comply with the recommendations set out in the audit report, it can be seen that the company has ensured the continued effectiveness of the program, thereby successfully completing enrolment and proceeding to mobilization.

From the initiatives that PG&E has created within the ESA network such as community outreach efforts, constant improvements and additions of technology, and expansion of eligibility for applicants (Pacific Gas and Electric Company, 2019), it is

understood that the network builder is ensuring success of the network. Even though the greater ESA network is continuously being altered, the simple network discussed in this essay is complying to the wishes of PG&E and has entered the mobilization phase.

Nest Power Project Network

Considering that both the WAP and ESA were well established programs with similar goals to the Nest Power Project for over 30 years before it was launched, it stands to reason that project managers attempted to differentiate themselves from these programs. In particular, Google Nest, the network builder, has enrolled several unique actors into the network, including the Nest Thermostat E, Fannie Mae, and non-profit organizations in addition to many similar actors as those in the WAP and ESA networks. A visualization of the network can be viewed in Figure 3.

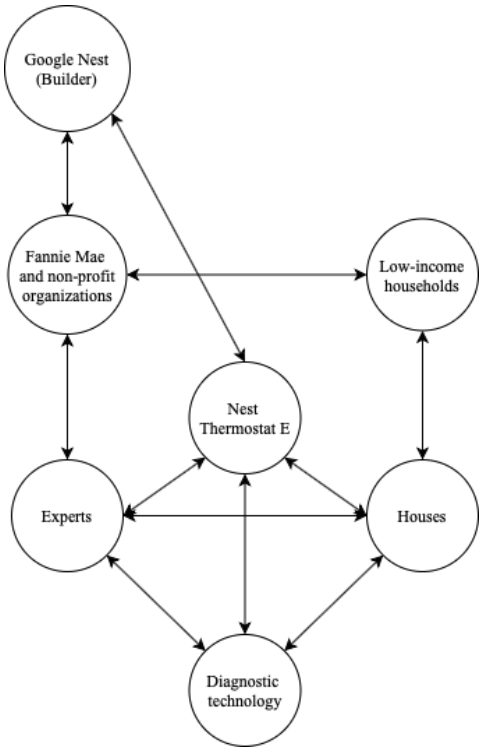

Figure 3: Nest Power Project Actor Network Diagram

Yet it is these differentiations that have most contributed to the vulnerability of the network. Despite the fact that the Nest Power Project is a newly established program, Google Nest has been able to quickly move through the problematization and interessement phases of translation. This has been done by Google Nest determining that they aim to eliminate high energy burdens for all low-income families and establishing themselves as the network builder and identifying the aforementioned actors. The network should now be in the enrolment phase. However, the Nest Power Project has been unable to successfully complete the enrolment phase and is facing vulnerability from two rogue actors: the Nest Thermostat E and Google Nest.

By using the Nest Thermostat E instead of a variety of traditional weatherization techniques as the main method of reducing energy consumption, the Nest Power Project network is unique compared to the WAP and ESA networks. The goal behind the use of the Nest Thermostat E was that it could use it's adaptive and diagnostic capabilities to provide temperature adjustments and maintenance alerts to households, ultimately saving them money and mitigating their energy burden (Rawes, 2019). But in actuality, "…heating and cooling [account] for less than half of the energy used in homes…" (Cluett, Amann, & Ou, 2016). Additionally, with "[t]he majority of savings from low-income energy efficiency upgrades currently [resulting] from weatherization shell measures and direct install measures, primarily lighting, faucet aerators, and showerheads," it becomes obvious that it will be extremely challenging for thermostat installations alone to mitigate the energy burden for low-income households. Because of this, it is impossible for the thermostat to act in the way that Google Nest requested to alleviate the energy burden for low-income households. Thus, the Nest Thermostat E is a rogue actor within the Nest Power Project

network that is exposing the network to vulnerability and preventing it from proceeding into the mobilization phase.

Another way in which the network is being exposed to vulnerability is through Google Nest's recent decisions regarding technology integration. Until August 2019, customers with Google Nest products have been able to integrate with a variety of third-party products from other manufacturers such as Amazon's Alexa. But as Google has taken greater control of the Nest product line, that integration capability has decreased. As of August 2019, "…consumers need a Google account – and access to the company's voice-based Google Assistant service – to integrate new Nest products with other devices in their homes" (De Vynck, 2019). As explained by De Vynck, this has made many customers apprehensive about purchasing Google Nest products. Though the Nest Power Project does not require that households purchase the thermostat themselves, it still requires that households be willing to accept Google Nest's technology into their homes. As homeowners in general have become more unwelcoming to Google Nest technologies, such as the Nest Thermostat E, it stands to reason that the integrity of Google Nest's technology has dwindled. Potential households looking to apply for assistance from the Nest Power Project may be deterred due to negative perceptions surrounding Google Nest. This would mean an even lower number of qualifying households receive assistance, because as witnessed in the WAP network, many households are already unwilling to apply for assistance even if they qualify. By negatively contributing to the perception of Google Nest and thereby the Nest Power Project, Google Nest has been unable to perform some of the duties of the network builder, such as successful recruitment of actors into the network.

Additionally, by solely relying on the Nest Thermostat E and Google products, Google Nest itself is acting as a rogue actor. This is similar to the situation faced by the ESA network in that the network builder itself is contributing to the vulnerability of the network. But unlike PG&E in the ESA network, Google Nest has been unable to realign itself with its intended goal of eliminating the energy burden for low-income families. One of the reasons why PG&E was able to realign itself with the goals of the ESA network and ultimately lead the network to mobilization is because it has constantly been expanding and improving the technology it supports and recommends for efficiency improvements. However, by limiting itself to one product, the Nest Thermostat E, and limiting it's integration capabilities, Google Nest has taken the complete opposite approach. Because Google Nest refuses to include other technologies in the network, it makes the network solely reliable on one actor, thereby limiting its possible success.

Furthermore, by failing to address the perceived risks of smart home technology, Google Nest is exposing the network to vulnerability in a similar manner. A recent study in the United Kingdom suggested that many consumers "…fear [a] loss of control in the home to smart home technologies…" as well as data and privacy loss. The study continued on "…[identifying] the need for industry marketing materials to better address the perceived risks of smart home technologies", suggesting that companies are inadequately communicating with their customer base (Crisp, 2019). This inadequate communication has led to continued fears surrounding the use of smart home technology and inherently limits the number of people who are willing to use it. Since the Nest Power Project requires that low-income households apply to the program, and thus requires that applicants be willing to use smart home technology, this is a reason for concern. As mentioned earlier,

the Nest Power Project network cannot enter mobilization if the low-income families being served begin acting as rogue actors and do not apply for weatherization assessment.

Overall, despite the resources available to Google Nest during the establishment of the Nest Power Project, it seems as if the network builder has been unable to create and foster a successful network. The Nest Power Project is being exposed to similar vulnerabilities as the WAP and ESA programs, and it is yet to be determined whether or not the network will successfully realign itself to enter mobilization.

Conclusion

Through the use of Actor Network Theory, I have shown how well-established programs – the Weatherization Assistance Program and the Energy Savings Assistance program – have either been restricted to the enrolment phase due to rogue actors or have overcome challenges presented by rogue actors to enter mobilization, respectively. By using these networks as a comparative tool, I have illustrated that the Nest Power Project network is currently facing similar vulnerabilities. Fortunately, the Nest Power Project is still fairly new and may be able to alter its proposed path forward to find success. In particular, as the network builder, Google Nest may still be able to realign the rogue actors in the network, the Nest Thermostat E and itself, to achieve the original goal set out in the problematization phase.

While previous analyses have focused on monetary measurements to mark success of the Nest Power Project, I have demonstrated how the consideration of societal factors provides a more in-depth and accurate analysis of the project. Understanding these factors will allow the general reader to more accurately decipher the goals and success of the project. As a society we will be unable to fully alleviate the high energy burden faced by

low-income families if we do not have an accurate understanding of the current solutions in place trying to accomplish this goal.

Word count: 3,669

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