A Technical Solution for a Mixed-Mode Study

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Abstract

The Pre-Post Deployment Study (PPDS) is a longitudinal component of the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). Approximately 9,000 participants were included in the study. The most recent wave consisted of a mixed-mode design utilizing a self-administered web survey (Blaise IS) and an interviewer-administered phone survey (Blaise 4.8).

The study design led to the creation of a new sample management system. The new system was integrated with the existing Blaise CATI call scheduler used by the call center. The Blaise CATI call scheduler managed the cases assigned to phone, while the new management system managed cases assigned to web, mail, e-mail and SMS text communications, the safety protocol, the tracking protocol, and incentives. The new system was the repository for all study information, including information from the Blaise CATI call scheduler.

Topics covered in this paper include BlaiseIS management, e-mail/SMS text message management, mode switching processes, data consolidation between two systems, and tracking. It also includes lessons learned over the course of the study.

Background

The Pre-Post Deployment Study (PPDS) is a longitudinal study with a sample of approximately 9,000 participants. The first wave consisted of a computerized self-administered interview (BlaiseIS) and a blood draw, all in a group setting on the installation prior to deployment. The second wave consisted of a paper self-administered interview and a blood draw, all in a group setting on the installation immediately after returning from the deployment. The third wave consisted of a computerized self-administered interview (Blaise IS) in a group setting on the installation. The fourth wave asked participants to complete a self-administered web survey (BlaiseIS) or an interviewer-administered phone survey (Blaise 4.8).

Participants were assigned to be invited in one of two modes, web or phone. Cases with only a phone number were assigned to the phone mode. Cases with only an e-mail address were assigned to the web mode. Cases with both a phone number and an e-mail (the majority of cases) were randomly assigned between phone and web. The majority of cases were assigned to begin on the web. Those participants received an e-mail invitation and SMS text notification. An experimental design switched the mode on non-response cases to phone after 7, 14, 21, or 28 days. The majority were switched to phone after 21 days. Participants initially assigned to the web mode received e-mail reminders and SMS text notifications once a week until they were switched to telephone.

Non-final cases moved to tracking once all contact information was deemed to be invalid. To be invalid, an e-mail had to bounce back as undeliverable and/or the phone number was no longer valid. When new information was found the case went back to the production environment to be worked. A case could move in and out of tracking as new information was deemed invalid and new leads were discovered.

The phone and web instruments contained much of the same content but were not identical. If a case began in one mode and was accessed in the other mode, the data were pushed to the other mode for the participant to continue the survey. Questionnaire sections that were incomplete were restarted so questions in a particular section always had the same reference period. Once a survey was completed the other mode was no longer available.

The design included a safety plan. Answers to certain questions in the instruments could trigger a follow-up to make sure the participants are ok. An algorithm ran to identify cases that needed clinical follow-up. A participant could also request to speak with someone during the course of the phone interview.

A management system (PPDS-MS) was created to manage the overall workflow of sample between web and phone. When a case was assigned to phone, a legacy sample management system (Blaise SMS) programmed in Blaise was used to manage the calling activities. The PPDS-MS controlled the activation of sample; managed the cases assigned to web; consolidated data from Blaise SMS; and managed all e-mailing and SMS text message activities, tracking activities, mode switching from web to phone, safety plan activities, and respondent payments.

Timed release and switch-mode protocol

The sample was randomly assigned to replicates released over an eight month period. This allowed control of the flow of cases to the call center as web non-response cases switched to phone for follow-up.

Each release of replicates was assigned to one of the following groups:

- Phone only - cases providing partial contact information, lacking an e-mail address
- Web only - cases providing partial contact information, lacking a phone number
- Web first - cases providing full contact information (name, phone number, mailing address and email address)
- Phone first - a random sample of cases providing full contact information

Each release was governed by a complex set of experiments involving pre-notification and reminder activities and the timing of mode switching between web and phone.

Technical components

The PPDS-MS system included several modules, with the main database on an SQL server. Programming languages include ColdFusion for the primary Web System, C#.Net for Windows batch processing and modules, extensive use of T-SQL stored procedures, and a third-party interface for sending and receiving SMS texts (Aerialink). Below is a brief list of the key components of the PPDS-MS system.

- Web system for managing case attributes, dynamic reporting and query, tracking updates (Coldfusion)
- Windows batch processing program to deliver files to the Blaise SMS (C #.Net)
- Windows program to handle sending e-mails and logging undeliverables (bounce backs) (C#.Net)
- Windows program to handle sending text messages(C #.Net and Aerialink API)

- Windows program allowing staff to send customized text message replies to participants on demand (C #.Net)
- Extensive use of SQL Server procedures for batch processing

Controlled Web Mode

The PPDS-MS managed cases assigned to web. Respondents logged into the web survey via a web portal. The web portal validated the login credentials entered against the participant's login credentials in the PPDS-MS. If the credentials were validated and the case was active, the web portal redirected the case to the BlaiseIS web survey. The web survey interfaced with the PPDS-MS during the initial start of the survey and during exiting or completion of the survey so that the PPDS-MS had the most current status for that case. At the end of the web survey respondents were asked to provide contact information and explicitly asked if they were willing to accept a monetary token of appreciation for the time spent completing the survey. Upon the completion of the web survey; updated contact, payment, and safety information was pushed from Blaise IS to the PPDS-MS.

Communication to consolidate data between Blaise SMS (phone) and the PPDS-MS (web)

Since the PPDS-MS controlled operations of the web, and Blaise SMS controls operations for the phone mode; the technical challenge was how to dynamically communicate between the systems in as close to real time as possible. A case needed to be available in both modes at all times regardless of current mode assignment. Mode assignment was primarily controlled through the PPDS-MS. When a case was assigned to phone, there was focused effort to call the case to complete the interview over the phone. However, when a case was assigned to phone, it was still accessible on the web via the web portal. If a case completed the web survey, the updated status needed to be communicated from the PPDS-MS to Blaise SMS as quickly as possible to avoid a telephone interviewer attempting contact. Conversely, if a case was assigned to web and contacted the call center and completed the survey over the phone, this updated status needed to be communicated from Blaise SMS to the PPDS-MS as quickly as possible to avoid the system attempting contact (e-mail and SMS text).

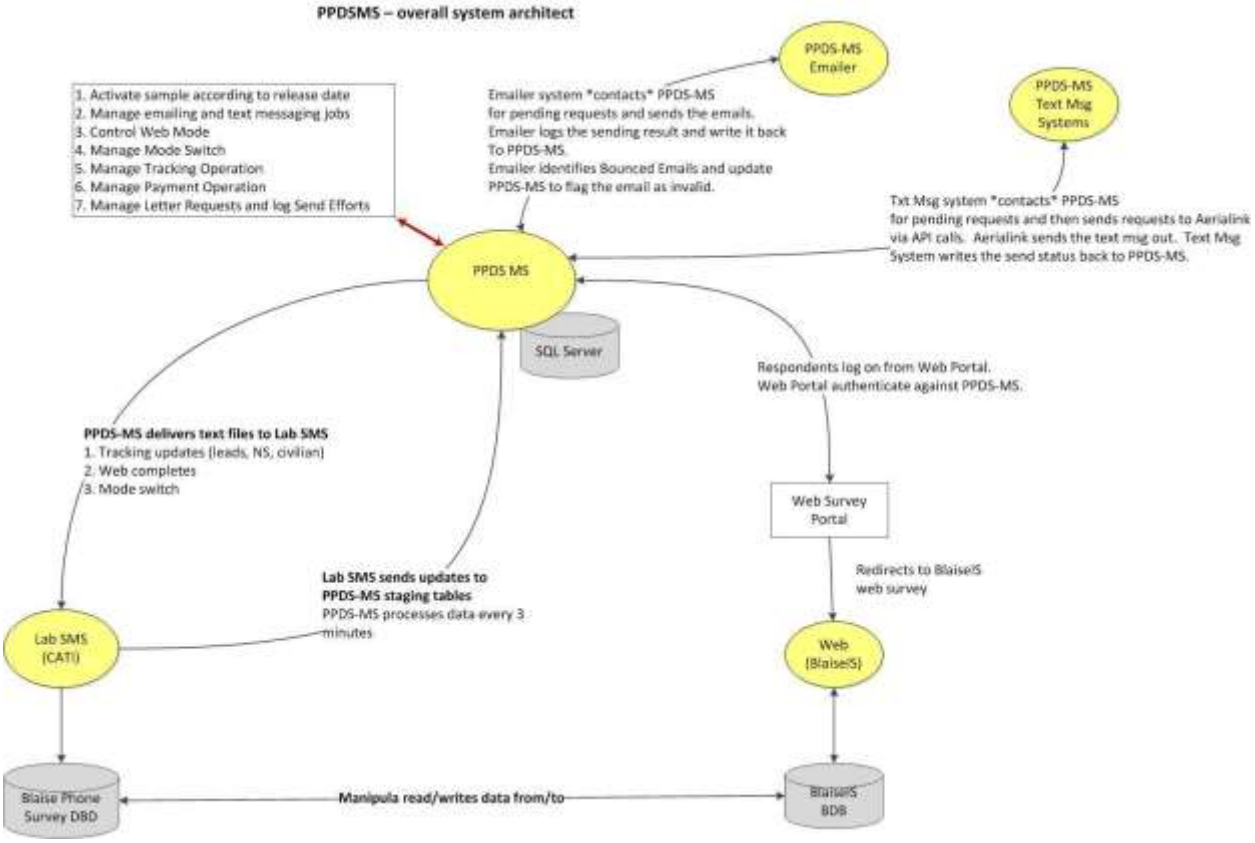
To facilitate communication, Blaise SMS pushed updated information to the PPDS-MS when a phone interviewer finished a case. The PPDS-MS had a scheduled job (SQL Server Stored Procedure Job) running every 3 minutes processing updates and taking appropriate action for a case. For example, during a phone interview, a respondent may have expressed a desire to receive an e-mail and provided a new e-mail address. Blaise SMS added a contact record signaling this action and sent the contact record along with the new e-mail address to the PPDS-

MS. After receiving this request and the new e-mail address, the PPDS-MS generated an on-demand email request. Requests were accumulated and triggered together with the automatic Batch Email job.

The PPDS-MS delivered a variety of text files at different time intervals to Blaise SMS communicating case status updates and information for next courses of action. Text files included information on:

- mode switching from web to phone
- finalization of cases (e.g. completion, refusal, lost, deployed during field period, etc.)
- mode re-activation and information updates from tracking

The diagram below describes the mixed mode management system architecture:



E-mail Job Management (sending, undeliverable (bounced) logging, throttle send speed)

The PPDS-MS managed the sending of e-mails (invitations and reminders) to cases assigned to web. Non-experimental cases were sent an e-mail invitation and three e-mail reminders. Experimental cases were sent an e-mail invitation and zero to three e-mail reminders depending on the experimental assignment. E-mail template types varied.

1. Different templates for invitation, reminder and final reminder (before switching to phone).
2. Templates varied based on e-mail domain. The ".mil" domain received a text e-mail, with a .pdf attachment with the same content containing the study and partner organization logos. All other domains (e.g., .com, .edu, .net., .org., etc.) were sent an HTML e-mail with the study logo and partner logos in the e-mail.
3. Templates varied based on experimental condition assignment. One group received an offer to call in to complete the interview via phone.

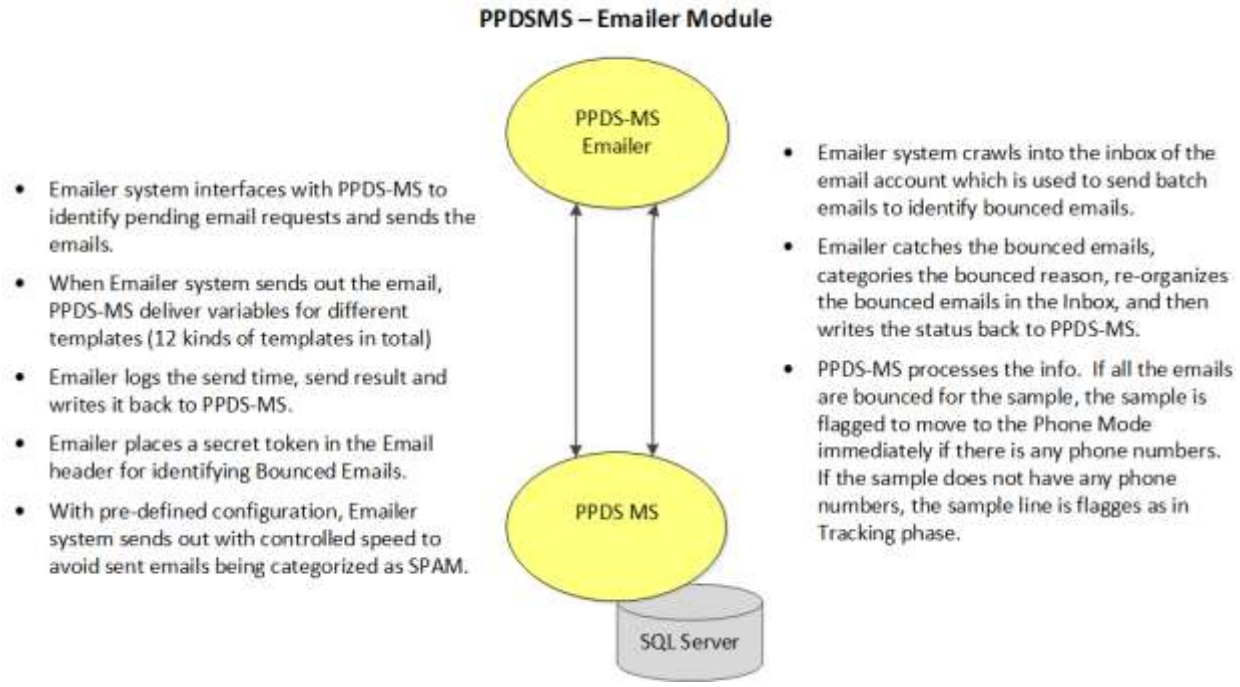
There were a total of twelve different e-mail templates. For each release, one of the twelve templates was assigned to a case. The PPDS-MS automated this process, eliminating manual intervention.

The PPDS-MS Emailer Utility was programmed in C#.Net and was created to send e-mails and log undeliverable (bounced) e-mails. Each morning, the PPDS-MS generated e-mail requests which were queued to be sent that day. The Emailer was scheduled to run each afternoon. It interfaced with the PPDS-MS to retrieve the generated e-mail requests and created a "sending job" with the .Net e-mail framework. When the Emailer sent an e-mail, it obtained the e-mail template type from the PPDS-MS to know which version of the e-mail to send. A token was added to the header of outgoing e-mails to identify and log an e-mail if it was undeliverable. The sending job had a throttle feature that was configurable. The throttle feature was configured with e-mails being placed in small batches with a 10 second pause between each batch and the rate (speed) between e-mails within a batch set at ½ second. This was done to minimize the chances of e-mails being marked as spam. When the sending job was triggered, it logged any error/failures encountered during the sending process. When sending failed, the error status was sent back to the PPDS-MS, and the e-mail was flagged as invalid. If there was no error, the status was posted back to the PPDS-MS with a timestamp.

Each night at midnight, the PPDS-MS Emailer triggered undeliverable (bounced) logging. The module scanned through the inbox of the sending e-mail address via the POP3 protocol. Using the token added to the header of the original (outgoing) e-mail sent from the Emailer, the Emailer logged undeliverable (bounced) e-mails and tracked them back to e-mail sent. The Emailer sent undeliverable (bounced) e-mail information back to the PPDS-MS and flagged the e-mail(s) as invalid.

With approximately 9,000 participants with multiple e-mail addresses, the automatic flagging of undeliverable (bounced) e-mail addresses saved significant operational time, eliminating the need for a manual review.

The diagram below illustrates the interaction between the PPDS-MS and the Emailer.



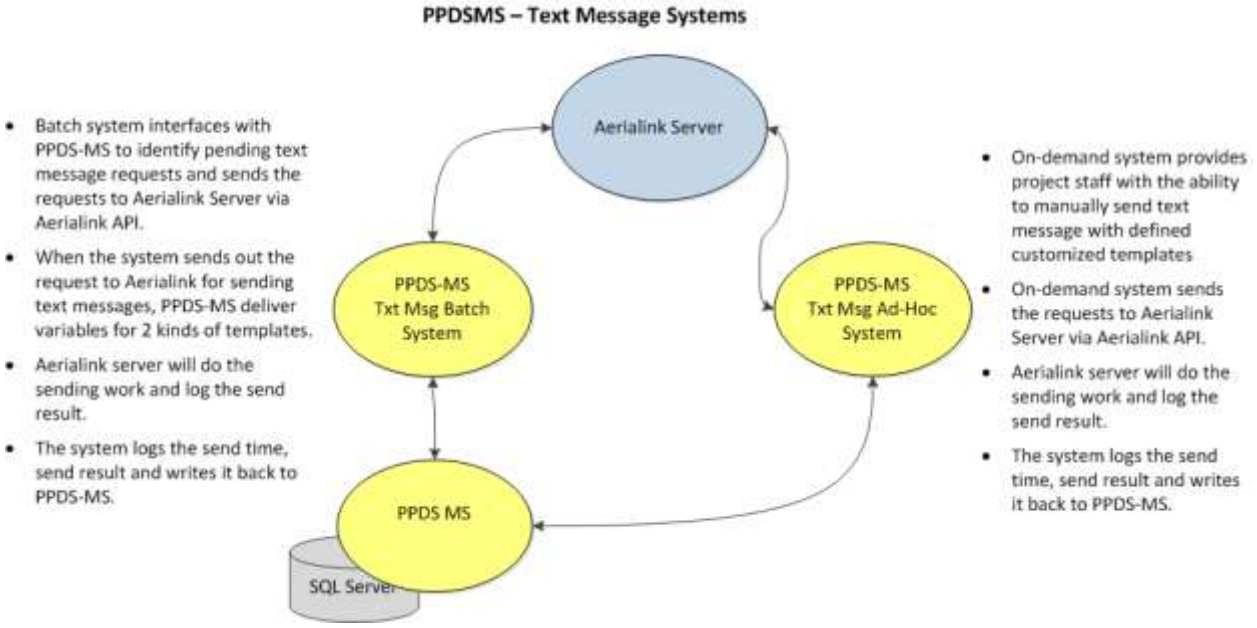
Text Message Management

The PPDS-MS also triggered the sending of SMS text messages to cases. Unlike e-mails, a SMS text message notification was sent to cases assigned to both phone and web when a phone number was available. The PPDS-MS used an external service provider (Aerialink) to send and receive SMS text messages. Aerielink provided a communication report of SMS text message failures/successes, and logged inbound text message replies from a case. Two sub-systems were created for this functionality: a Windows Batch System to trigger sending batches of SMS text messages, and an on-demand system (Windows Form application) for staff to reply to inbound SMS text replies from a case. Both sub-systems utilized the Aerialink API to send SMS text message requests to Aerialink servers. When the Aerialink API replied with an SMS text failure, the phone number was flagged as invalid in the PPDS-MS.

Similar to the way e-mail request lines were generated, the PPDS-MS generated a Batch Send job of SMS text message request cases each morning. The Batch System interfaced with the PPDS-MS to get the requested cases and information and made a call to the Aerialink server to send out SMS text messages. This processing was scheduled to run each afternoon following the e-mail sending batch job.

The Batch Send job and the on-demand manual send job both interfaced with the PPDS-MS to obtain current case status, recorded the send activity as a contact record, logged the send result and flagged out invalid phone numbers.

The diagram below illustrates the communication between the PPDS-MS and Aerialink.



Mode Switch

The PPDS-MS managed the complex cycle of mode switching. Web non-response cases switched to phone according to their experimental assignment. When it was time for switching to occur, the PPDS-MS Windows batch processing application delivered a switch-mode text file to Blaise SMS. The text file included the case ID and any updated contact information. When Blaise SMS processed the switch-mode text file each morning, it released cases into the calling pool for the phone interviewers. If there was any updated contact information, such as a new telephone number, mailing address or e-mail address; Blaise SMS updated its information from the text file.

Since web was always accessible to active cases, the PPDS-MS delivered a text file of cases completed on the web three times each day to Blaise SMS. Blaise SMS finalized those completed cases to remove them from the active calling pool.

For cases switching from phone to web, an interviewer entered a contact record in Blaise SMS. When the PPDS-MS identified the case to switch from phone to web, it activated and started the case with the correct communication (e-mail and SMS text message) protocol. If no valid e-mail address existed when the PPDS-MS received this notification, it triggered the case being assigned to the tracking protocol.

Respondent Tracking

When communication efforts, including calling and e-mailing were exhausted; a case moved to tracking and followed a five step protocol. About 30% of cases were tracked during the most recent wave of data collection.

For a case assigned to phone, an interviewer had to first confirm that all available phone numbers were invalid. Once all phone numbers were deemed invalid, the interviewer recorded a contact record that the case needed tracking. When the PPDS-MS received and processed this tracking contact record, it updated all phone numbers associated with a case as invalid. The PPDS-MS then checked to see if there was a valid e-mail address for the case and if it had previously been assigned to web. If it had not yet been assigned to web, the PPDS-MS switched the case to web. If no valid e-mails existed or the case had previously been to web, the case was assigned to tracking.

For a case assigned to web, the Emailer Bounce Back logging triggered each night. Any e-mail addresses that were undeliverable (bounced), the PPDS-MS updated to invalid. At this time, another processing procedure was triggered.

- If the case had other valid e-mail addresses, the case remained assigned to web.
- If the case had no other valid e-mail addresses, and had valid phone numbers, it switched to the phone immediately.
- If the case has no other valid e-mail address or valid phone numbers, it went to tracking.

Once cases were flagged for tracking, the PPDS-MS managed cases through the tracking protocol. There were a total of five steps in the protocol a case could go through. When a tracking lead was identified the case moved out of the tracking protocol and moved back to production. An updated e-mail address reactivated a case on the web, and an updated telephone number reactivated a case in phone, unless there was also an updated e-mail address which reactivated the case to web first. When a case reactivated in phone mode, a text file was delivered to Blaise SMS that activated the line and imported updated contact information.

Lessons Learned

1. The interviewer needs access to all of the contact attempts. The e-mail and SMS text message contact records were only stored in the PPDS-MS. The interviewers using Blaise SMS never had access to these records. Having the additional context is helpful to the interviewer so they can see how a case was previously contacted and can reference that they may have received an e-mail or SMS text message when contact is made. An

interviewer can also confirm an e-mail was sent if a case requested an e-mail in a previous contact.

2. Inbound SMS text messages need to be logged/recorded by the system. The PPDS-MS recorded outbound SMS text messages but not inbound SMS text messages (reply from a case). Staff monitored a separate e-mail account to check for inbound SMS text messages and manually logged those messages.

3. Having one management system managing all aspects would be more efficient than having two separate systems: one to manage the majority of the processes including web and a second system just to manage telephone calling. Data had to be pushed back and forth between two systems in a timely manner to ensure each system had the most up-to-date information.

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