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Using Business Process Re-engineering to Find Solutions for the Most Common Improper Payment Errors in the Defense Travel System Trip-Planning Process

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Abstract: Companies, organizations, and government services need a reliable travel planning and reimbursement system to repay costs and manage financial resources. The original intent of the Defense Travel System was to facilitate user-friendly travel and financial management; however, the system's average improper payment rate of 4.1% creates administrative workload burdens and generates an estimated $18.9 million dollars in improper payments each month across the Department of Defense service. The aim of this study is to use business process re-engineering to create a model to assist in the determination of invalid versus valid receipts, decreasing both the administrative burden and improper payments rate. Our approach combines a third-party open-source receipt optical character recognition library with a receipt validation algorithm to determine the probability that a receipt is valid, thus focusing the attention of Authorizing Officials on payment requests that have the greatest risk of containing errors. Preliminary verification tests produce an improvement in false positive occurrences from 4.2% for an Authorizing Official to about 3.5% using the receipt reader, potentially reducing IP expenditures by about $3.4 million monthly.

Keywords: Travel management, Receipt Reader, Process Reengineering

1. Introduction

The Defense Travel System (DTS) is the DoD's fully integrated, electronic, end-to-end travel management system used for processing Temporary Duty (TDY) travel documents. Personnel submit authorizations and vouchers to request travel and reimbursements, respectively, through the DTS Trip-Planning Process (TPP). The TPP is the process, outlined by the Joint Travel Regulation (JTR), by which a traveler routes completed authorizations and vouchers for approval by a reviewing official. The most common type of reviewing officials are Authorizing Officials (AOs), who are responsible for performing a final review to decide if the traveler's plans (on an authorization) or payment claims (on a voucher) are within the rules of the JTR and whether to approve the trip or payment.

This paperless system was created with the intent to automate many steps in processing TDY travel documents and reduce the overall administrative workload on personnel. A traveler can search for and book airline, hotel, car rental, and even rail reservations, all conveniently located in a singular, online system for ease of accessibility when planning official travel. While successful in that, DTS administrators still encounter problems and errors that arise from implementing an electronic, do-it-yourself system (Williams and Rhoades, 2006). Bureaucratic policies and procedures have piled up and significantly degraded the efficiency and productivity of military units (Burleson, 2018). Anecdotally, improper payments (IPs) are typically attributed to poorly educated users of the DTS, an unintuitive DTS interface, or inadequate AO training. A Defense Finance and Accounting Service (DFAS) stratified sampling of paid vouchers conducted in March 2020 estimated that roughly 3% of the total money used to pay vouchers, or about $18.9 million, was expended through IPs across all service branches and agencies in the Department of Defense (DoD; DFAS, 2020a). Thus, it is imperative that the DoD's travel management system is updated and improved to prevent fraudulent activity and invalid payments.

1.1 Problem Statement

From the same DFAS report, errors associated with invalid receipts account for about 55% of IPs, identifying itself as the primary concern to confront to reduce IPs (DFAS, 2020a). These IPs trouble program administrators not just because of the

high price tag involved, but also due to the ever-increasing pileup of administrative workload to identify errors in itineraries or vouchers, document and review amendments, and correct reimbursement amounts. Furthermore, the mishandling of money within the DoD, even if accidental, raises concerns by taxpayers who are ultimately funding the U.S. military. All these problems, coupled with a DoD-wide urgency to scale down on wasted administrative time, point to a need to address IPs within DTS. The aims of this study are therefore to create a solution that assists in the accurate recognition of invalid receipts, as well as to use business process re-engineering to identify and provide recommendations to reduce points within the DTS Trip-Planning Process that cause IPs.

2. Methodology

In addressing our research question, we focus on applying business process re-engineering (BPR) and building an automated receipt reader to reduce the administrative workload of DTS. First, we reconfigure the process by following the five steps of BPR: envisioning the new process, initiating change, diagnosing the current problem, re-designing the current process, and reconstruction (Subashish, 1993). The idea to create a receipt reader stems from the fact that the administrative voucher approval requirement causes many problems (Burleson, 2018), and that more than half of all IPs are a result of an approved invalid receipt.

The first step of a business process re-engineering project—envisioning the new process—requires the organization at hand to reassess the strategies used to accomplish their goals. For us, that meant rethinking how the voucher approval process can be handled differently so that safeguards are not removed, and administrative workload does not continue at its current pace. It also required the organization's commitment to change. Finally, in this stage we identified processes for improvement. The second step of the business process re-engineering project—initiating change—focused on tackling the inefficiencies within DTS. Here, key performance metrics were identified and evaluated: IP rates, inherited cost, number of receipts an AO must clear per day, and the time that each AO spends clearing these receipts. The analysis and results section of this report (Section 4) addresses how the remaining BPR steps—diagnosing the current problem, re-designing the current process, and reconstruction—were completed.

2.1 Data

Preliminary data regarding IP errors and their causes are collected from two primary sources: DFAS and the Travel Policy (TP) Compliance Tool. DFAS provides a stratified sample each month of approved vouchers to identify the percentage of those vouchers that may have included an IP, which is then compiled into a monthly report that identifies each error. This is retrospective data, so there is a lag in determining if changes to DTS improve or worsen IP error rates and therefore is more useful to provide monthly snapshots of the system. As changes are made in DTS, the data collected from this system can be used to measure the impact of those changes.

Error! Reference source not found. summarizes the percentage of approved vouchers from the DFAS sample that had an improper payment. The DoD IP reduction target, the amount that the DoD would like to have the improper payment rate reduced to within a fiscal year (FY), is currently 5.5%. The Air Force currently meets that target. Reduction targets are a minimum requirement, though, so it is imperative that there is effort to continually reduce IP rates for the aforementioned reasons. The administrative workload for managers and AOs of DTS is consistently high, so finding any solutions to reduce it are valuable to military efficiency and productivity.

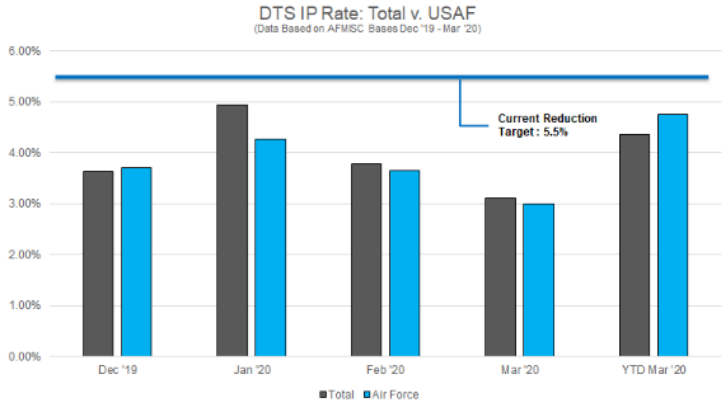

Figure 1. DTS IP Rate for DoD and Air Force, December 2019 - March 2020

Table 1 lists the top four error codes as found in the DFAS' March 2020 monthly report and includes the total costs of those potentially improper payments as well as the proportion of IPs that were attributed to that error during the month. This highlights that invalid receipts within the voucher approval process of the TPP are a significant issue to be addresses within DTS; more than 50% of IPs include some type of invalid receipt-related issue.

Table 1. Primary IP Errors, March 2020

Error Type	Projected Occurance Loss	Percentage Attributed Occurance
Airfare paid with invalid receipt	$5,338,483	28.2%
Lodging paid without receipt	$3,179,004	16.8%
Lodging paid with invalid receipt	$2,628,368	13.9%
Rental car paid with invalid receipt	$2,502,760	13.2%
Total	$13,648,615	72.0%

2.2 Receipt Reader

Among the largest drivers of improper payments is the submission of vouchers with invalid receipts. Thus, finding a means to automatically review those documents and alert the member prior to submitting the voucher can significantly reduce not only the total amount of improper payments but also the administrative burden required to review and address the issue. Three of the top errors that cause improper payments across the DoD are payments with invalid receipts for airfare, lodging, and car rentals. There is an extensive list of criteria that identifies a receipt as invalid, but some examples include receipts with an incorrect name, an unauthorized receipt of purchase (e.g. a flight itinerary or e-mail confirmation), or a receipt that is not reimbursable under JTR guidelines (Bolton and Hand 2002).

Anecdotally, authorizing officials have described their onerous experiences with determining whether a submitted receipt was valid or invalid. Usually, checking each individual receipt takes a considerable amount of time, especially since most travelers have multiple purchases listed including, at a minimum, airfare, rental cars, and lodging. Moreover, even if a considerable portion of time is spent reviewing receipts, human error could still cause an improper payment to occur through an invalid receipt. Time spent to ensure that each receipt is valid quickly accumulates, taking AOs away from other duties and increasing the likelihood of a mistake. A receipt reader that helps to automate the process can quickly identify many invalid receipts, thereby saving AOs valuable time and lowering the rate at which invalid receipts are wrongfully approved.

One approach to combatting invalid receipts is the creation of an "end-to-end novel receipt recognition system for 'Capturing Effective Information from Receipts (CEIR)'" (Xie and Bailey, 2020). This approach provides a great baseline for receipt reader development and includes three steps: preprocessing, text detection, and text recognition. The preprocessing crops the actual receipt text area. Boxes then bound the text that was identified in the text detection step. Lastly, text recognition translates the image areas enclosed by the boxes into words. Our work takes advantage of the *Tesseract* Optical Character Recognition (OCR) tool to accomplish the general objectives that the CEIR methodology listed, and our receipt reader accurately reads most receipts to include those that are hand-written. Therefore, we are able to use its results to determine the validity of the receipt.

The advantage of CEIR is that it will improve the speed and accuracy of AOs with respect to the voucher approval process. First is an adaptation of the approach presented by Burleson, Rorick, and Terrain (2018) to remove the administrative voucher approval requirement by incorporating a receipt reader and implementing an automated voucher reviewing algorithm to identify key errors within a submitted voucher. This removes the AO from the voucher approval process entirely and ensures the effectiveness of the voucher reviewing algorithm's ability to identify errors. Thus, CEIR could be used simply as a flagging mechanism that scans each receipt that is attached in a voucher for any keywords or requirements that might be indicative of a valid or invalid receipt.

Through the current stage of development, our proposed DTS receipt reader is centered around an open-source JavaScript OCR library known as Tesseract.js. Ultimately, the receipt reader will be implemented as a background script in the DTS website. Figure 2 below represents how receipts are uploaded and accepted by Tesseract.js in preparation for reading. For testing and evaluation, our team has created a basic sandbox page calling the receipt reader functions. Here, our team can upload multiple or individual pdf and image files. Because Tesseract.js only accepts image files or equivalent data types such as **B**inary **L**arge **Ob**ject**s** (BLOBs) at this time, all uploaded PDFs are first converted into a BLOB object type using another open-source JavaScript library known as pdf.js. All image and image equivalent BLOB objects are stored in client-side local memory and are then sent to a Tesseract read-in function, where these objects are converted to Strings. These Strings are then scanned for keywords that determine a receipt validity score, which ultimately provides guidance to reject or accept user uploaded substantiation. Presently, our concerns are focused on low receipt processing speeds. As it stands, our receipt reader's runtime is highly dependent on client computer performance and browser memory allocation. Potential solutions going forward include revising the receipt reader script to run server side in order to promote faster and more uniform runtimes. Additional concerns include potential paperwork and auditing of open source dependencies such as Tesseract.js and pdf.js.

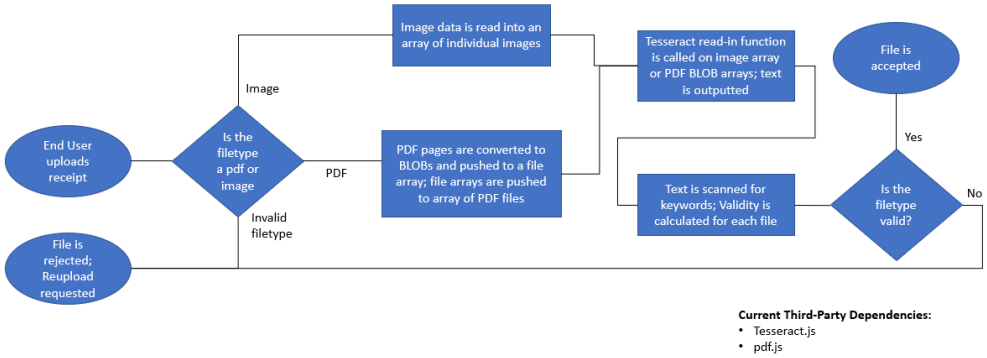

Figure 2. Graphical Representation of Receipt Acceptance by Tesseract.js

3. Implementation

The first stage in BPR is to diagnose the problem and process to be re-engineered. In this case that meant understanding the job of an AO and documenting the existing process, specifically creating a workflow of how an AO verifies receipts. Following process descriptions by AOs, the online AO training program, and additional resources provided by AOs, we took on the role of an AO and verified receipts to get hands-on experience; Figure 3 represents the typical voucher approval process. Several key items need to be present on a receipt for it to be valid: the traveler's full name, date of payment, the agency to which the payment was made, taxes, total cost, last three or four digits of the charged card, and a total cost of $0 dollars after the charge. We realized that a majority of the issues with improper receipts stemmed from the fact that the last three or four card digits were missing. Moreover, we found that if the last three or four digits of the credit card existed, then the name, dates, agency, and total cost including taxes were highly likely to exist as well. This evidence led us to believe that when receipts list the final credit card numbers then those receipts are likely to have the rest of the information that the reader looks for. In this stage we also measured the current state by looking at quarterly reports and monthly reports on the cost and IP rate, as seen in

Table *1*.

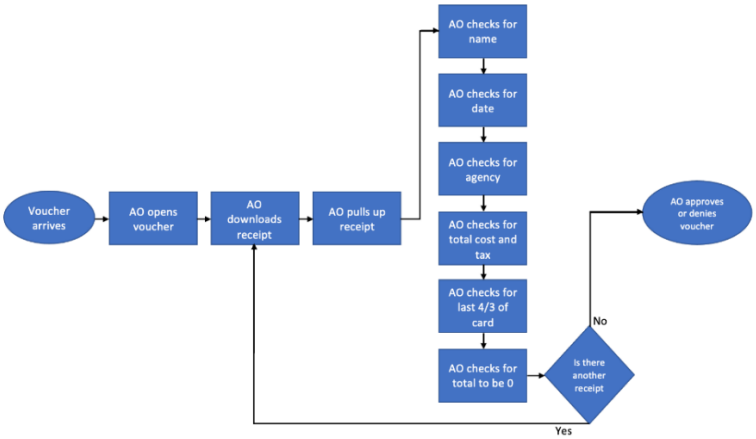

Figure 3. Current Voucher Approval Process

The second stage in business process re-engineering is designing a new process; our proposal is depicted in Figure *4*. The new workflow uses the receipt reader technology described in Section 2.2 to automate a portion of the process while removing steps for the AO. If we were able to implement an automated solution, not only would the new process continue to meet DTS benchmarks, but we could potentially reduce the number of IP attributed to invalid receipts by approximately 72%.

Figure 4. Proposed Voucher Approval Process

The final stage in business process re-engineering is reconstruction. Here this step involves incorporating the Tesseract text detection software and receipt reading algorithm into the DTS website and reframing the roles of AOs as quality assurance managers, rather than the primary receipt readers. With this change, AOs will no longer have to check every receipt that comes their way; instead, they will only need to track performance measures such as corrective rate and processing time. Additional random AO verification may also be implemented to mitigate erroneous approvals. Administrative workload of AOs will reduce greatly, allowing more time for other duties and obligations. Because the DoD-wide approval process makes it very difficult for changes in DTS processes to occur, reconstruction can only be offered as a future consideration or recommendation to our client. However, we still analyzed the potential beneficial effects of reconstructing the administrative voucher approval process.

4. Analysis and Results

The receipt reading model is currently being validated by our client and by AO volunteers. As such, it is unclear if the receipt reader model is accurate just to the training set or to all receipts available. Moving forward, we anticipate using consolidated feedback to refine and adjust the model. Moreover, expanding the training set will allow continual adjustments and refinements as needed.

Under the training set, the program correctly identifies user-uploaded receipts 88.7% of the time as summarized in Table 2. False positives, or instances when the program identifies an invalid receipt as valid, occur only 3.5% of the time, which is slightly better than the rate of 4.4% that AOs currently experience. False negatives, or instances when the program identifies a valid receipt as invalid, occur at a rate of 7.8%. The false positives, however, are of primary concern because those are the errors that cause IPs.

False positive receipts were often incorrectly identified due to the total balance on the receipt not reading "$0.00," which indicates a processed payment. In every one of these cases the receipt included necessary credit card information, but did not show that the payment had been processed. Two-thirds of the false negatives stemmed from the receipt language-recognition process misreading the uploaded document; the most common example was "VI" being read as "V1." The remaining false negatives occurred when the reader could not find the payment information. This is a design choice as adding those additional parses would raise the false positive rate.

Table 2. Confusion Matrix Based on Current Testing Results

N = 115	PREDICTED VALID	PREDICTED INVALID
ACTUAL VALID	39 (0.339)	4 (0.035)
ACTUAL INVALID	9 (0.078)	63 (0.548)

Based on the results of these preliminary tests, we forecast that our receipt reader will make the lives of the AOs much easier. By allowing us to remove various steps from the current voucher approval process, leading to the complete reengineering of approval methods, the receipt reader can help significantly lighten the workload for AOs.

5. Conclusion

In this paper, we have assessed the statistical evidence that contribute the most to improper payments in the DTS Trip-Planning Process. Wrongly uploaded invalid receipts for major components of government travel—airline tickets, car rental reservations, and hotel reservations—contribute almost 75% of IPs across the DoD, and the heavy responsibility to review, identify, and amend these receipts is both taxing and time consuming. Implementing a functional receipt reader that identifies valid receipts with an 87% accuracy rate into the AO review process using business process re-engineering, we find that the DoD can save about $3 million dollars monthly, and considerably reduce the administrative workload for AOs. Follow on efforts to our work include the continual refinement and development of the model, a flagging feature that informs users that they uploaded a potentially invalid receipt, and integration of the receipt reader as a backend process to further automate this important part of the DoD's travel management system.

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