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Abstract

A recent pilot test to enable an Automatic Demand Response system in California has revealed several lessons that are important to consider for a wider application of a regional or statewide Demand Response Program.

The six facilities involved in the site testing were from diverse areas of our economy. The test subjects included a major retail food marketer and one of their retail grocery stores, financial services buildings for a major bank, a postal services facility, a federal government office building, a state university site, and ancillary buildings to a pharmaceutical research company. Although these organizations are all serving diverse purposes and customers, they share some underlying common characteristics that make their simultaneous study worthwhile from a market transformation perspective.

These are large organizations. Energy efficiency is neither their core business nor are the decision makers who will enable this technology powerful players in their organizations. The management of buildings is perceived to be a small issue for top management and unless something goes wrong, little attention is paid to the building manager's problems.

All of these organizations contract out a major part of their technical building operating systems. Control systems and energy management systems are proprietary. Their systems do not easily interact with one another. Management is, with the exception of one site, not electronically or computer literate enough to understand the full dimensions of the technology they have purchased. Despite the research team's development of a simple, straightforward method of informing them about the features of the demand response program, they had significant difficulty enabling their systems to meet the needs of the research. The research team had to step in and work directly with their vendors and contractors at all but one location.

All of the participants have volunteered to participate in the study for altruistic reasons, that is, to help find solutions to California's energy problems. They have provided support in workmen, access to sites and vendors, and money to participate. Their efforts have revealed organizational and technical system barriers to the implementation of a wide scale program.

This paper examines those barriers and provides possible avenues of approach for a future launch of a regional or statewide Automatic Demand Response Program.

Introduction and Background

A recent pilot test to enable an Automatic Demand Response (Auto-DR) system in California has revealed several lessons that are important to consider for a wider application of a regional or statewide Demand Response Program.

This Automated Demand Response test has been developed as a government sponsored conceptual study whose primary purpose is to test the hypothesis that an automated Demand Response system is technically possible. An outcome of the study is some information about the likely users and their organizational capabilities of responding to demand response program. The information on the organizational capabilities is reported in this study.

All of the participants have volunteered to participate in the study for altruistic reasons, that is, to help find solutions to California's energy problems. They have provided support in workmen, access to sites and vendors, and money to participate. Their efforts have revealed organizational and technical system barriers to the implementation of a wide scale program.

This paper examines those barriers and provides possible avenues of approach for a future launch of a regional or statewide Automatic Demand Response Program. It also describes lessons learned in a mock up of a Auto-DR program.

In each of these large facilities, the core business is not energy management and the energy management team gets little attention from top managers unless things go wrong. Each of these organizations operates through a complex bureaucracy that can seem impenetrable at times. All of the facilities are operated with extensive outsourcing of control and service activities which removes the management from the first level of understanding of the problems they will encounter. The facility managers have had some technical preparation in Demand Response programs since they all participated in an earlier test. None of the companies had engaged in any real life Demand Response programs and all were unclear how their organizations would participate in the future.

Lessons learned in the implementation of a pilot study often fail to report the organization's response to the introduction of new technologies. For the purposes of the test, some organizational impediments are smoothed over and others are ignored to be solved later. This paper will describe some of the organizational impediments and suggest ways that future research can be conducted to examine some of the barriers further. It will also discuss briefly the manager's concerns with Demand Response programs and help define the strategic vision for organizational Demand Response Technologies.

Methodology

The Auto-DR test was a test of a technical Auto-DR program. The managers were asked to help implement the new technology, but the business decisions were hypothetical. This means that Auto-DR program is a real test of the technology, but only a simulation of organizational behavior. The managers' organizations did not receive direct economic benefits from participating. The Auto-DR response that they responded to was hypothetical and limited.

The methodology to collect information on organizational behavior included telephone interviews, some on site interviews, observation of some meetings, and reports from the project team members who were assisting with the technology and measurement part of the study.

The research was conducted as Participant Action Research, that is, the technical and organizational researchers were both observing and directing. The technical members of the research team were closely involved with helping solve technical problems as they arose and had first hand knowledge of owner problems. The technical researchers sent email copies of notes and status of the job to all the team members to keep them informed. This researcher was involved in some project management type tasks including checking on schedules and making sure the managers understood the test.

Although the organizations are not selected for innovativeness, the selection of the organizations in the study was not random. After considering their previous involvement in a Demand Response program, a further underlying motivation for selecting these particular organizations is their size. Specifically, the size of their portfolios would offer good future opportunities for larger scale energy shedding and the existence of an automated demand response would offer flexibility and advantage to the grid operators.

The institutional owners represent several classes of building use. They manage university buildings, grocery stores in a chain, financial services, state and federal office buildings. For the purposes of future full scale Automated Demand Response Program, these owners are Lead Users whose participation will reveal not only their technical issues, but also organizational and business issues that can encourage or imperil an Auto-DR program.

The diversity of the use, ownership, and management methods reflected a good cross section of large facility owners.

Figure 1. Facilities Involved in Auto-DR Test

Type of Business	Ownership	Facilities Managed By
Retail Grocery Chain	Private	Corporate staff manages through regional staff, outsourced controls and most HVAC outsourced
Pharmaceutical Research	Private	Large private staff managed by company employees, outsourced controls
Public University	Public	Large government employee staff, outsourced controls
Government Office Building	Public	Large government employee staff, outsourced controls
Government Postal Facility	Public	Large government employee staff, outsourced controls
Large Bank	Private	Third Party Property Manager provides engineering staff, outsourced controls.

At the close of the project, managers were only asked if they thought they project was successful and if they would do it again. A detailed organizational study was not done as these facility managers are expected to be in future Auto-DR tests and a more complete organizational test can be done at that time.

Results

In the course of most research on innovations, it is useful to determine before undertaking the study which of the potential users are most innovative. This was not possible in this study as the selection criterion included using organizations that had undertaken a previous study demand response study. Some part of the infrastructure was in place to enact the demand response program. The institutions studied were given to the organizational researcher and were not intended to form the basis for a formal case study analysis. Without conscious plan, the facilities did represent a good cross-section of the potential Auto-DR market for large facilities.

Large facilities are managed by a complex system of organizations. To an outsider, these organizations can be dauntingly large especially when trying to approach them for the introduction of new innovations. Everyone in the organization presently has a job responsibility and most are very busy. The routine responsibilities of most of their work keeps them busy handling the day-to-day operation of the facilities.

Lead Users

Lead users of these large facilities are an extremely valuable cluster of customers and potential customers who can contribute to identification of future opportunities and evaluation of emerging technologies. (von Hippel) Understanding these users can provide richness of information relatively efficiently. The concept of Lead Users was introduced by von Hippel in the middle 1980s, von Hippel defines lead users as those who exhibit the following two characteristics.

- They face the needs that will be general in the market place, but face them months or years before the bulk of that marketplace encounters them
- They are positioned to benefit significantly by obtaining a solution to those needs

To help the managers in the organizations understand what was required for the test, the researchers prepared a Memorandum of Understanding (MOU) which carefully described the technical aspects of the Auto-DR Program. The researchers followed up the MOU with telephone calls that urged, convinced, suggested and encouraged the idea that some form of an Auto-DR Program would likely be seen in California's future.

Unlike, many studies with Lead Users, these Lead Users did not self identify themselves as potential lead users of an Auto-DR program. From conversations with the users it was clear that they had not formerly thought in any detail about the idea of an Auto- DR program. Most were familiar with the meaning of demand response, but were uncertain how a real Auto-DR program would be applied to their operations.

Getting participation in the project was not easy since they needed to be persuaded that it was in their long term interests to participate by helping them to understand that DR performed a

valuable public service of shedding loads at peak times. They were told that they would likely be asked to automatically shed in the future. The researchers told them that they would likely be the first to understand new programs if they chose to participate and presented this as a business advantage to participants.

At some time in the initial "sales" calls, four of the potential study sites decided not to participate and had to be resold the concept. One of the participant's vendor problems caused them to drop out of the study entirely. Reasons for not wanting to participate may be easy to understand, but are restated here for those not familiar with this type of test. The program is exploratory, conceptual, complicated and may include some unknown costs. The benefit is not clear and the individuals in the organization at this level are not risk takers. The primary motivation these Lead Users offered for their willingness to undertake the test was their desire to be good citizens (altruistic motivations) and a weak secondary reason was their desire to be on top of a new trend in energy purchasing (business forecasting, cautious risk aversion).

Government Testing

There is some reluctance to get involved with large government sponsored studies. Government's role in conceptual testing is not a well understood phenomenon despite the large amount of government sponsorship of such tests. Some research shows that the role of government is often at odds with the primary motive of most companies, that is, to make a profit. Government testing often leads to regulations and complications that industries would rather avoid. But, government has a role here in serving the "public good" and all of the Lead Users appeared to accept that role.

During the course of questioning about the Demand Response Program, the participants were all asked how they would feel about a program that was very simple for the gird operator to implement.

> "What do you think of a system that will shut your facility down entirely from time to time when there not enough energy to serve the entire grid?"

It is not an exaggeration to say that each participant reacted with horror to this suggestion. In fact, this is the existing situation they face now. Large parts of the grid are now shutdown apparently indiscriminately when energy demand exceeds energy capacity. When they come to this realization, these Lead Users are willing to accept that the government and research has role in solving the problems of balancing energy capacity against demand.

Although government's role in conceptual testing is often unclear, a major study that compared the US model and German model of government sponsorship of conceptual testing. (Sabel, Herrigal, Kazis and Deeg). This study revealed that policies to promote shifts in technology or innovation were unsuccessful unless the government simultaneously encourages or at least allows the effected industries to reorganize themselves to take advantage of innovations. Further, in cases where large scale action is required to accomplish some public "good", it may be necessary for the bonds of competition and collusion to be weakened so that sharing of information is possible. As representatives of the citizens, government can guide the development of concepts that are good for industry and good for the citizens. The government can act as an intermediary (Sabel, Herrigel, Kazis, Deeg) and effectively lead innovations that enhance both sectors if the goals are not set too high and the purposes sufficiently compelling.

From the perspective of these Lead Users, both criterions were met in this test. They were not asked to do too much and they accepted the role of the researchers' study of Auto-DR because the purpose was sufficiently important to them.

Large Facility Lead Users Share Characteristics

Owners of the institutions we studied share common characteristics. They are large and operate as entities whose boundary edges are far apart. Some members of the institution spend almost all of their professional lives dealing only with other members of that institution. The core business or goals of the institution are clear to all participants and members are valued who can do routine things efficiently – deliver mail, process federal operations, conduct financial services, prepare and graduate students, deliver groceries, conduct long term testing of products. From previous research, we had an entry point of contact provided for these organizations; nevertheless, the site coordination was not easy. Putting aside for the moment the complexity issues that arise from the out sourced technology that is located at a distance from other technologies, there were still problems. Since there is not Auto-DR program in existence for these companies to develop and organizational response to, no one in these organizations is responsible for implementing the program.

The institutions primary focus is to do something over and over again with low transaction costs and high efficiency. That is not to say that they are not innovative, but the operation of the physical facilities are incidental to the routine core mission of the organization. Each day, buildings are operated, bills get paid, and the air conditioning runs at is a level of service that is below the top management radar unless something goes wrong. The mid level management personnel within these bureaucracies value optimizing and managing routine functions efficiently and without fuss.

The researchers explained the Auto-DR program to the potential participants and an early first response was the statement from the manager that he was not responsible for that. They often offered the name of a peer in another department or area who they thought provided a better fit. Of course, it did not fit into that department either and we were found ourselves cast back and forth between individuals in the company. An Auto-DR program is complex and the inability to find someone to "own" it was an impediment to the research program.

Institutions are operated by a bureaucracy. Bureaucracy is often used as a pejorative epithet in common usage and is meant to define mindless over-conformity and rule-encumbered inefficiency. The term bureaucrat is used here in the Max Weber (Weber, 1947, trans: 339 and quoted in Scott 1987) sense of an organization of extremely high efficiency that focuses on doing routine things very well. Combining the word bureaucracy with institution seems to call to mind particularly strong prejudices in the minds of most readers. But this is not necessarily so. Whether their core business is financial services, producing undergraduates, delivering the mail, distributing groceries or providing drugs to a heavily regulated marketplace, the institutions in this study share common characteristics. They do a workmanlike, quality job at their core business and it is the shared goal of every member of the bureaucracy to make the operations more efficient.

When the main purpose of an organization is well known understood by all the participants and optimized routine functions are the expected and desired outcome of every manager's job, even worthwhile innocuous innovations may fail to thrive. Innovations that

imperil the core goals of the institutional bureaucracies are certain to cause anxiety to responsible managers.

Widespread Outsourcing of Technology is Likely to Cause Problems

The large institutional owner that is managed by a professional bureaucracy shared many common problems. The widespread use of outsourcing causes the specific knowledge required to be located outside the company. The size of the organizations and organizational emphasis on routine provides a difficult to overcome organizational culture. Adoption of technology over time, the fact that the enabling technologies are located at some distance from each other and the complexity of the systems makes implementation difficult.

An impediment now widespread in these large institutions is that the knowledge about many technical functions is now outsourced to specialty vendors and subcontractors. These specialty companies are in the business of selling services to the institution and while their opinion is valued, it is often discounted as sales talk. The CEC's support and LBNL's leadership can overcome some of the prejudices that the owner's representative may feel about engaging in the test, but it is not a solution for a long term DR program.

The typical mid level manager at these types of organizations does not really understand the technical detail necessary to accomplish a Demand Response study. In fact, it is not easy for them to understand what is involved sufficiently well for them to accurately budget the work to be done. They require assistance to enable a Demand Response system. The intermediary role between the outsourced technology company and the mid level manager at the institution has been undertaken by the researchers on our team. This is not a condition that is a test only condition. Any large scale implementation of this technology will have to adapt to these conditions and provide knowledge and leadership assistance if it is to be successful.

Recommendations for Future Research and Full Scale Auto-DR Programs

The role of the intermediary was partially developed on this project and the next discussion will include the organizational "assistance" that the research team undertook to accomplish this test. It is not clear how much assistance will be needed on future Demand Response Programs including a full scale test, but it appears to be significant and should be funded and tracked so that we can analyze it further.

Large facilities generally are built over time. Although there it is not intentional or desired, many of the EMCS and EIS systems accrete technology over time. That is, additional features are added and layered on to existing systems controls in a messy fashion. This messiness is a leading cause of the technical support needed. The systems are unique, have differently aged layers and suffer from the obscurity that comes from the use of proprietary hardware and software. One of our team members spent a considerable amount of time deciphering the layers and prepared a set of graphics to describe the systems that we encountered (Piette, et. al. 2004). It is likely that this messiness will be found to be similar at all future sites too. We must determine how to deal with this messiness if we are to have future success using commercial systems.

A traditional problem with large, complex systems is that they may be so complex that it is difficult to know if they are operating correctly. Although, this is partially a condition that

could be corrected by good commissioning, commissioning alone is not the complete answer. The "science" of how things fundamentally operate is being lost to many technology users. As older operators retire and new operators come on board who do not really understand the systems they operate, more problems are likely to occur. The training of the operators of the demand response programs may be the most difficult and most important need for implementation of a long term program. Specifically, it will be necessary to have local experts in the institution who understand how the Demand Response system works. In the short term, technical assistance from the research team will include debugging and testing, but this is not a long term solution. The institution must "learn" and be able to provide an adaptation to the Auto-DR need or the systems will not be adopted.

Providing energy is a complex endeavor. Making sure that every customer has power and that it is delivered in a routine and safe way is a tremendous accomplishment of modern civilization. But the provision of energy services has relied in the past on a paradigm that is changing. Good energy services today imply not merely getting the energy to the right place, safely and without interruption, but new public goals of peak shedding and demand responsiveness. The existing industry organization does not presently support these goals and although there is universal agreement among the six participants that these programs are necessary, they cannot provide the leadership to solve the problem. Industrial users at these Lead User sites, accept the role of government sponsored research in developing a solution.

There are very few industries and institutions that do not have Lead Users. But in the case of Demand Response programs, the Lead Users may not self identify themselves. They do not have real Demand Response programs to study yet. Their technology is cumbersome and values safety and security of information over demand responsiveness. It will be important for the researchers to target clusters of lead users and educate them about the long term likelihood of demand response programs and help mid-level managers to guide their cumbersome bureaucracies towards participation in these programs.

In future studies, we will need to identify opportunities for demand response programs and evaluate emerging concepts. It will highly desirable to further engage participants as Lead Users so that they can become part of the extended demand response design team. They should be encouraged to share the burden of investment but we will need to keep the costs paid by the participants low in the initial stages of the research until the concept has been proven to them. They are unlikely to have continued interest unless a real Demand Response program is revealed after the next round of testing.

The lack of any real Demand Response program is presently an impediment to the research. Another impediment is that these lead users buy some or all of their energy from Direct Access suppliers. A Demand Response program for Direct Access customers should be developed as they are likely users of an automated demand response program.

There may be a long term enabling project that has associated services for these large users. Assisting them to understand the technology they presently have and helping them to understand how Demand Response fits may not seem to be the role of researchers or government, but it will undoubtedly be necessary for a full implementation of these systems. In the short term, continued intensive technical assistance will be required to make Demand Response programs successful.

In order to be possible to roll out a full scale Auto-DR program in the future, someone needs to identify and undertake the formative education of the institutions that are likely

candidates. Large institutional owners with formal bureaucracies will not be able to respond in a single season unless they have some previous knowledge about Auto-DR program and can identify within their organizations a responsible participant. The potential participants are low power actors in their overall organizations. To make the Auto-DR programs successful in getting things done in these organizations, it is critical that we are able to diagnose the relative power of the relative power of the various participants and comprehend the patterns of interdependence. One needs to know and understand not only the game, but the players. (Pfeffer, 1992)

A likely avenue of approach to institutional owners appears to be to work up through the knowledgeable vendor and controls supplier rather than down from the institutional owner. Owners who fully understand their outsourced technologies are rare, but an educated vendor can enact the change more easily. Further, an educated vendor can supply the essential information on cost that the midlevel managers need in order to get permission to participate. Vendors may also be able to supply the names and departments of the individuals who should be approached so that a relationship can be developed.

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