VALUE OF IN-HOUSE RESOURCES FOR TELEMETERED SAMPLING SUCCESS

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Introduction

For the last several years the Load Research group at Detroit Edison has maintained an active sample of Residential Interruptible Air Conditioning customers. The sample has provided valuable insights into the usage patterns of central air conditioning customers plus given the company a firm understanding of the value and magnitude of interruptible load for use in load management. In 1998 Load Research decided to replace the existing four year old Interruptible Air Conditioning Sample and evaluate the use of newer technologies to gather sample load data. This paper discusses the methodologies, innovations, and outcomes of the project that incorporated telemetered technology with in-house expertise to achieve success and minimize costs.

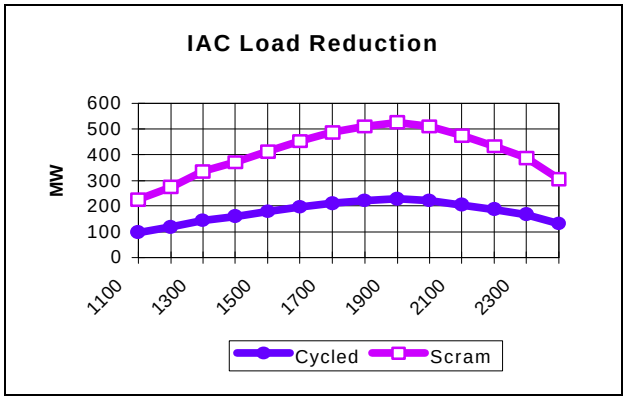
ELEMENTS OF SUCCESS

- ✓ Use Customer Representatives rather than Tele-Marketers
- ✓ Internally design and develop cell phone modules
- ✓ Customize installations to minimize equipment attached to a customer's premise
- ✓ Encourage team members to be creative problem solvers
- ✓ Develop software to guide processes
- ✓ Recognize that people skills are as essential to Load Research as technical skills

History of Interruptible Air Conditioning

The Residential Interruptible Air Conditioning rate has been available to customers for over 15 years. Under the provision of the rate, customers are billed at a reduced cost per kWh during the cooling months of May-September in exchange for Detroit Edison having the ability to interrupt air conditioning service up to thirty minutes per hour for no more than eight hours per day. The Interruptible Air Conditioning (IAC) rate is served via separate/dedicated meter with attached Remote Control Unit to receive the interruption signal. Currently 28% of all customers with central air conditioning are served on the rate. Interruptions normally occur 4-10 times annually based on several factors including weather, system load and generation capacity. The company uses two interruption programs. When interrupting for normal load control the air conditioners are 'Cycled' on and off at 15 minute intervals. Under emergency conditions the air conditioners may be interrupted the full 60 minutes of an hour. This type of interruption is referred to as a 'Scram'.

Load Research, using a forecasting model developed from 5 minute interval demand sample data, provides projected load reduction curves for load management decision making prior to actual interruption. The graphic below is typical of the model output produced .



The original IAC Load Research Sample consists of 185 sites installed in early 1994. Through 1998 the sample consistently provided precision levels of 10% or better at 90% confidence for the peak hours of 1500-2000 for days with a maximum temperature ≥ 87º.

Motivation for New Sample & Telemetering

Continuous demand for timely load data, coupled with the increased load management efforts of the company focused heavily on Interruptible Air Conditioning and Load Research during 1998. The ability of Load Research to forecast and measure the amount of interruptible load has become critical to load management. After reviewing the age and deteriorating state of the 1994 sample, a cost analysis of new meter equipment, and telemetering technologies, Load Research decided to replace the IAC Sample by June 1, 1999 in order to record this summers air conditioning load and enhance the value of Load Research. It was further determined that within the central air conditioning customer population significant changes had occurred since the 1994 sample was designed. Among these changes were a large change over in existing units to more efficient properly sized units, a significant change in the IAC customer demographics due to economic strength in the service area and the number of new housing starts. Furthermore, new housing in the Detroit Edison service area has continued to show increases in square footage and builders often include the interruptible rate when installing central air conditioning

Load Research also wants to continue offering new value added services through a progressive approach to timely data gathering and meaningful presentation of analysis. In addition, the new sampling strategy has both a survey and control group to accurately measure the magnitude of interruptions and payback. Payback refers to the increase in both demand and kWh sales following an interruption that would not have been present without interruption. The importance of this data dictated that we look at gathering data as close to real time as possible.

In the end, we decided on a telemetered sample using customer friendly installations with customer approval and a cellular phone network.

Sample Design

Sample development was conducted using standard Load Research methodologies including an analysis of various stratification schemes. Both ratio estimation and mean-per-unit expansion techniques were examined with ratio estimation being rejected because no efficiency was added to the sample using the more complex technique. The sample design required 90% accuracy at 10% precision for all hours between 1100 & 2100 on days with maximum temperature ≥ 87°. The design also dictated a distribution of sample customers based on rate, average kWh use and geographic location equal to the class population.

Sample Features

- ✓ ***Increased number of hours covered***
- ✓ ***Telemetered Data Collection***
- ✓ ***More accurate measure of interrupted load***
- ✓ ***Survey (interruptible) and Control (non-interruptible) groups***
- ✓ ***Ability to study Payback***
- ✓ ***More precise model inputs***
- ✓ ***5 minute data collection***
- ✓ ***4 hour data turn around - meter to analysis***

The survey and control groups were designed to be identical in size and as statistically equal to the population as possible while minimizing the sample size. The final sample size is 200 sites each for both the Survey and Control groups.

Final Design Statistics			
Statistic	**Sample Group**	**Control Group**	**Population**
Average of Avg Use (kWh)	10.17	10.86	10.66
Standard Deviation	7.13	8.02	7.79
Variance	50.87	64.25	60.61
Covariance (CV)	0.70	0.74	0.73
CV % of Population	96%	101%	100%

Innovative Implementation

In general the planning for this new sample and its design follow standard Load Research practices. What sets this sample apart from all others are the innovative techniques employed in the implementation, installation and hardware development of the project. The collective success of these innovations not only shortened the project length but saved substantial sums of money contributing to the cost justification of telemetered samples.

Customer Contact

The decision to install a telemetered sample meant that an additional box to hold communication equipment would be mounted on the customer premise. In the spirit of maintaining quality customer relations and promoting customer acceptance, it was decided to contact each selected sample customer to explain the purpose of the sample, what new equipment would be installed, obtain customer approval,

and collect demographic data. After reviewing several proposals from Market Research firms to conduct the telephone interviews, the Customer Representative Telephone Center of Detroit Edison was selected to make the contacts. The decision to use Customer Representatives (CR's) seems obvious in hindsight because of the numerous advantages they offer. CR's have a vested interest in our customers and are highly trained to answer other questions customers may ask during the solicitation call. Through training provided by Load Research, CR's are positioned to answer detailed questions related to samples plus the meters and equipment to be installed. This is an ongoing benefit because CR's are now trained to answer inquires related to all Load Research samples on a continual basis.

The cost for each customer acceptance using CR's was $11.50 compared to the lowest Market Research firms proposal of $22. In addition the use of company CR's offered scheduling flexibility and made Customer Representative management aware of opportunities for a new line of business.

Communication Network

In the planning and design stage of the new IAC sample a thorough study of the various methods to retrieve metered interval data was conducted. Historically a hand held device carried by Load Research contract meter readers has been used to extract data from Detroit Edison sample meters. Although this method is reasonably inexpensive, the process of gathering data is lengthy, analyzed data usually follows the day of interest by at least a month, and data is often missing or incomplete.

In an effort to improve the total process we evaluated vendor supplied cellular communication and traditional telephone communication equipment. The load profile meter we purchased contains a built in modem that can accommodate either type of communication network. In addition the meter has a probe port to facilitate manual data retrieval via hand held device if necessary.

Vendor Supplied Cellular Hardware

Vendor supplied cellular communication equipment, although initially attractive, presented key negatives to the project.

1. They are built as multi-purpose devises, which makes the size of the cellular cabinet exceptionally large and heavy. Although vendor supplied cabinets are built to accommodate the installation of optional modems and battery back-ups, their overall dimensions and weight (approximately 14" x 12" x 6 ½" and 10 - 12 lbs.) were obstacles to most customer installations.
2. The average cost of $750 per unit was a definite barrier to using cellular communication.
3. The vendor supplied cellular phone required a battery back up to guarantee successful reconnection following power outage.

Traditional Telephone Communication

Together with our Communications department, we worked to develop a partnership with our major local Telephone Company to plan a traditional telephone connection to our load profile meter. Although the Telephone Company was very enthusiastic and accommodating, this method also had several drawbacks.

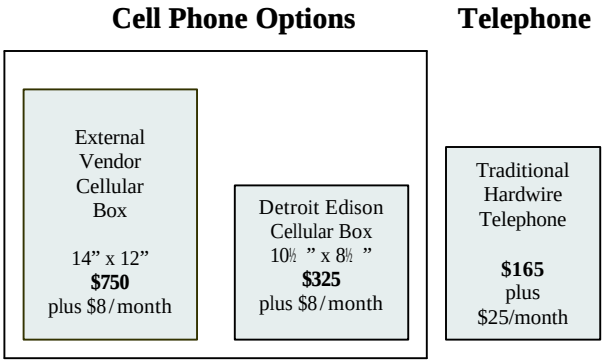
1. The Telephone Company's average installation cost per site was $150. In addition, we would have had to install a $15 telephone junction box connected to our meter for the telephone wire to terminate.
2. Telephone service drops are often connected to a different side of the house than the electrical drop. Additional costs would be incurred to run telephone wire from the drop to our junction box. This would also add a great deal of unsightly wire to the outside of our customer's home.
3. Monthly telephone charges would be as high as $25 per month in comparison to $8/month for cellular and $9.25/month for actual meter reading.

Over and above these concerns is the fact that these negotiated rates only covered 90% of our service area. To facilitate installations throughout the service area, we would have to negotiate individually with up to 6 other telephone companies serving Southeastern Michigan.

Internally Designed Cellular Box

After noting the problems inherent in both hardwired systems and vendor supplied cellular hardware, our Communications engineers set forth to design a cellular solution that would not only satisfy installation concerns but also reduce project costs. Their innovative effort resulted in the design of a cellular box that met all of our technical criteria plus could be assembled and delivered for $325 per unit. In addition the unit weighs under 4 pounds and measures only 10½" x 8½" x 6½" which is

considerably smaller and lighter than vendor offered hardware. The in-house designed box contains the same components and features offered by vendors including the cellular receiver, transformer and internal antenna. Our Communications engineers also negotiated a rate of $8/month for off-peak service from a national cellular carrier. The $8/month rate would also apply to vendor supplied units. The following diagram represents the decision to use our own cellular box design.



In addition to the economics, the decision to use our internally designed cellular box had two distinct advantages. First, the receiver was capable of full reconnection following a power interruption without requiring battery backup. Second, the box is smaller and light enough to mount on the existing meter cabinet. Because of this, we were able to design a method of installation without mounting any hardware to the customer's home. It is our intention to remove the equipment in 3 – 4 years, so we do not want any holes drilled in the customer's home. This also made it much easier to obtain customer installation permission.

Equipment Installation

Prior to actual installation we spent considerable time defining how the installation would be completed, who would actually perform the installation, and who would be responsible for on-going maintenance. Several concerns were addressed during this phase of the project including safety, ease of installation, method of mounting the cellular box, selection of installers, and training. Similar to using our Communications engineers to develop the cellular box, we enlisted the help and expertise of our Meter Safety & Training, Meter Performance, and Field Service groups along with our Design Shop to assist and join our project team. This cross-functional team brought a great deal of enthusiasm and creativity to the project that produced both innovative and cost saving solutions.

Field Service Installers

The Field Service group viewed their involvement in the project as an opportunity for their field servicemen to learn new skills, be part of the new technologies, and create diversity in their job tasks. As a result, they selected ten senior servicemen to become dedicated installers for the duration of the project. Field Service also provided each serviceman with a van equipped with a cellular phone and Field Service Automation System display terminal. This system facilitates automated entry of installation orders by Load Research, displays orders on the terminal in the installers van, and allows entry of the completed installation at the job site. The cellular phone is used to field verify the cellular box connection at the site following installation.

The ten servicemen were assigned specific geographic areas to minimize cost and travel time. Typical installations were completed in less than 30 minutes.

On going maintenance of the sample sites will be performed by the Field Service group as part of their normal meter and service activities.

Safety, Training & Engineering

Through the combined efforts of Safety & Training, Meter Engineering, and our Design Shop, a simple yet efficient installation method was devised. For safety, a fused power supply was wired from the lead side of the meter to the cell box transformer. To accommodate a variety of field installation meter configurations, two cell box mounting brackets were designed and built which allowed the cell box to be mounted on either the side, top or bottom of the meter cabinet. The cell box is actually mounted on the bracket that is then fastened to the meter cabinet. Again, this avoids drilling holes in the customer premise. The graphic below illustrates a typical installation containing the cellular box, IAC meter, residential meter, and the remote control unit that receives the interruption signals.

Custom Databases

The majority of this project was coordinated and monitored using two Microsoft Access databases custom designed by Load Research and Meter Engineering personnel.

The Customer Contact/Demographic database (Exhibits 1-4) designed by Load Research was used to:

1. Select primary and alternate sample sites.
2. Facilitate CR customer calls and automatically provide CR's with an alternate customer if the primary customer declined to participate or could not be contacted.
3. Track successful customer solicitations and collect demographic data.
4. Produce demographic reports.

The Installation Control database developed by Meter Engineering, tracked hardware installation, cellular testing, and hardware maintenance, plus it contains a complete inventory of equipment and cell phone numbers installed by site. In addition the database built a customer record that was electronically sent to our data retrieval and translation system (MV-90) to establish each site.

Data Retrieval

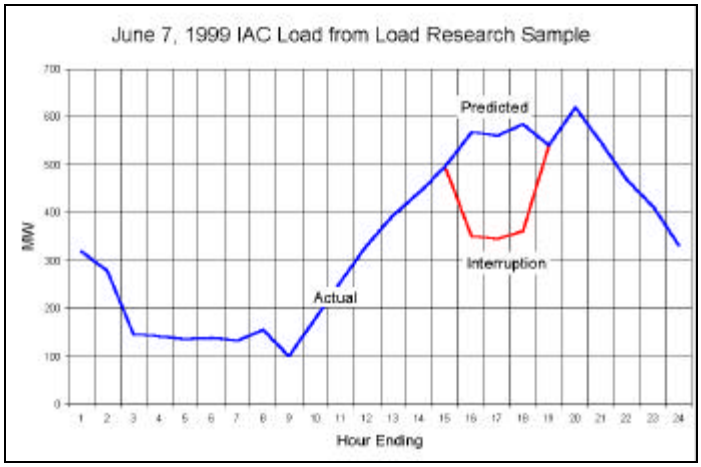
On a weekly basis the MV-90 system, via modem, communicates with each telemetered site to extract the interval demand data. Following translation and validation processes the MV-90 passes the data to LodeStar®, our data analysis system, for storage and analysis by Load Research. If needed, we have the capability to dial all 400 sites and produce final analysis of the IAC load within 4 hours.

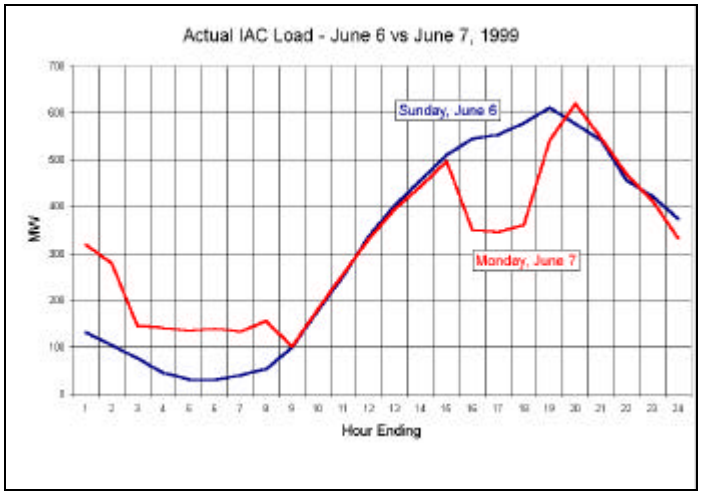
Sample Outputs

As of June 1, 1999 the new IAC Sample was in place and recording 5-minute interval data. Remarkably, the Detroit Edison service area experienced an extreme heat wave the following week and load management procedures were implemented. As part of the Load Management Team, and at the request of management, Load Research called the new sample daily to produce an analysis of air conditioning impact and measurements of load reduction due to interruption of IAC customers.

The timeliness of the telemetered sample data has proved to be extremely valuable to decision makers planning and providing for the energy needs of our customers. As a result, Load Research has become a key player in managing our company's summer load.

The two graphs shown below represent data gathered from the new sample on Sunday, June 6 and Monday, June 7, 1999 when temperatures reached 92º each day. As clearly illustrated, the IAC customers were interrupted for load management purposes on June 7 from 1500 through 1800 hours.





The data obtained from this sample will continually be analyzed, together with the associated demographics, to provide meaningful information for:

- Rate Making
- Public Service Commission Request & Reports
- Forecasting
- Load Management
- Residential Marketing
- Management Requests

Lessons Learned

As is typically the case with large projects, we learned several valuable lessons during the course of this project. Overall the lesson learned is simply encourage others to be creative and give them the opportunity to utilize their talent. Specific lessons are:

Empower Others: By empowering members of our project team representing areas other than Load Research, the cellular box was developed, mounting brackets were designed, and databases built that resulted in cost savings that justified installing a telemetered sample.

In-house can be better: Unfortunately, recognizing the talents that exist in your own organization is sometimes overlooked. It was our experience that we have superior talents within our company that can add value to a project as well as lower costs and create valuable long term relationships.

Customer buy-in worth the effort: Although Detroit Edison has the right to change metering equipment without customer approval, acquiring customer acceptance helps build customer satisfaction and lowers cost. By soliciting customer approval prior to actual field installation, we not only eliminated customer calls and complaints but often were able to avoid installation attempts based on information gathered from the customer. We found customers very willing to participate and appreciative of our contacting them. As a result, even though we did not offer any incentive, very few customers refused to participate. In fact, many who declined during the solicitation call actually called back with a change of mind. The call is also a low cost method to obtain demographics from 100% of participating customers.

Micro oversee rather than micro manage: Many times in this paper I discuss using several organizations during the project. We found that giving organizations full management control of their portion made them a stronger, more committed partner in the project. By closely monitoring activities rather than managing them, we witnessed organizations build-in efficiencies we are convinced would otherwise not have happened.

Additional Information

For additional information related to the topics discussed in this paper contact:

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PROJECT SUMMARY

Innovations

Customer Contact

- ✓ Company Customer Representatives used to acquire customer approval and collect demographic data.
- ✓ Developed software to guide Customer Representatives, provide alternate sample sites and create demographic database.

Communication Medium

- ✓ Cellular technology used instead of phone line.
- ✓ Internally designed and assembled cell phone module.

Field Installation

- ✓ Developed method to attach cellular box to meter cabinet without putting holes in customer's house.
- ✓ Trained existing field personnel to install and maintain cellular equipment.

Advantages

Customer Reps vs. Market Research Firm

- ✓ Reduces costs to acquire sample sites.
- ✓ Customer Reps have a stake in customer satisfaction.
- ✓ Customer Reps can answer other customer questions.
- ✓ Customer Reps positioned to answer year round questions related to Load Research meters and equipment.
- ✓ Opens up a line of business for Customer Reps.
- ✓ Scheduling flexibility.

Internally designed / assembled cell phone unit

- ✓ Reduce cost by 50%.
- ✓ Utilize in-house expertise and create additional business opportunities.

Load Research value added project

- ✓ Progressive approach with applications for customer choice.
- ✓ Load Research recognized as a creative leader in providing timely decision making data (i.e. Load Research continually invited to the party).
- ✓ Collection and analysis of data is almost immediate versus the time-delayed analysis from probed data.

Exhibit 1 - Customer Contact/Demographic Database - Customer Information Screen

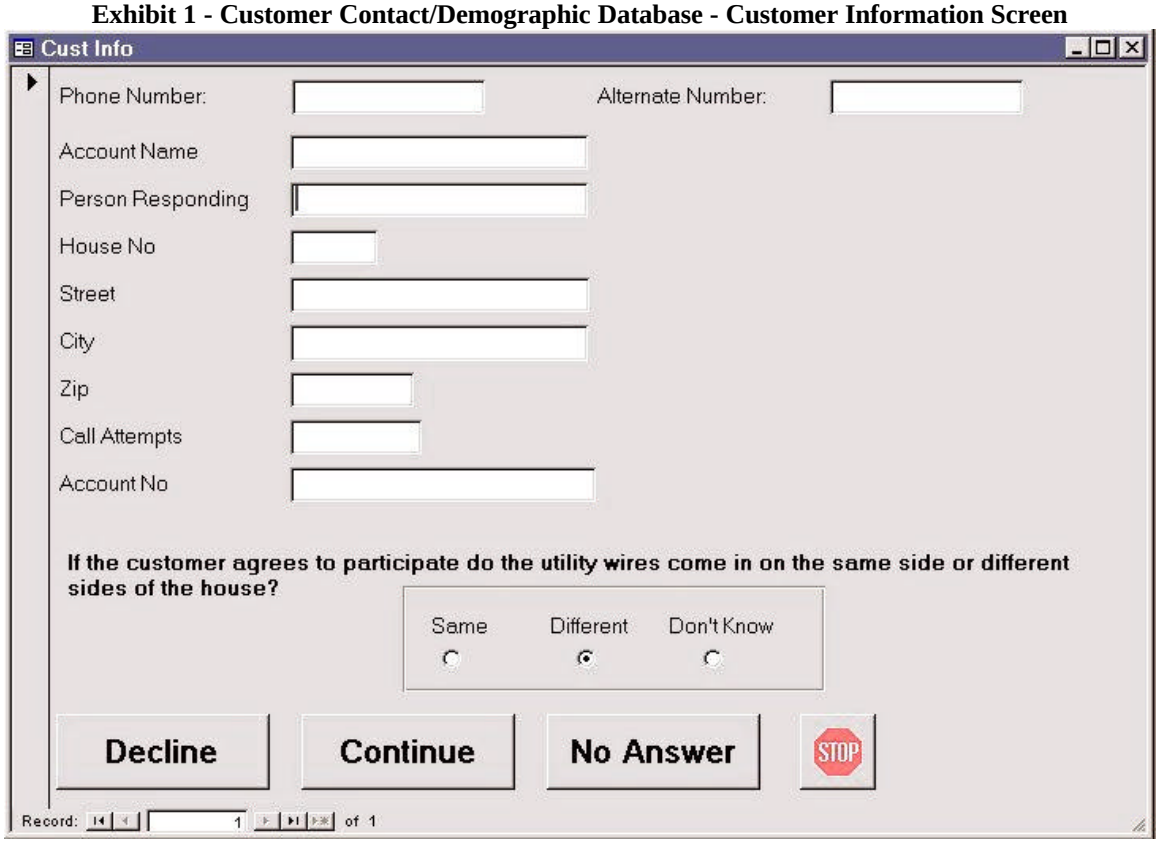

Exhibit 2 - Customer Contact/Demographic Database - A/C Information Screen

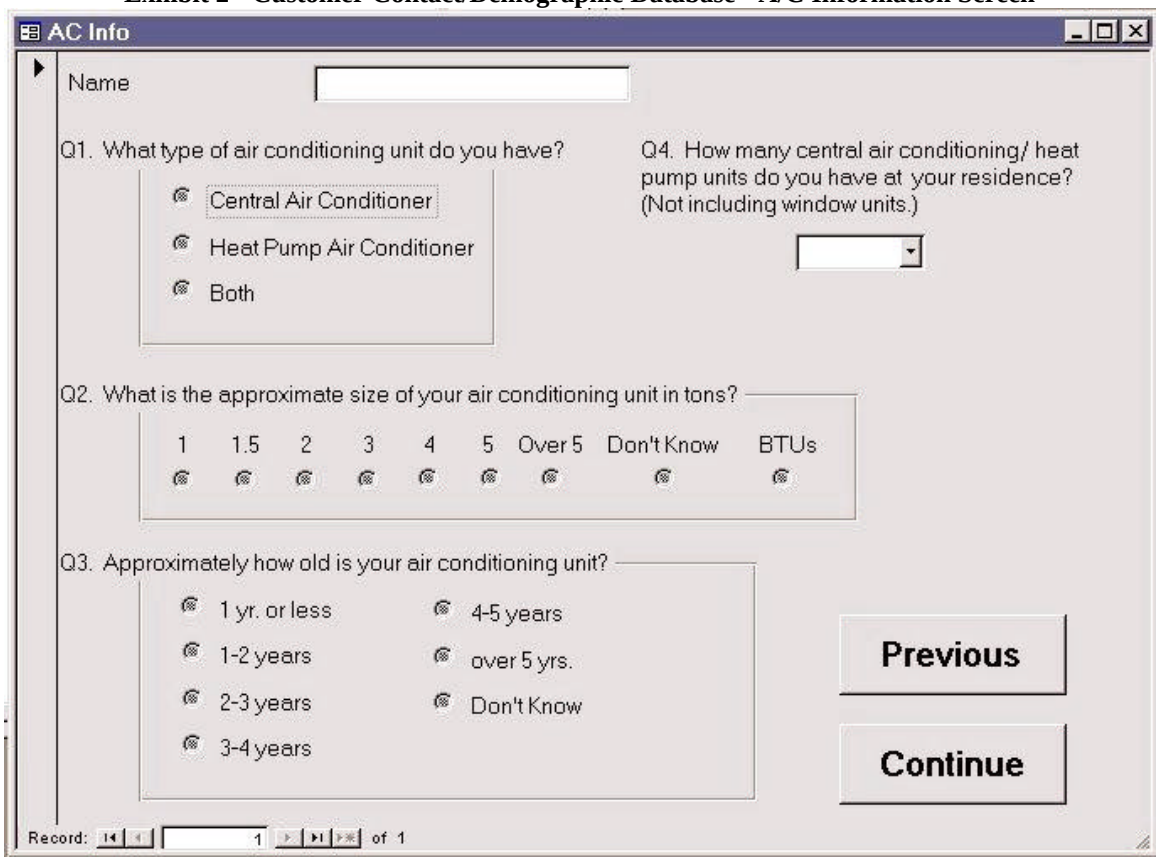

Exhibit 3 - Customer Contact/Demographic Database - Residence Information Screen

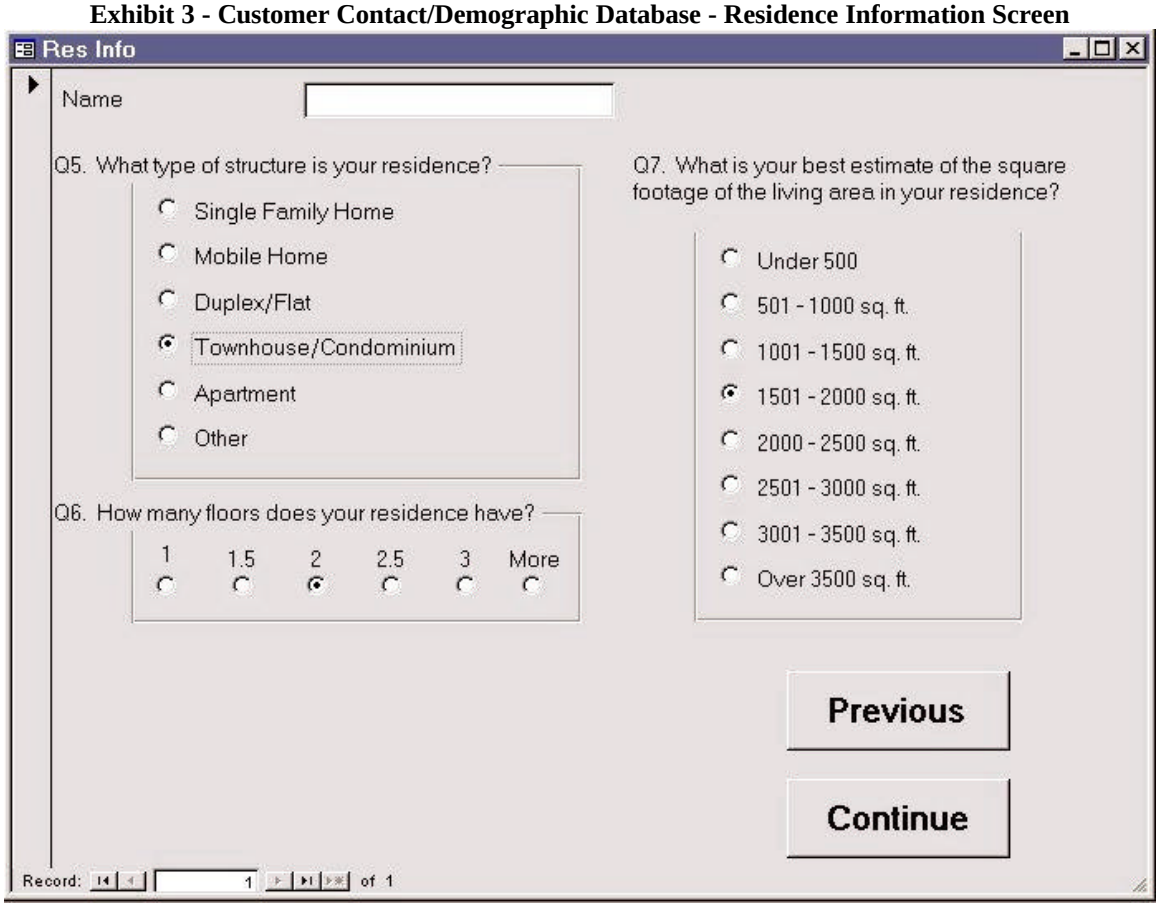

Exhibit 4 - Customer Contact/Demographic Database - Other Information