Lessons Learned using CBR for Customer Support

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Abstract

Three CBR systems were created to improve customer support at General Electric Appliances. The first tool helped call takers answer customers' questions by using a case base of frequent questions and their answers. This has been in use since 1999 and increased the percentage of questions that could be answered without sending a field service technician to the customers' home. The second tool is a web-based version of the first tool that is designed for customer self-service. This has been in use since early 2000. The third tool is an email handling system that helps customer service answer email questions by storing previous email with their answers. This has been in use since late 2000 and reduced the average time to answer an email message by 40%. This paper focuses on business aspects of the systems described.

Introduction

Case-Based Reasoning (CBR) (Aamodt and Plaza 1994) has been used to automate customer support help-desks by many companies such as Compaq (Acorn and Walden 1992) and Broderbund (Watson 1997). Using CBR for customer support (Simoudis, 1992) has become of interest to many other companies with help desks. This paper describes lessons learned from creating three tools, which use CBR techniques to assist General Electric (GE) Appliances' customer support personnel. The tools are an internal phone call taker assistant, an external web site for customer self-service, and an internal email assistant. I hope that these lessons will help anyone considering using CBR to automate their customer support. This paper will step through the development process and point out lessons learned whenever possible.

Phone Call Center Assistant

GE Appliances provides a variety of customer support services over the phone and on the web. One of the phone services GE provides is a group of 300 field service order takers who schedule field service personnel to visit customers' homes. There are around 1.4 million home visits that are scheduled per year. In the past, about 20% of the time a field service representative arrived at the home all that was needed was to educate the customer. This education could usually have been done over the phone saving time for the customer and field service representative. However, the field service call takers were not trained to diagnose and explain issues over the phone. This training was difficult because of the large number of appliances that can be serviced, complexity of modern appliances, and the high turnover in the order takers. Before the system was implemented the call takers were only using their personal experience to determine when a field service representative was or was not needed. Even though feedback from service technicians indicated that 20% of the calls could be answered on the phone, they were only successful on 3.9% of the calls. A cost benefit analysis of this problem showed that creating a CBR system would cost one million dollars for software, development time, domain expert time, and ongoing maintenance costs for the first five years, but the benefit from answering just 10% of calls was over two million per year. This analysis showed we should create the system.

Tool Selection

There are many companies that provide CBR tools for customer support, but selecting the correct tool can be complicated. There are new tools being created all the time and existing tools are constantly evolving, so the correct tool to use can change from year to year. We listed various attributes that were desirable in the tools. Below is a short list of some of these attributes.

- User interface (web-based, easy to use, graphical attachments, customizable)
- Case base management (authoring tool exists, ease of initial creation, maintenance difficulty, multiple authors possible, automated testing of case base)
- Integration (working with current systems, input attribute value pairs and text description, output multiple top possible solutions, output summary of usage to database for reporting, custom reporting)
- Cost (initial development, professional consultation, ongoing maintenance)

Each of the attributes was rated from 1 to 9 on its importance to the project. Then each tool was rated from 0 to 5 on how well it satisfied that attribute. The importance was multiplied by the satisfaction value to produce a score for that tools attribute. The sum of these values for each tool was the score for the tool. The tool with the highest value was selected.

When we performed this analysis in 1998 we looked at tools from Inference, Servicesoft, Serviceware, Clarify, and Spotlight. There were many more tools that could have been evaluated, but understanding each tool in order to give it a rating took a considerable amount of time. The tool we selected was k-commerce from Inference. Inference was later purchased by eGain.

Case Description

After k-commerce was selected the first step was to create a style guide that set down strict formats for the cases that would be created. Each case could have a title, description, questions, actions, and attachments. The style guide set a format for each of these. For example, each case was created with an HTML attachment in a standard look and feel that described the action to be taken when the case is selected. The style guide allowed multiple authors to work together and produce a consistent result.

Gathering the Data

Before the case base could be created we needed to collect the information that would go into the cases. The information was in many forms

- A list of the top 5 issues for each type of appliance
- A database that includes everything from a list of all model numbers to the address of every repair person
- Paper repair manuals
- Paper flyers that had been sent to the call takers
- Call taker training manuals
- Reports on calls received for the last year
- Feedback from field service technicians on what work was performed
- Undocumented knowledge of engineers and call takers

An initial collection, organization, and understanding of this information took two people two months. The most important information was probably the feedback from the field service technicians. This feedback showed that on 20% of their service calls they did not perform any work on the appliance and only gave information to the customer. The feedback gave an estimate of the frequency of each repair or piece of information that was the result of the service call. This allowed us to know what were the most frequent issues, which would be stressed in the case base. The 80-20 rule held that 80% of the calls were on 20% of the issues. These most frequent 20% were emphasized.

The gathering of data was not a one-time event. The initial case base was created for just one type of appliance, refrigerators. Later, case bases were created for all types of appliances. When new products are introduced or new issues are detected with existing products the case base needs to be maintained.

Selecting the Authors

After the initial gathering of data was finished we needed to create the case base. I believe one of the most important decisions was selecting who the case authors would be. Since the case authoring is not a one-time event it was very important to get the people who would be in charge of maintaining the knowledge in the case base involved at the beginning of the case base creation. The alternative approach of having someone develop a prototype and then hand it off to someone else for maintenance would have caused the loss of the understanding of the tradeoffs that were made in creating the case base. We had a team of four people. Two team members who had technical writing and call taking skills were planned to be the knowledge managers after the system goes into production. Two team members with AI and computer science skills were only going to work on the project until its success was proven. This worked well.

In addition to the four case authors there were a variety of engineers and call takers who provided undocumented knowledge that should be included in the case base. At first we met with the engineers in separate meetings from the call takers. It was quickly apparent that the two groups of people had different knowledge to offer. The engineers could explain the issues that should be stored as cases in detail and the call takers could explain which issues are most common and how to communicate this to the customers. Our most successful knowledge acquisition meetings had both engineers and call takers.

CBR vs. Decision Tree

One of k-commerce's features is that questions can be attached to cases. The questions allow the appropriate case to be selected by answering the questions that differentiate the possible cases. For our application we wanted to be able to suggest one and only one case as the solution. A way to guarantee that these questions can differentiate every case in the case base is to form a tree of questions over the case base where each case is a leaf in the tree and each internal node in the tree is a unique question. We consider this approach as both a decision tree and CBR methodology. The decision tree is simply the selection mechanism of the CBR system. Figure 1 shows a decision tree where rectangles are questions, parallelograms are answers, ovals are solutions, and circles are indicators that the decision tree is continued on another page.

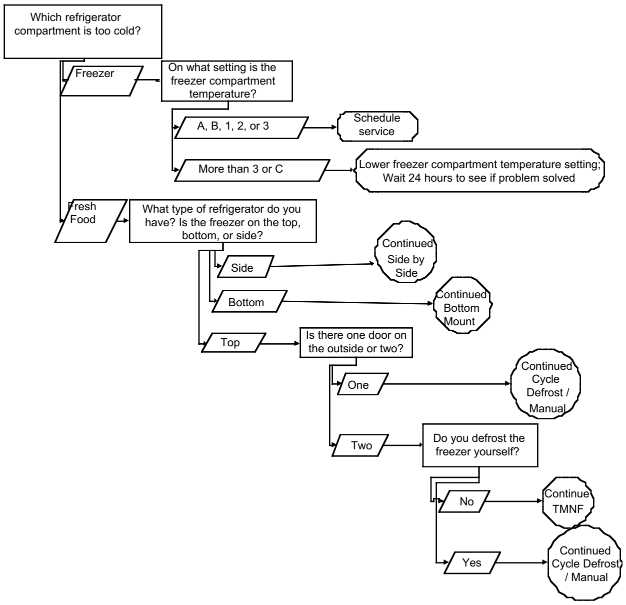

Which refrigerator compartment is too cold?
Freezer
On what setting is the freezer compartment temperature?
A, B, 1, 2, or 3
Schedule service
More than 3 or C
Lower freezer compartment temperature setting; Wait 24 hours to see if problem solved
Fresh Food
What type of refrigerator do you have? Is the freezer on the top, bottom, or side?
Side
Continued Side by Side
Bottom
Continued Bottom Mount
Top
Is there one door on the outside or two?
One
Continued Cycle Defrost / Manual
Two
Do you defrost the freezer yourself?
No
Continue TMNF
Yes
Continued Cycle Defrost / Manual

Figure 1: Decision Tree

Requiring a full tree has other benefits. k-commerce has a case-tree authoring tool that allows for a visual creation of a question/answer tree. This tool allows a case author to construct a tree by dragging questions onto an existing tree. The tree is represented as an indented list of questions. A case is automatically created at each leaf of the tree with the appropriate questions attached. This greatly reduced the difficulty in attaching questions to cases.

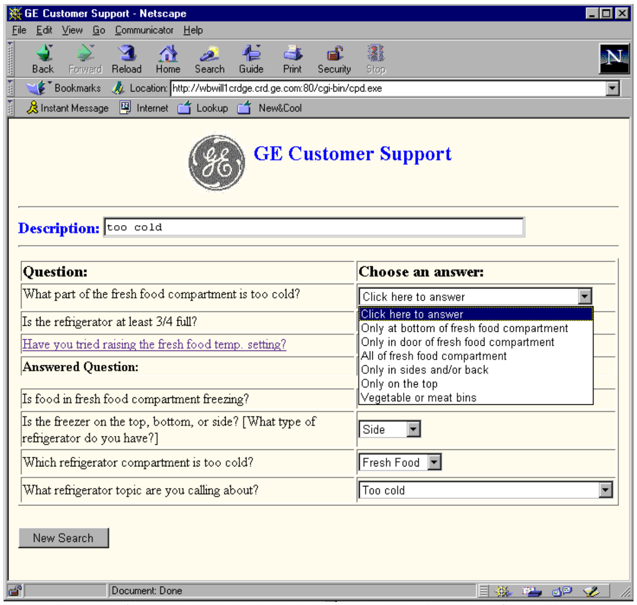
Although Inference's case-tree authoring is an excellent tool, we found Visio® was a better graphical tool for knowledge acquisition. One of our knowledge acquisition sessions would typically involve two engineers, two call takers, and two case authors. The case authors had a computer with a video projector. One case author would lead the engineers and call takers through the creation of a decision tree while the second author created the tree in Visio®. Once the Visio® decision tree was finalized it was a trivial process to create the case base with the case-tree authoring tool.

Pilot Test

After the case base was created we had a two month pilot test. The user interface of the pilot system is shown in Figure 2. Eight call takers used the tool during the pilot. Every time the case base was used to answer a call a description of the call was written to a reporting database. The description included start time, end time, caller phone number, call taker ID, type of appliance, short text description of issue, all questions asked by CBR, all answer given to these questions, case suggested, and if this answer was accepted by the caller. Each week a case author would analyze this information in the reporting database for every call that was taken for the week. The author was looking for any trends and especially any times a caller would not be satisfied by a suggestion. Any trends or outstanding items would be discussed in a weekly feedback meeting with the call takers. The result of the feedback meetings would be a few changes in the case base. These changes would be made immediately and reviewed in the next weeks meeting. The call takers were a valuable part of the development team and felt ownership in the case base when the pilot test was finished.

One of the issues we found in the pilot test was that callers really did not like answering a lot of questions. If an issue could be identified in about four questions then they were usually happy to answer them. However customers were sometimes frustrated answering more questions. Some of our initial decision trees were up to twelve questions deep. We reduced the number of questions needed to diagnose an issue by automating some questions, combining some questions, and changing the order of other questions. Questions, like "what is your model number?" were automated by creating a database with information on each customer. Multiple simple questions in a row were combined. Changing the order of questions so that the most important ones are asked first reduced the depth of trees by widening them.

After the pilot test was completed we needed to train the users. The 300 call takers were split into three groups at three different locations within the United States. Training material was created and a local expert was identified at each location. We rolled the tool out to the different locations one at a time, with about a month between rollouts. We checked with each call taker to see if they had any problems with the tool and used the reporting database to see if the call takers were not using the tool properly. During this time the call takers found some cases that needed to be added or changed. We gave these changes a high priority and were usually able to update the case base quickly when an issue was identified. Answering questions and fixing issues quickly helped win the acceptance of the call takers.


GE Customer Support - Netscape
File Edit View Go Communicator Help
Back Forward Reload Home Search Guide Print Security Stop
Bookmarks Location: http://wbwill1crdge.crd.ge.com:80/cgi-bin/cpd.exe
Instant Message Internet Lookup New&Cool
New Search
Document: Done

GE Customer Support

Description: too cold

Question:	Choose an answer:
What part of the fresh food compartment is too cold?	Click here to answer Click here to answer Only at bottom of fresh food compartment Only in door of fresh food compartment All of fresh food compartment Only in sides and/or back Only on the top Vegetable or meat bins
Is the refrigerator at least 3/4 full?	
Have you tried raising the fresh food temp. setting?	
Answered Question:	
Is food in fresh food compartment freezing?	
Is the freezer on the top, bottom, or side? [What type of refrigerator do you have?]	Side
Which refrigerator compartment is too cold?	Fresh Food
What refrigerator topic are you calling about?	Too cold

Figure 2: Internal Pilot User Interface

Maintenance

The maintenance actually started before the tool was released. Planning for the maintenance is a key factor in the tool's success. There is a half-life for the knowledge that is represented in the tool. If that knowledge is not updated it will soon become obsolete.

In General Electric there is a set process for the steps that need to be taken when new products are introduced. We needed to have an extra step inserted into this process for maintenance of the case base. When a new product was finished with its field test and was ready to be sold the team releasing the product needed to help the case authors create or update the case base for that product. This is important because many questions are on new products and it would be better to have that information ready for the customers before they even ask the first question. An example of this is that GE released the Advantium™ range right after this tool was rolled out.

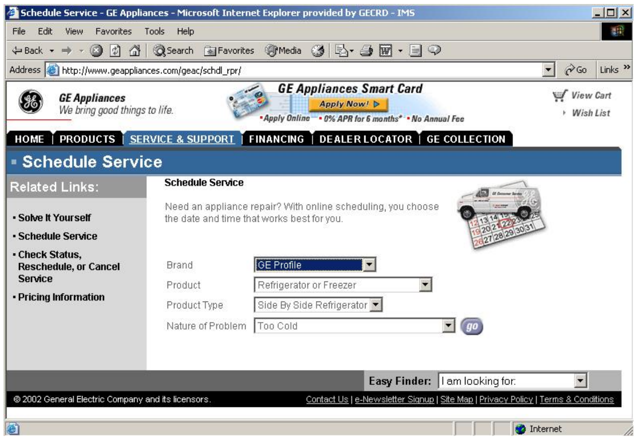
Other companies have used k-commerce and developed methods of gathering data. Thompson Consumer Electronics Inc., which manufactures and markets GE branded electronics, has used k-commerce for their call center (Thomas et. al. 1997). They have a group of case authors that are split into two groups, people who add cases to the case base "knowledge authors" and people who find new data for cases "hunter gatherers." Our case authors worked with domain experts to create the decision trees, as in Figure 1, then authored the cases after the trees were finalized.

Results

The system was deployed to the 300 order takers in June of 1999. The percentage of calls that could be correctly answered over the phone, without sending a field service representative, increased from 3.9% to 12.3%. The average call times decreased slightly, from 256 seconds to 232 seconds. Since each service call that is handled over the phone saves over $25 the system has resulted in a savings of over $2.5 million per year. The cost of development, including time of developers and purchased software, was $1.2 million. Surveys of customer satisfaction also showed the customer preferred having their issues solved without the need for a house visit.

Web Self-Service

After the call taker support tool proved successful, the next step was to make the k-commerce based tool available to our customers by placing it on a public web site. This allows customers to have direct access to the information they need. Figure 3 shows the first screen of this tool.


Schedule Service - GE Appliances - Microsoft Internet Explorer provided by GECRD - IMS
File Edit View Favorites Tools Help
Back Search Favorites Media
Address
Go
Links
GE Appliances
We bring good things to life.
GE Appliances Smart Card
Apply Now!
•Apply Online •0% APR for 6 months* •No Annual Fee
View Cart
Wish List
HOME
PRODUCTS
SERVICE & SUPPORT
FINANCING
DEALER LOCATOR
GE COLLECTION
Related Links:
• Solve It Yourself
• Schedule Service
• Check Status, Reschedule, or Cancel Service
• Pricing Information
go
Contact Us | e-Newsletter Signup | Site Map | Privacy Policy | Terms & Conditions
Internet

http://www.geappliances.com/geac/schdl_rpr/

Schedule Service

Schedule Service

Need an appliance repair? With online scheduling, you choose the date and time that works best for you.

Brand: GE Profile
Product: Refrigerator or Freezer
Product Type: Side By Side Refrigerator
Nature of Problem: Too Cold

Easy Finder: I am looking for:

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Figure 3: Public User Interface

Case Base Development for Self Service

Even though the call taker support tool was a web-based application there were some changes that were needed to deploy it for use by our customers. The user interface needed to be improved. The cases contained jargon, instructions for the call takers, and proprietary information that all had to be removed. New graphics and information needed to be added. Finally, there needed to be a way for customers to get help if they could not find what they wanted in the case base.

The modifications needed were made in a few months, but the case base is constantly growing and changing. The web self-service tool was made available on the http://www.geappliances.com/geac/schdl_rpr/solve.htm web site in early 2000. The benefits of the web self-service were difficult to calculate, so we do not claim any here.

We found that when a self-service web site is created you want most of the possible questions to be handled by the tool when it is first rolled out. If the tool does not answer a significant number of issues then people will not use it. Taking time to perfect the tool before its release is time well spent. First creating an internal call-taker tool is a good way to test out the public one. When the internal tool gets to the point that it can handle most of the calls and little training is needed for someone to start using it, then it is ready to be transformed into a self-service tool.

Maintenance

The maintenance of knowledge in a tool is important. When multiple tools use the same knowledge the maintenance becomes even more important. You do not want to maintain the same knowledge in multiple systems. When any new system is created it should be able to leverage the knowledge that is being maintained in another tool. You really want to have one central repository for knowledge that each system would access. Otherwise you could end up with many inconsistent knowledge bases that are difficult to maintain.

If issues were not in the case base, customers could phone or email the call center with the question. The email acted as feedback on which cases were the most important to add. Each email could be considered a defect in the case base. Either the information requested did not exist or the customer was unable to find it. That information should be added if it was missing or restructured if it could not be found.

Email Response Automation

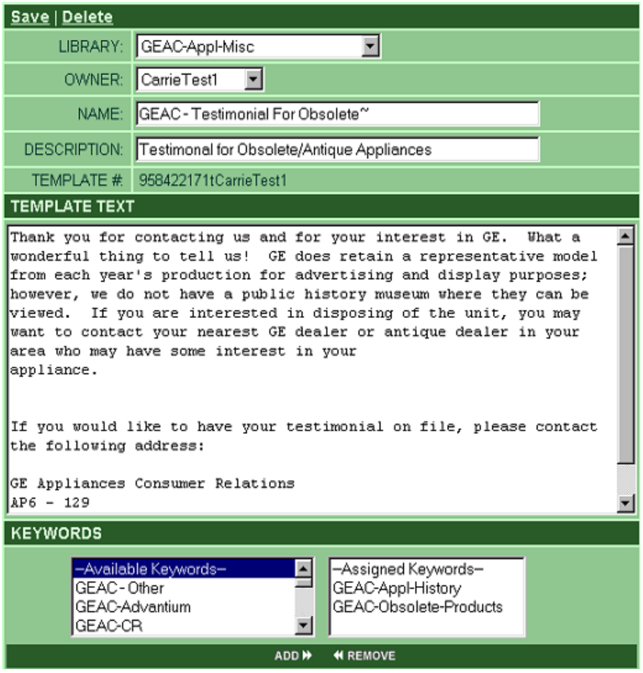
The down side of asking people to send in email with questions is that you then have to answer all the email messages. We found that it actually took longer for a person at the call center to answer an email message than a phone message. An email message is a recorded piece of information, so more care was needed in the wording than was used in a phone conversation. Therefore, we also needed a tool for answering the email messages.

Tool Selection

There are several commercial tools for automating the response to email messages. Some of these companies include Kana, eGain, and Cisco. We went through the same process described earlier and selected Cisco's email manager tool. This tool stores replies to frequently asked questions so that they can be reused on future similar questions. In order to select the appropriate reply a decision tree is created where each node in the tree is a rule about the keywords and text in the email message. Each leaf node in the decision tree specifies a set of replies that can be used to answer that specific type of email message.

When vendors give their pitches to sell their email handling tools they claim you can automatically answer a percentage of your email messages. This is wrong. Anything that can be automated should be a tool on a web page. The email handling tool can be a temporary remedy until that web-based tool is created, but should not be a long term solution. On the other hand, auto-suggesting answers is a good thing. Having solutions automatically suggested to a person who then just selects the correct response from a list of suggestions allows you to handle the special cases that can not be addressed easily on a web page.

Figure 4 shows a case from the email manager. A customer emailed GE saying they have a fifty year old refrigerator in perfect working condition and asked if we would like to purchase it from them. The reply to this email was stored in the case base and is now used about two times per week. Customer support personnel either send this exact reply or edit it if the request was slightly different. The case is given keywords that help in case selection.



LIBRARY:	GEAC-Appl-Misc
OWNER:	CarrieTest1
NAME:	GEAC - Testimonial For Obsolete~
DESCRIPTION:	Testimonal for Obsolete/Antique Appliances
TEMPLATE #:	958422171tCarrieTest1

```
Thank you for contacting us and for your interest in GE.  What a
wonderful thing to tell us!  GE does retain a representative model
from each year's production for advertising and display purposes;
however, we do not have a public history museum where they can be
viewed.  If you are interested in disposing of the unit, you may
want to contact your nearest GE dealer or antique dealer in your
area who may have some interest in your
appliance.


If you would like to have your testimonial on file, please contact
the following address:

GE Appliances Consumer Relations
AP6 - 129
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–Available Keywords–
GEAC - Other
GEAC-Advantium
GEAC-CR

–Assigned Keywords–
GEAC-Appl-History
GEAC-Obsolete-Products

Figure 4: email Case

Simplifying the Problem

Understanding a free text email message is difficult for an automated system. The first thing we did was to make the problem of understanding an email message easier. Instead of having customers send email directly to us, we made them enter it on a form on our web site. All email addresses on our products were replaced with web pages. In addition to the free text of the email the customer needed to classify their message based on a few pull-down menus on the web site. This self-classification of the email made it much easier for an automated system to select similar cases.

In the section on web self-service I mentioned that the tool should have most of the information needed before it is released. The email handling tool is different. It can be released with a reasonable amount of information. When a question is found where a solution does not exist, the new solution that is created can be added to the tool. The customer gets quick service either way. Since most easy questions can be answered by the stored solutions, there is more time to answer complicated questions. Questions that are repeated can be added to the web self-service tool.

Results

Our implementation of Cisco's email tool went into use in June of 2000. The tool reduced the average time a person needs to answer an email message by 40%. Since our yearly projected cost to answer email was $1.5 million, the savings of this tool is $600,000 per year.

Conclusion

Customer support technology can provide many benefits. Several tools including call-center automation, web self service, and email handling might be needed to provide customer support. The integration of these tools can provide support that is better than any one tool can provide.

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