INTERNET, INTRANET AND THE WEB

Case Studies in Data Management on the Web

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ABSTRACT

The Highway Safety Research Center (HSRC) at the University of North Carolina in Chapel Hill uses the data management capabilities available through SAS/IntrNet® CGI Tools for several projects. This paper will examine three applications. The PBCAT Order application captures information, forwarding relevant fields to a fulfillment house. The Walk to School application collects data from the web and quickly resurfaces that data after human scrutiny. The PedBike Information System is similar to a problem tracking system. Questions are directed to a team of experts. Both questions and answers are entered into the system, creating a searchable database. This paper describes the structure of these projects, which incorporate base SAS®, SAS/SHARE® and two SAS/IntrNet components (htmsql and the Application Dispatcher) in a Solaris environment.

INTRODUCTION

For each case study we begin with how the application behaves through a web interface. The parameter section describes project requirements that give direction to the system design. The solution overview describes the general organization and dynamics of the system. The data management section highlights coding techniques.

PBCAT ORDER SYSTEM

This software available free of charge on CDROM helps a customer categorize pedestrian and bicycle crashes. The order form is available on the virtual Web site hosted at Highway Safety (Figure 1).

The process begins when a customer submits an online order (Figure 2).

The order arrives at the fulfillment house in an email message:

Subject: PBCAT CD-ROM Order 868796
Date: Mon, 28 May 2001 12:45:53 -0400 (EDT)
From: somewhere@server.unc.edu
To: fulfillment@hatplace.com

Please send a PBCAT CD-ROM to the following person:

Ms Carol Martell
UNC HSRC
730 Airport Rd CB# 3430
Chapel Hill NC 27599-3430
USA
phone 919-962-2202
email carol_martell@unc.edu

This order was placed on 28 MAY 2001

The customer receives acknowledgement email:

Subject: PBCAT CD-ROM Order 868796
Date: Mon, 28 May 2001 12:45:53 -0400 (EDT)
From: somewhere@server.unc.edu
To: carol_martell@unc.edu

Thank you for ordering the PBCAT CD-ROM. We will mail it to:

Ms Carol Martell
UNC HSRC
730 Airport Rd CB# 3430
Chapel Hill NC 27599-3430
USA
phone 919-962-2202
email carol_martell@unc.edu

This order was placed on 28 MAY 2001

Please wait 15 business days for delivery.
If you do not receive your CD within that time, please send email to: contact@unc.edu and reference order number 868796.
If the customer does not receive the software, they may follow up
INTERNET, INTRANET AND THE WEB

with the contact provided, who has access to a dynamic web page showing all orders placed (Figure 3). Each order has links allowing address correction and reordering:

```
INTERNET USA  IL  input 1#100
INTERNET USA ID Christopher  Name  ilp#1100
INTERNET USA W  From  Sanders  ilp#11100
INTERNET USA WC  Card  Mail  ilp#11200
```

Figure 3

PARAMETERS
The fulfillment house is external to HSRC, so orders must be forwarded to them. Their legacy system only accepts manual input, so we could not code something to automatically feed into their system. Instead, order requests are submitted to them by email. Because HSRC plans email notification to previous recipients of future software releases, order information is retained.

SOLUTION OVERVIEW
A single SAS table houses the order data. New information is added to the table through the Web form in Figure 2. Unacceptable mailing addresses, obviously invalid email addresses, and inconsistent zip codes are returned to the browser for correction and resubmission. Email to order the software is automatically sent to the fulfillment house when a record is added. At the same time, an email message acknowledging the order is sent to the customer. In-house maintenance is available through the dynamic web page (Figure 3) that lists each record with links enabling various actions. From this page we can, for instance, correct an address and resubmit the order for a customer.

DATA MANAGEMENT
The Application Dispatcher is used for data entry. All the information from the web form is passed into a SAS program as macro variables. In the SAS code, a temporary, one-observation table is created for the order. Data is checked for completeness and validity. The following sample code shows email address screening:

```
email="&email;"
if email = "" then do;
   str='We need your email address';
goto errorm;
end;
if index (email, '@')=0 or index (email, '.')=0 then do;
   str='We need a viable e-mail address';
goto errorm;
end;
```

If problems are encountered, the customer is prompted to correct the problem and resubmit. Further processing must be prevented to avoid sending empty email messages. This is accomplished by using a macro variable (&quit):

```
errorm: do;
   file _webout;
   put "Thank you </html>";
call symput('quit', 'yes');
   stop; end;
run;
```

If all required data items are present and acceptable, the temporary table is appended to the main table. Next, the order is sent:

```
data;
   set temporarytable;
```

```
filename sendit email
   "fulfillment@thatplace.com"
subject="PBCAT CD-ROM Order &order";
```

```
file sendit;
   put 'Please send a PBCAT CD-ROM to the following person:';
   put ' '/salutation first_name last_name /
   organization;
```

The acknowledgement message is composed similarly. The wording differs and the email filename statement contains the customer's email address in place of the fulfillment house email address.

Customer inquiries about an order are resolved through the in-house maintenance htmSQL page (Figure 3). This page lists each order record with four links to other htmSQL pages. The six-digit order reference number, created with a random number generator, is used to specify the record in the links. The four actions available for a record are update, delete, email, and reorder. We examine the entire htmSQL code for the main page. We begin with the opening (query) directive pointing to the SAS/SHARE server:

```
{query server="myshareserver"}
```

Next we select all records from the table:

```
{sql}
   select * from mylib.cdrom
   order by date
{/sql}
```

We will present the results in a single HTML table, so we must first open the table and provide header information:

```
<font size=+2>
   PBCAT Order List for Maintenance</font>
```

```
<table border=0>
```

```
<tr>
   <td>order date</td>
   <td>country</td>
   <td>state</td>
   <td>first name</td>
   <td>last name</td>
```

```
   <td>update record</td>
   <td>delete record</td>
   <td>email customer</td>
   <td>reorder for customer</td>
</tr>
```

We want an HTML table row for every observation. We specify in
the {eachrow} section the HTML formatting and variable display for a single observation. This specification will be applied to each row returned from the query:

```
{eachrow}
<tr>
  <td>{orderdate}</td>
  <td>{country}</td>
  <td>{state}</td>
  <td>{firstname}</td>
  <td>{lastname}</td>
  <td><a href="update.hsql?o={ord}">update record</a></td>
  <td><a href="remove.hsql?o={ord}">delete record</a></td>
  <td><a href="emailem.hsql?o={ord}">send email</a></td>
  <td><a href= "...broker8?...Program=ared.sas&o={ord}">reorder for customer</a></td>
</tr>{eachrow}
```

The first five HTML columns above display variable values. The next three build the links with accompanying name/value pair. The last column is an Application Dispatcher call to a program that sends a reorder request to the fulfillment house. Having composed the row, we close the {eachrow} section. Next we close the table and the {query} section:

```
</table>
{query}
```

The update.hsql page is exactly like the original order form except that it is already populated with the observation’s values. We can easily accomplish this by making a copy of the order form, naming it ‘update.hsql’. We place a query to select a specific observation at the top.

```
{query server="myserver"}
{sql}
select * from mylib.cdrom where order='{&o}"
{/sql}
```

Then we surround the form with {eachrow} directives, supplying values for each field. For example, where the order form contained an Input field for first name with no value supplied:

```
<input name="firstname" value="">
```

the update form contains:

```
<input name="firstname" value="{&firstname}">
```

The order number must be passed along in a hidden field. Finally, we change the _program name to a different SAS program - one that updates an observation’s values instead of the one that adds a new observation.

The code for the htmSQL page to delete a record could contain an {sql} section as simple as the following:

```
{sql}
delete from mylib.cdrom where order='{&o}"
{/sql}
```

Weaving back and forth between htmSQL and Application Dispatcher allows the developer to take advantage of the strengths of each tool.
The screener can delete a bogus registration, approve it as is, or correct typos and approve corrected version (Figure 8). Upon approval, the registrant receives a 'welcome' email message (Figure 9). The message includes a link for updating their record. The link brings up a registration form already filled out with their information, ready for additions (Figure 10).

All previously approved registrations are also available for in-house review in an update mode (Figure 11).

The image map on the web site is the starting point for the public to view event details for all registered events (Figure 12). States with registered events are highlighted. Within ten minutes of registration approval, a new registrant's state becomes highlighted on the map (Figure 13).

Clicking on the state brings up a list of communities with registered events (Figure 14), and clicking on a community name brings up event descriptions for that community (Figure 15).
PARAMETERS
This application is streamlined and otherwise improved from the previous year’s registration application. Goals included avoiding problems that cropped up the previous year. Registrants reluctant to navigate a web site or to supply login and password can take advantage of the update link provided in the welcome email message. Those who mistakenly register anew instead of updating are flagged on the screening page, minimizing the chance of duplicating records. Registrants are allowed to choose their own passwords. The code to refresh the image map and the code to send the welcome email message is placed in frequently run scheduled batch SAS jobs. No Application Dispatcher is used in the system; it is written entirely in htmSQL and scheduled batch jobs. Presenting a record to be screened in an update form allows for on-the-spot typo correction. We introduce the use of frames to simplify navigation for data maintenance.

SOLUTION OVERVIEW
A single SAS table houses the screened registration data. Each unscreened registration or update is a separate table that is deleted after screening. To flag instances where the customer mistakenly registers anew rather than submitting an update, the dynamic screening page provides links to display similar preexisting registrations. Since passwords are user-defined, duplicate logon information is also displayed. New submissions and preexisting records are displayed side-by-side on the screening page for easy comparison. Both new and preexisting records are displayed in a populated form; each can be accepted, modified or deleted.

DATA MANAGEMENT
Record flags are used to accomplish tasks requiring a data step. A batch job is scheduled to run periodically that checks for the welcome message flag. All new registrations have this flag set. The job sends a customized message to the email address in each record having the flag set and then resets the flag to 0. A batch job publishes the image map of the US every 10 minutes. Other tasks are accomplished using htmSQL. The screening page frameset defines the layout seen in Figure 16.

```
<frameset cols="20%,40%,40%">
  <frameset rows="10%,90%">
    <frame src="menu.html">
    <frame src="screen.hsql" name="thelist">
  </frameset>
  <frame name="incoming">
  <frame name="existing">
</frameset>
```

This code divides the page into three vertical columns (frames), the first of which is also divided horizontally. Each frame given a name can be the target of a link from elsewhere on the page. We use the convention of always displaying new data in the center column, and always displaying preexisting data in the far right column—hence the names ‘incoming’ and ‘existing’. The bottom left frame displays screen.hsql, listing all new records for screening.

```
{sql}
select *
from dictionary.tables where libname="WOCSLIB" and memname ne "REGISTERED"
{/sql}
{norows}No new registrations at this time
{/norows}
```

For each record found, we must look for similar names and watch out for duplicate name/password combinations. We use the nesting capabilities of htmSQL to accomplish our various tasks:

```
{eachrow}
{sql}
select fname as f, lname as l, type as t,
uid as unew, pword as pnew,
{"&memname}" as filename
from wocslib.{&memname}
{/sql}
{eachrow}<a href="view{ &t} . hsql ?f= {&filename}
target="incoming">
{&f} {&l} {&t} {&crdate}
</a>
```

We now look for similar preexisting data, comparing the names using soundex and spedls functions. If we find none, we display a message to that effect. For each record found we construct a link to display the existing data in the far right column:

```
{sql} select uid as u, pword as p, first_name as fn, last_name as ln
from wmain.registrants
where
  ( soundex(first_name)=soundex("{&f}"))
  and
{/sql}
```

Figure 16
We examine the code for screen.hsql. We query the dictionary tables to find all tables other than the main registration table. If there are none, we display a message to that effect:

```
{sql}
select * from
dictionary.tables where libname="WOCSLIB"
and memname ne "REGISTERED"
{/sql}
{norows}No new registrations at this time
{/norows}
```

For each registration found, we must look for similar names and watch out for duplicate name/password combinations. We use the nesting capabilities of htmSQL to accomplish our various tasks:

```
{eachrow}
{sql}
select fname as f, lname as l, type as t,
uid as unew, pword as pnew,
{"&memname}" as filename
from wocslib.{&memname}
{/sql}
```

We build a link targeting the center column to display the new data. The variable type, aliased as t, specifies whether the record is a new registration or an update, taking on values ‘new’ and ‘upd’. The link will resolve to either viewnew.hsql or viewupd.hsql. They must differ because if the data is new it should be added while updates replace an existing observation.

```
{eachrow}<a href="view{ &t} . hsql ?f= {&filename}
target="incoming">
{&f} {&l} {&t} {&crdate}
</a>
```

We now look for similar preexisting data, comparing the names using soundex and spedls functions. If we find none, we display a message to that effect. For each record found we construct a link to display the existing data in the far right column:

```
{sql} select uid as u, pword as p, first_name as fn, last_name as ln
from wmain.registrants
where
  ( soundex(first_name)=soundex("{&f}"))
  and
{/sql}
```
INTERNET, INTRANET AND THE WEB

soundex(last_name)=soundex("{&l}")

or

spedis(first_name, "{&f}")

+ spedis(last_name, "{&l}")

<50

{/sql}

{norows}no similar records{/norows}
similar records already registered
{eachrow}<a href="viewold.hsql?u={&u}&p=(&p}

target="existing">

{&fn} {&ln}
</a>

We perform another search for exactly matching preexisting logon information (the login has been constructed by compressing together first and last names). Again, we either announce that there are no matches or build links to these similar records, targeting the far right frame. We close the encompassing eachrow sections:

{sql} select uid as ux, pword as px, first_name as fn, last_name as ln from wmain.registrants where ux="{&unew}" and px="{&pnew}"

{/sql}

{norows}no matching login and password
{/norows}

already registered with login/password
{eachrow}<a href="viewold.hsql?u={&ux}&p=(&px}

target="existing">

{&fn} {&ln}
</a>

{/eachrow}

{/eachrow}

.html formatting to display these results is not included in the code above. The formatting we use organizes the gathered information about each new record into a table with a border. The similar names and matching login/password records are displayed as unordered lists. Consequently, the person screening data sees a box for each new record, with bulleted lists of preexisting data that should be used for comparison.

Data screeners are very happy with this solution. Providing access to all relevant information in a single Web page has proved to be extremely advantageous.

PEDBIKE INFORMATION SYSTEM

The use of frames for the Walk to School application was applied to another Web data management project. This project functions like a problem tracking system. A panel of experts answers questions posed by the public through a variety of avenues. Questions and answers are logged into the system through the web. The single Web page for this application is divided into five frames (Figure 17). The top left frame provides a menu. We will examine the avenues available there. Suppose someone named David Harkey poses a question. The first step is to determine whether or not he is already in the system. Entering a portion of his name, 'hark', and clicking 'find' (Figure 18) sends a list of matching names to the lower left frame. We see that a record is found for David Harkey (Figure 19).

Figure 17

Menu

hark  new name
everybody

find

...in questions

Keywords

Figure 18

Names Found

sort by firstname lastname organization email

David Harkey

UNC

see record

new question

Figure 19

Clicking 'see record' sends his personal information record to the middle frame (Figure 20). It is displayed in a form so that information can be easily added or corrected.
Clicking 'see activity' sends a list of David's questions with the answers and outstanding referrals to the top right frame (Figure 21). Clicking 'add question' sends a form to the bottom right frame (Figure 22). Clicking 'answer' in the activity frame sends a form to the bottom right frame (Figure 23). Clicking 'refer' in the activity frame sends yet another form to the bottom right frame (Figure 24).

Dynamic select lists used throughout the forms provide choices for items such as the expert's name or the question source (Figure 25).
INTERNET, INTRANET AND THE WEB

To explore another avenue, we return to the menu frame (Figure 18) and click 'todo'. A list of four followup categories appears in the bottom left frame (Figure 26).

**ToDo Page**

Referrals: none
Phone calls to make: 1
Faxes to send: none
Letters to send: none

**Figure 26**

Beside each category is a numbered link for every item requiring attention. We click the link to see a not-yet-conveyed answer in the top right frame (Figure 27). The answer not yet conveyed is displayed as a form with conveyance marked in red. Once the answer is conveyed, the expert clicks the 'completed' button and the item will no longer show up in the 'todo' list.

**John Feyga see record**

04JUL2000 (Clarke) Wants trail design information; waiting for call back. He talked with Christopher and got what he needed.
edit question| answer| refer| delete| question+answers
keywords:

04JUL2000 A(conveyed from Clarke via Clarke):
Wants trail design information; waiting for call back. He talked with Christopher and got what he needed.
edit answer| delete answer

18MAY2001 A(phone from via): blah edit answer| delete answer

**Figure 27**

The menu (Figure 18) offers the ability to search questions or answers for a word or phrase. We enter the search term, choose the file to search, and click 'find' (Figure 28). Results are displayed in the lower right frame (Figure 29). Each matching item has a numbered link. Clicking the link would display the specific question and answer(s) in the top right frame.

**Search Results**

With interest we learned about some of your publications. As the subject matter covers the field of our interest, we would be most grateful if you could provide us with paper copies of the following publications: Intersection geometric design and operational guidelines for older drivers and pedestrians. Volume III guidelines, 1997, FHWA-RD-96-137 Analysis of older drivers on freeways: HSIS summary report, 1997, FHWA-RD-96-035 Development of the bicycle compatibility index: a level of service concept, final report, 1998, FHWA-RD-98-072 and Engineering solutions to enhance the safety and mobility of older persons. Paper presented at the 30th Annual Human Factors Workshop of the Transportation

**Figure 29**

Now we choose the 'keyword' link from the menu frame (Figure 18). We see, in the lower right frame, three forms, two of which have select lists (Figure 30). These forms manipulate keywords. The first allows modification of an existing keyword.

**Keywords**

**Figure 30**

Clicking modify brings up three choices (Figure 31). One might find that two keywords should be collapsed into one, or that a keyword was misspelled and should be replaced with a new, correctly spelled keyword. Keyword deletion is also available.
Changing keyword

Replace BIKE_STATISTICS with this new value and redirect references:

\[
\text{BIKE\_STATISTICS} \quad \underline{\text{REDIRECT}}
\]

Redirect references to BIKE_STATISTICS to the following keyword list and then remove BIKE_STATISTICS from keyword list:

\[
3 \quad \underline{\text{REDIRECT}}
\]

Delete BIKE_STATISTICS and references without redirecting to another keyword

Figure 31

The keyword search form (Figure 30) allows multiple selection of keywords to find questions flagged with all the selected keywords. The search results (Figure 32) follow the familiar conventions: clicking the result number causes the question to display in the top right frame (Figure 33) with the usual accompanying information and links.

Search Results for questions with keyword BIKE_SAFETY

I am a student majoring in elementary education at Otterbein College. This quarter, I am taking a health class in which I am required to create a lesson on a health issue that affects our children. I decided on a lesson about bike safety and wondered if you could send me any information that would be useful. Any children's literature, posters, worksheets, etc., that would be useful, would be greatly appreciated! Thanks for your help.

I am helping with a WS DOT study on before and after analysis for two future crosswalk locations (through TRAC - Transportation Analysis).

Figure 32

Questions

Laine Peterson see record

26SEP2000 (PBIC email) I am a student majoring in elementary education at Otterbein College. This quarter, I am taking a health class in which I am required to create a lesson on a health issue that affects our children. I decided on a lesson about bike safety and wondered if you could send me any information that would be useful. Any children's literature, posters, worksheets, etc., that would be useful, would be greatly appreciated! Thanks for your help.

eat question::answer::refer::delete question+answers

keywords: BIKE_SAFETY

15FEB2001 A(conveyed from Suttles via Suttles): First, I am a student majoring in elementary education at Otterbein College. This quarter, I am taking a health class in which I am required to create a lesson on a health issue that affects our children. I decided on a lesson about bike safety and wondered if you could send me any information that would be useful. Any children's literature, posters, worksheets, etc., that would be useful, would be greatly appreciated! Thanks for your help.

eat question::answer::refer::delete question+answers

keywords: BIKE_SAFETY

INTERNET, INTRANET AND THE WEB

PARAMETERS

The system needed to track who is asking questions, what those questions are, who is answering the questions, and what the answers are, and needed to be searchable to allow reuse of previously supplied answers. An expert should be able to refer a question to another expert. All question and answer activity for a customer should be available to help provide the expert with a context. Determining whether someone is new versus already in the database should be extremely easy. A list of keywords to select and associate with questions must be included, along with the ability to add new keywords. Since the experts are scattered around the country, a web application was requested.

SOLUTION OVERVIEW

There are separate tables for the questions, answers, people, keywords, referrals, and experts. Each person, question, answer and referral is assigned a unique id. These are used to link the information for display. Where possible, answers are automatically sent by email or fax, using scheduled batch jobs that search the answer table for flagged records, send the answers, and change the flag values. Keyword management with retroactive action is included.

DATA MANAGEMENT

We will examine the htmSQL page invoked by clicking the 'activity' button from the person record (Figure 20). The person id has been passed in as 'p'.

<h2>Activity</h2>

{query server="myserver"}

{sql}

select fname, lname from pbic.person
where pid={&p}
{/sql}

{eachrow}{* display name, person rec link}

{&fname} {&lname}<{a href="person.hsql?p={&p}"

</font>target="br">see record</a>

</font></font>

{/eachrow}

{sql}{* find answers}

select qid as q, * from pbic.question
where pid={&p} order by date
{/sql}

{norows}<br>no activity

{norows}{eachrow}{table width=350 border=1>}

{&date}<cr>

{&source}<br>

{&text}<br>

{&author}edit question</a>

{&date}<a href="newref.hsql?p={&p}&q={&g}"

</font>target="br">refer</a>

{&date}<a href="newques.hsql?p={&p}&q={&g}"

</font>target="br">answer</a>

{&date}<a href="newref.hsql?p={&p}&q={&g}"

</font>target="br">refer</a>

{&date}<a href="deleteques.hsql?q={&g}"

</font>target="br">delete question+answers</a>

</font></font>

</table>{td}</td></tr>{/table}

{/eachrow}{/* show keywords*/}

{query server="myserver"}{* find keywords}

{sql}

select *,

* words/fonts vary by status

{/sql}

{case sendthis

* words/fonts vary by status

end sendthis}

{when 'a' then 'conveyed' when 'p' then

<font color="red">phone</font>}</font>
INTERNET, INTRANET AND THE WEB

Web data management allows a distributed population to add, modify and query shared data. In this examination of case studies we have seen that a tailored solution can be designed to suit project requirements.

CONTACT INFORMATION
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CONCLUSION